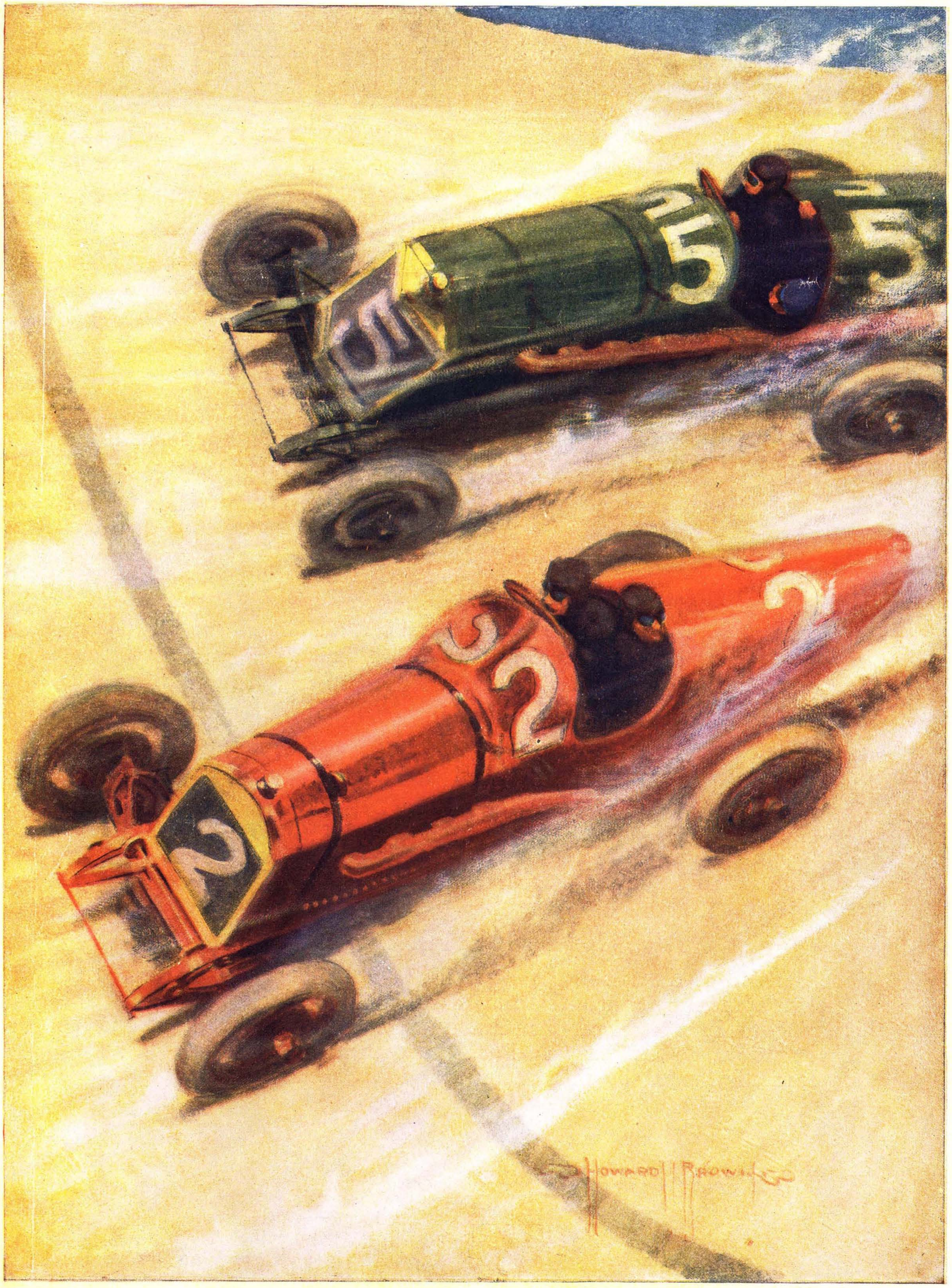
EIGHTEENTH ANNUAL MOTOR NUMBER

SCIENTIFIC AMERICAN



Vol. CXIV. No. 1
January 1, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

WHITE TRUCKS

Awarded the GRAND PRIZE

BY THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION AT SAN FRANCISCO

THE ONLY GRAND PRIZE—THE HIGHEST AWARD FOR MOTOR TRUCKS

Was conferred upon White Trucks by the Superior Jury of Award, as officially announced by the Secretary of the Jury under date of August Second.

This is the ONLY GRAND PRIZE received by any motor truck at the Panama-Pacific International Exposition.

This decision of the Superior Jury of Award reflects the opinion of the largest users of motor trucks throughout the world—and is in accordance with the actual service results of motor truck experience. The points of merit upon which the Grand Prize is awarded are identical with those that have determined the selection of White Trucks by America's foremost firms in every line of business.

White supremacy in the motor truck industry is thus recognized by the highest award that can be bestowed by the greatest exposition the world has ever known—just as this supremacy has been recognized by motor truck users for many years.

REGARDING OTHER CLAIMS

The decision of the Superior Jury is final in the matter of Exposition awards. Hence any announcements of other motor truck manufacturers, claiming to have received the Grand Prize and Highest Award for motor trucks at the Panama-Pacific International Exposition, are automatically denied by this decision of the Superior Jury of Award.

THE WHITE COMPANY

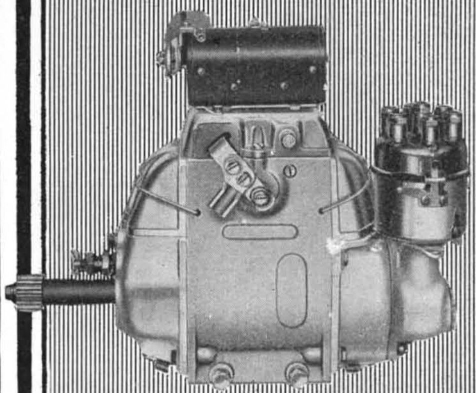
CLEVELAND

Largest Manufacturers of Commercial Motor Vehicles in America

DELCO

ELECTRIC CRANKING LIGHTING IGNITION

THE Motor Car Manufacturers who use Delco starting, lighting and ignition are manufacturers who are not willing to sacrifice safety and endurance in order to save a few dollars in cost.



They believe it to be sound business judgment to pay three-quarters of a million dollars more for Delco Equipment than they would have to pay for other standard electrical systems.

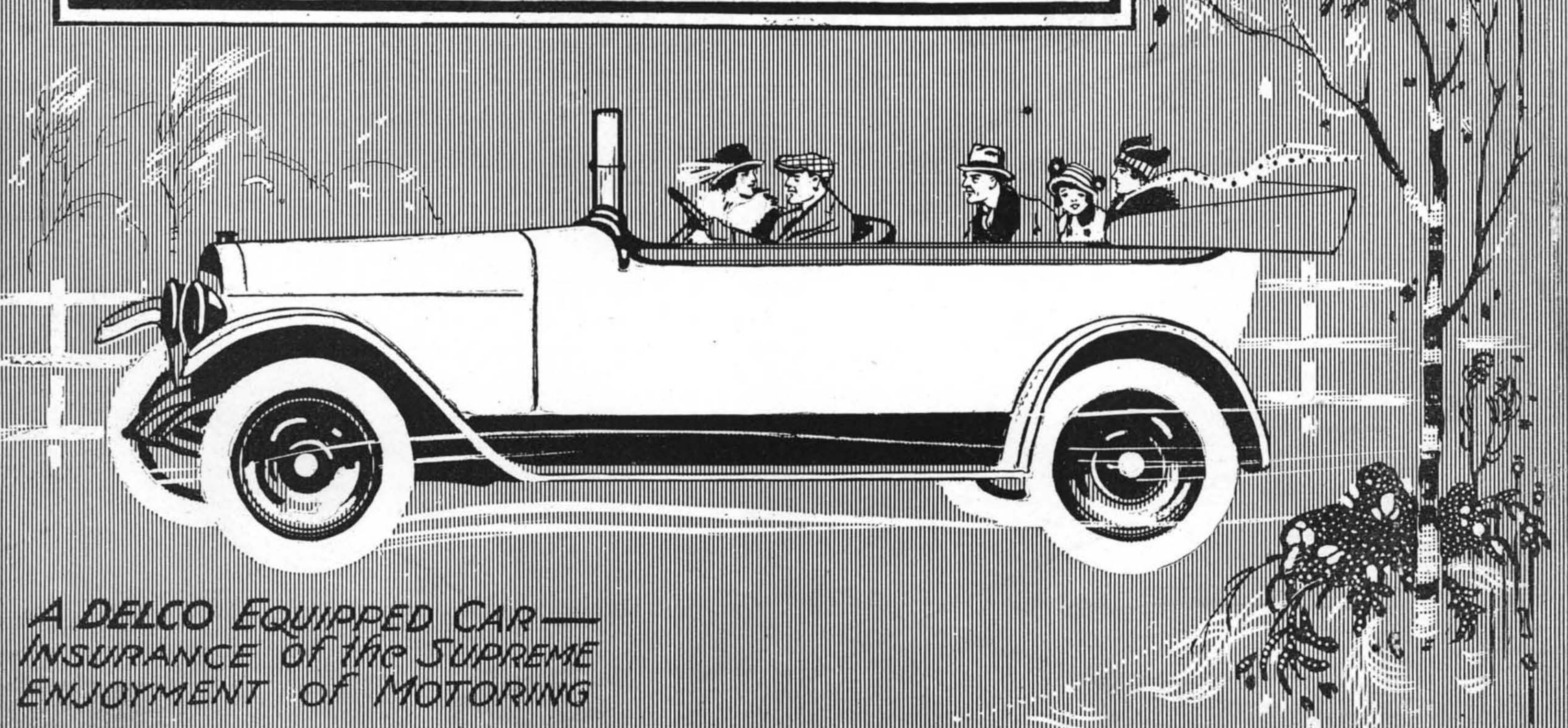
They demand an Electrical Equipment with endurance that will stand up under hard, continued service, and with a degree of efficiency that is unfailing, no matter how severe may be the demands upon it. And they are willing to pay more for this extra margin of safety.

They look upon Delco Equipment as an additional insurance to motor car buyers of the supreme enjoyment of motoring.

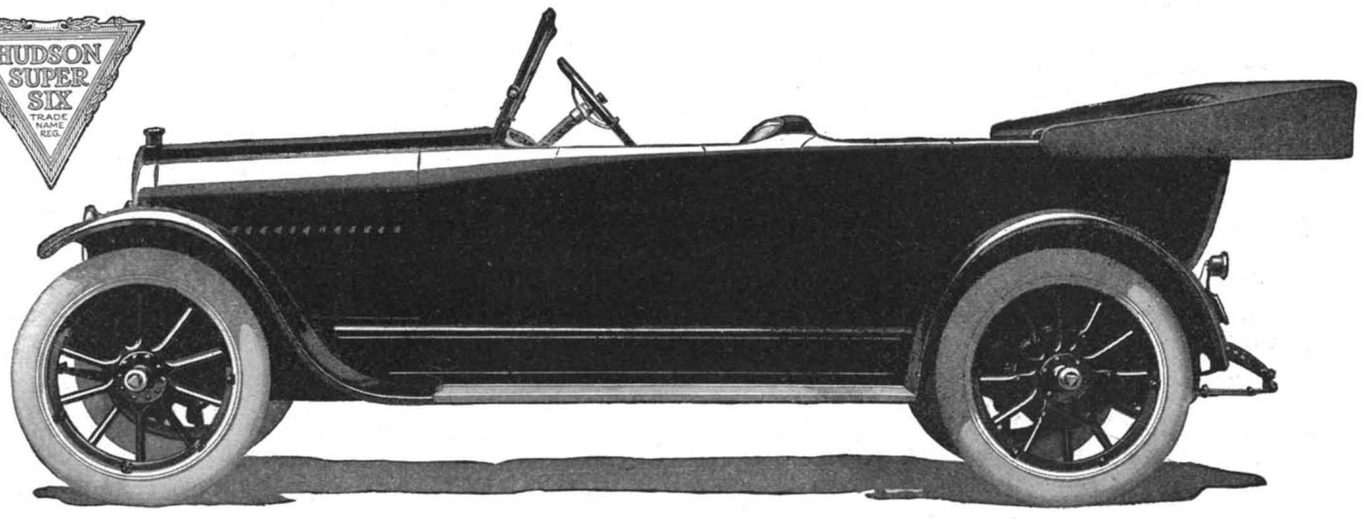
And 295,000 satisfied owners of Delco-Equipped cars are the living proof of the soundness of their business judgment.

The Dayton Engineering Laboratories Company

Dayton, Ohio



HUDSON SUPER SIX TRADE NAME REG.



7-Passenger Phaeton, $1375 at Detroit. Five other body styles.

We Now Present the

Hudson Super-Six

Patented by Hudson December 28, 1915

76 Horsepower—An Added 80%, Without Any Added Size

Officially Breaking All Stock Car Records Up to 100 Miles Also All Stock Car Records for Quick Acceleration

100 miles in 80 min., 21.4 sec., averaging 74.67 miles per hour, with driver and passenger.

The previous best record of 72.49 was made by a car with more cylinders, more cylinder capacity and driver only.

75.69 miles in one hour with driver and passenger.

During this speed trial laps were made at 76.75 miles per hour.

From standing start to 50 miles per hour in 16.2 seconds.

All these records made with same stock car, using same motor, at Sheepshead Bay Speedway in November, under American Automobile Association supervision.

The most powerful stock motor per cubic inch displacement which the world has ever known.

Mark what those records mean.

No other stock car in history has done what this car has done. No other like-size motor has developed such power.

A car almost twice better than the best of former Sixes. Which has outrivaled Eights and Twelves.

That is what Hudson engineers present in this marvelous Super-Six. And, because of Hudson patents, we control it.

EXCELS BY 80 PER CENT

The Hudson Six-40 of last year stood first among Sixes. Its matchless performance made it the pattern type. It quadrupled Hudson sales in two years.

But the Super-Six excels it by 50 per cent in high motor speed capacity. It excels it 80 per cent in power. Yet the cylinder size is identical. Lightness and economy are retained. All this increase —this 80 per cent—comes through wiping out vibration.

AN ENORMOUS RESERVE

The Hudson Super-Six develops 76 horsepower. That means an enormous reserve. It enables you to creep on high gear, to pick up quickly, to mount hills without effort, to avoid changing gears.

And it all comes through lack of vibration. So it brings with it bird-like motion. The motor is so quiet that one almost forgets it. The car seems to move by magic.

OLD TYPES DISCARDED

This Super-Six invention led us to stop production on the former Hudson at the zenith of our success. We lost thousands of sales in consequence.

It led us to cease experiments with Eights and Twelves, because the Super-Six excelled them.

It led us to double our factory to meet a doubled demand, at a cost of $1,500,000. And to buy materials for $42,000,000 worth of these new cars before the first Super-Six appeared.

For this car means Hudson supremacy, over all other cars and types. Any man who knows it will choose it if he buys a high-grade car. Also many a man who would buy a cheap car were it not for this marvelous motor.

The Super-Six is resistless. Its performance will alter all your ideas of motoring. And now, for the first time, a master feature is controlled for one car by a patent.

MOST LUXURIOUS CARS

The Super-Six looks its supremacy. The body lines are perfect. The finish is superb. In the upholstery we use a rare grade of grain leather. Each compartment of the Phaeton has a rounded, finished dash.

In every detail we attain luxury's limit, regardless of the cost.

Yet our mammoth production brings the price to $1375. That for the finest motor ever built, in the finest car that's possible. Go now and see this new car at your local Hudson showroom.

7-Passenger Phaeton, $1375 at Detroit.
Five Other Styles of Bodies. Ask for Our Super-Six Catalog.

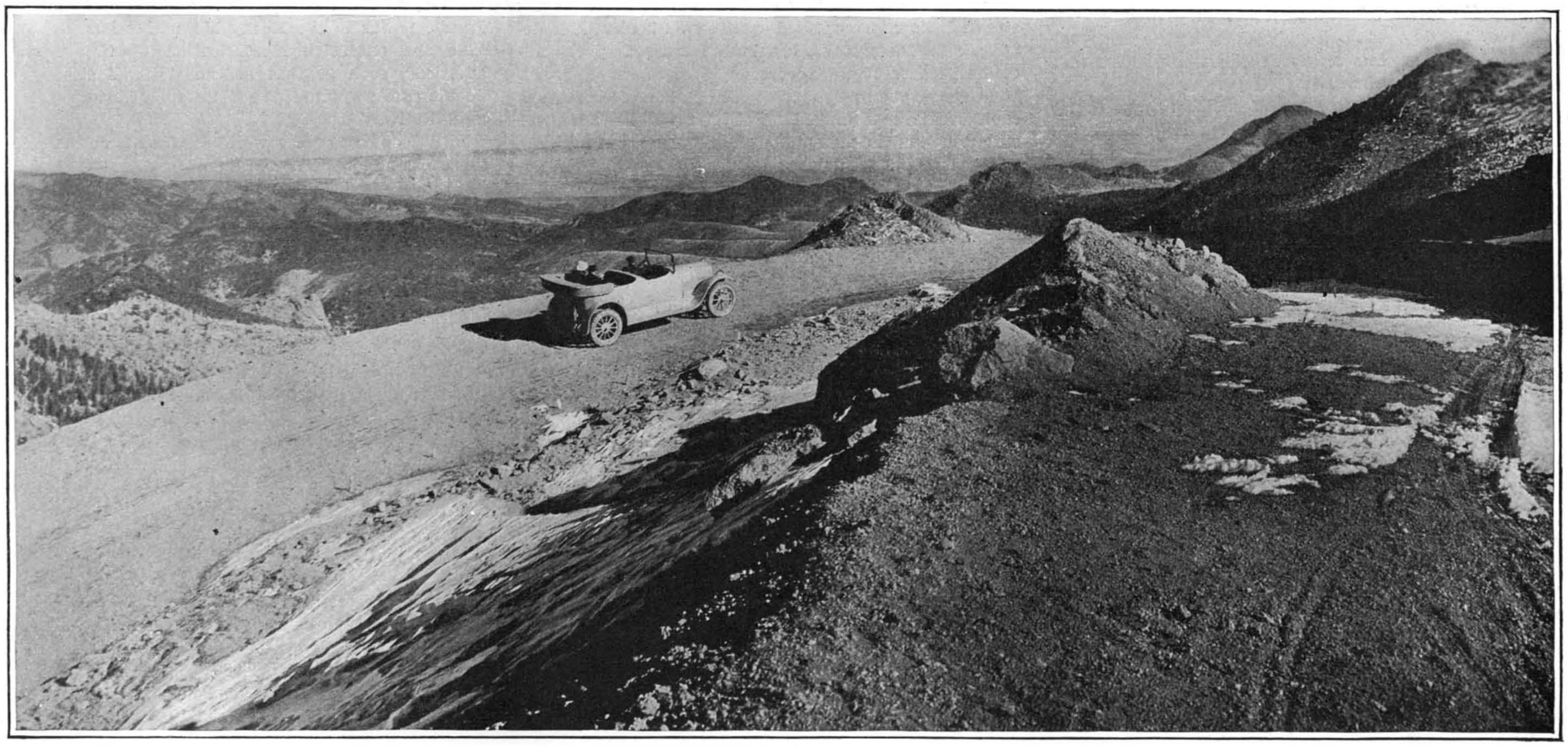
HUDSON MOTOR CAR CO., Detroit, Michigan

SEVENTY-SECOND YEAR

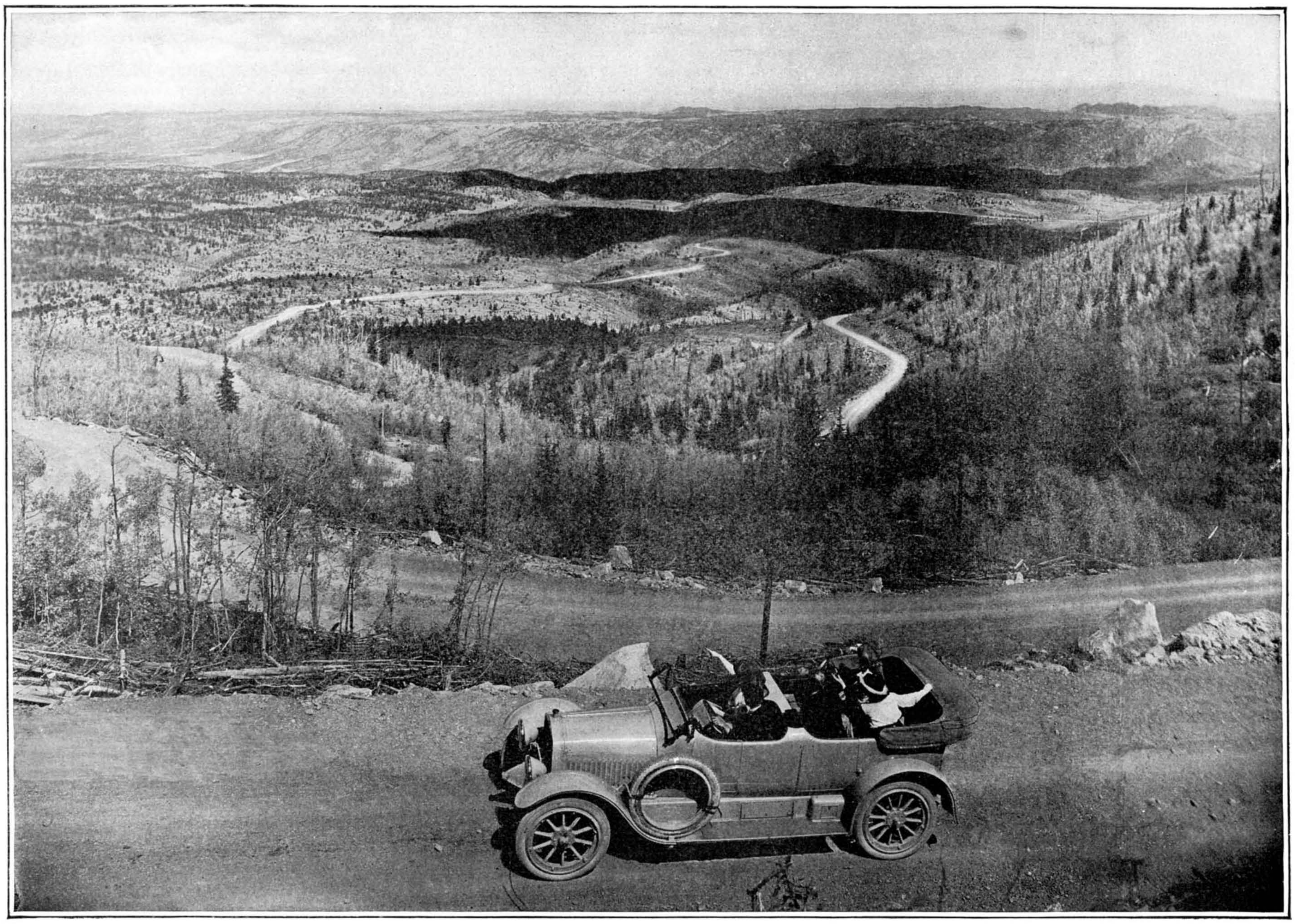
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV.] NUMBER 1 NEW YORK, JANUARY 1, 1916 [15 CENTS A COPY $3.00 A YEAR



Recently completed highway to the summit of Pike's Peak, 14,109 feet above sea level. The gradients average 6 per cent and never exceed 10 per cent



Looking back over the highway to Pike's Peak. The road is 18 miles long. The sharpest curves are from 25 to 50 feet wide

SCIENTIFIC AMERICAN
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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Retrospect of the Year 1915

The World War

A CURSORY view of the military situation in Europe, as seen from the outside of the so-called "iron ring" which the Allies have attempted to maintain around the Central Powers, would seem to justify the assertion of the Imperial Chancellor, von Hollweg, that Germany is everywhere victorious. She holds Belgium and one of the richest sections of France in the West; Poland is hers; and, recently, with the aid of Bulgaria, she has overrun Serbia and opened up rail connection with Constantinople.

The question of German success, however, is indissolubly bound up with the question of German aims, and, thanks to the explicit teachings of her military writers, we know exactly what the military aims of Germany were, when the Kaiser let loose the dogs of war in the summer of 1914. A swift drive in overwhelming force upon Paris; the occupation of the French capital; an army of occupation in France; a rapid transfer of the flower of the army to the Eastern frontier, and a furious campaign by overwhelming forces against Russia, for the purpose of breaking up, capturing and dispersing the Russian hosts, preparatory to the occupation of Warsaw and Petrograd.

The German plan, magnificent in conception, failed utterly when the allied forces under General Joffre turned furiously upon the invaders and threw them back at the battle of the Marne. In the East the Austrian armies were overwhelmed by the Russian hosts. The close of 1914 found the German army held fast in France, and the victorious Russians in possession of Galicia, and making ready to pour down through the Carpathian passes into the plains of Hungary.

In the early spring of 1915, Germany, taking over the supreme control of the Austrian troops, broke through the Russian lines on the Donajec, and commenced that great drive, which must go down into history as one of the most stupendous military exploits of all time. Brilliant as these operations have been, there is a consensus of military opinion that they have been inconclusive. The Russian army is to-day despite its reverses unbroken; its losses have been enormous; but although it has bent it has never been broken. The Central Powers have failed to disperse and disarm the armies of the Czar, which under the spell of rest afforded by the rigor of the Russian winter, are being reënforced and munitioned for the spring campaign.

Judged, therefore, solely by the test of what Germany set out to do, it must be confessed that she has failed. The German lines in France are holding, it is true; but the Anglo-French drive in September gave every reason to believe that when another million of the British troops has been thrown into France and the requisite supplies of ammunition have been stored back of the allied position, it will be found possible to break through the German line on a front wide enough to cause a retirement of the whole front to new positions. Failing that, the war on the Western front must settle down to one of attrition, and judging by the acknowledged Prussian losses to date of 2,250,000 men, and the monthly losses on all fronts estimated by the best military authorities at 300,000, the decisive issue must surely come before the close of 1917.

The outstanding fact of the naval operations has been the remarkable success of the British defensive against the German submarine raid on merchant shipping. The means adopted have been many and all appear to have been more or less successful. The narrow channels have been netted, and great success has attended the towing of large nets between pairs of destroyers and trawlers. The swift destroyers have accounted for many, and a vast fleet of fast motor boats, some of them private craft and others built specially for submarine chasing, acting in concert with the aeroplanes, has proved a veritable terror to the under-sea craft.

Since their disastrous running fight with the British battle cruisers, the Germans have remained in port, so far as the North Sea is concerned. The British battleship fleet at its station in the Forth of Firth, awaits the long-deferred coming out of the German fleet, while its scouts, destroyers and submarines scour the North Sea to give early tidings of the challenge, should it ever come.

The various naval engagements have emphasized the supreme value of speed. Great Britain has completed the five 25-knot battleships of the Queen Elizabeth class. Since the war opened, by the way, she has added twelve dreadnoughts to her active fleet. Also, she has just about completed five new battle-cruisers of the largest size and the unprecedented speed of 32 knots. Her destroyer fleet, moreover, has been increased by the addition of over 70 destroyers of 35 to 37 knots' speed. It begins to look as though nothing short of a miracle could break the strangle hold of the fleet upon the naval situation; and in the opinion of the naval and military critics it is believed that this may prove to be the decisive factor in a war which seems destined to settle down into one of naval, military and economic endurance.

National Defense

The close of 1915 found the United States Government involved in most serious diplomatic differences with Germany and Austria, due to the murder of American citizens upon the high seas. As an offset to our case, the Central Powers believe that they have cause for a deep-seated grievance against us, on the ground that we have constituted our factories a veritable arsenal for the supply of ammunition to the Allies. It was the realization of the portentous possibilities of ultimate war contained in this international friction, coupled with the fatuous determination of the Administration to take no steps whatsoever in the direction of naval and military preparedness, that has led the people of the United States to inaugurate an agitation whose ultimate design is to force the hand of the Administration and Congress into taking proper measures for adequately strengthening our defenses on land and sea. How deficient these are is shown by a brief recapitulation. Thus, the Navy, which in 1904 stood second in strength, is now third in material strength and fourth or fifth in the strength of its personnel. As compared with the Navy of Germany, we have 8 dreadnaughts in commission against her 22; we have not a single battle-cruiser to match against her division of 5; we have 3 old and slow scouts to match against her fleet of a dozen or more 28-knot scouts; and, finally, we have a miscellaneous lot of small, non-seagoing submarines as compared with Germany's large fleet of big, able, sea-going submarines, which, in common with their officers and crew, have been keyed up to a high pitch of efficiency during many months of deep-sea service under war conditions.

As showing the farcical weakness of our mobile land forces, it is sufficient to say that we have in the continental United States to-day only 30,000 effective mobile troops of the Regular Army. We have, possibly, 60,000 effective militia; but, in the event of a surprise invasion, it would take 30 days to concentrate these 90,000 regulars and militia against the enemy. The Administration, taking note of the temper of the country, as expressed in the Navy League, the National Security League, the American Legion, and other non-political and purely patriotic movements for defense, has submitted programmes for the enlargement of our forces. The five-year building programme of the Secretary of the Navy, while correct in principle, is too remote in its results to meet the crisis. We should build up to the full capacity of our Government and private yards until the neglect of the past has been made good. The plan of the Secretary of War for the increase of the Army has the serious defect that reliance is placed upon a so-called "continental army" of 400,000 men, which, it is our firm conviction, would never materialize. The proper remedy is to be found in an increase of the Regular Army from its authorized strength of 110,000 to at least 200,000 men, and the building up of a regular reserve until we have, with the colors and in reserve, a total of 500,000 trained regulars. With this force assured to take the first shock of invasion, we should prepare, back of it, a trained volunteer reserve of 500,000 to 800,000 men.

Engineering

It was inevitable that the great war would interfere with those great engineering activities of a civil and mechanical character which are designed primarily for the uses of peace. Not that the war has rendered the engineering world idle; on the contrary, it has been called an engineers' war—which, indeed, it is; for there is scarcely a single branch of the engineering arts which is not represented in the activities of the war. As a result of our freedom from war, the engineering works in this country have gone forward without interruption. Our steam railroads have been extended and notable progress has been made in the application of hydro-electric power to the hauling of main line traffic. The New Haven electrification has been extended to New Haven and put in full operation, both for freight and passenger service. This alternating current installation therefore extends for over seventy-five miles. The New York Central, using the direct current system is operating to Croton, a distance of thirty-five miles. A recent notable electrification is that on the stretch of the four-track Pennsylvania Railroad between Philadelphia and Paoli, and that on the Norfolk & Western Railroad between Bluefield, W. Va., and the coal mines. The abundance of hydraulic power in the Rocky Mountains has made possible the extensive electrification of the Mountain Divisions, such as that of the Butte, Anaconda and Pacific Railway and the Chicago, Milwaukee & St. Paul Railway.

In no country of the world is there such activity in the construction of dams and reservoirs of great size as in the United States. One by one, the great reclamation projects of the West and Middle West are being completed. The Bassano Dam in Southern Alberta, Canada, exceeded only by the Assouan Dam in Egypt, was opened early in the year. It provides water for 440,000 acres. Also there has been put in service the Arrowrock Dam near Boise, Idaho. This is an arch dam, 1,100 feet long on the top and 348.5 feet in total height —the loftiest structure of its kind in existence. The massive Olive Bridge Dam forming the Ashokan Reservoir for the supply of New York city with 500 million gallons daily, has been completed. The dam is 220 feet in height, 4,650 feet in length, and has a capacity of 132 billion gallons. The 92-mile aqueduct from the dam to New York city is practically completed, as also are the deep tunnel beneath Manhattan and Brooklyn and the pipe line across the Narrows to Staten Island. The Panama Canal, after being for a great many months in successful operation, was completely closed, during the autumn of 1915, by two enormous slides on the east and west sides of the Culebra cut, which extended along the bank for 2,000 feet. The break reached back over 1,000 feet on each side of the canal, and, altogether, between 7,000,000 and 10,000,000 cubic yards of earth were set in motion. The problem is one of simple digging until the ground on either side reaches its natural angle of repose. A notable event in the history of bridge design and construction was the completion late in the year of the 1,000-foot span, arch bridge, over the East River at Hell Gate, New York. This is not only the longest arch bridge, but it is the heaviest steel bridge per linear foot of its length, in the world. The structure weighs twenty-six tons per foot of length, and it has a capacity of four of the heaviest freight trains on four tracks.

The war has had no effect of checking the progress of the greatest work of tunnelling in the world, as represented by the new subway construction in New York city. This vast work, which has been pushed along with great activity during the past year, embraces 325 miles of subway and elevated single track, making, with the existing subway, 621 miles which ultimately will be at the service of the city. The new work includes 150 miles of tunnel under construction, and in this will be included, when the whole work is opened up, eight new single-track tunnels under the East River and a new four-track tunnel under the Harlem River. The total cost of the new work will be about equal to that of the Panama Canal (exclusive of the cost of the slides), or, say, about $365,000,000.

Electricity

Were it not for two remarkable achievements, transcontinental telephony and transatlantic radio telephony, the year 1915 would be barren of any truly startling contributions toward the progress of electricity. It appears that but little has been done in the way of important research and experimental work by the scientists at large, and this is readily accounted for in view of the fact that the greater number of them have been called to the aid of their country either as soldiers or in an advisory capacity.

Radio communication has scored heavily in the development of the radio telephone. Totally unexpected, even by those who closely follow the subject, was the announcement of successful wireless telephony between Arlington and San Francisco, Darien (Panama), Honolulu and Paris. The greatest distance achieved by the wireless telephone is recorded as 4,900 miles, while the record for radio telegraphy was between Nauen (near Berlin) and Honolulu, a distance of about 9,000 miles. In the United States there has been evinced an effort to standardize the wireless equipment of steamers by the leading companies. The radio amateurs have joined in goodly numbers the organizations formed with an

object of being of service to the Government in time of war or emergency.

Second in importance to the radio telephone success has been the transcontinental telephone line permitting a conversation to be held between the East and the West, a distance of 3,400 miles by wire in the instance of New York and San Francisco.

The war has been instrumental in developing many new applications for electricity, prime among which have been those making use of the microphone for the detection and actual locating of invisible airships and submerged submarines. In the hospitals behind the firing lines powerful magnets have been used for removing shell splinters from the flesh of the wounded, and special lamps have been used for hastening the healing of wounds. Electrified fences have been used by the fighting nations to some extent.

The electrification of railroads has progressed to a considerable degree; not only have there been new converts to this form of motive power, but railroads that were already using electricity have increased their electrified zone. Of great moment has been the electrification of the Chicago, Milwaukee & St. Paul Railroad, in that it represents the first direct current installation of such a high potential, 3,000 volts.

Among the most conspicuous new devices introduced have been the thermophone, a telephone of diminutive size employing the thermal rather than the magnetic properties of electricity; the audion lamp as a producer of music, and the phonopticon, which enables the blind to read printed matter, making use of the variable resistance of selenium under the action of light. New types of lamps and improvements over the old ones have appeared, the object being more light with less current consumption and the accurate testing of colors.

The Automobile

Alike in its magnitude and in the quality of its output, the automobile industry during 1915 has made a notable advance. Despite the enormous growth of the previous year, not only has there been as yet no sign of the peak of the demand being reached, but the industry is expanding at a rate which so far as we know is unapproached by any of the other leading industries of the country. Very impressive is the fact that some of the largest establishments have new construction in the way of buildings and plants in hand, which will double and, in some cases, triple the present output. This vast enlargement is being made for several sound economic reasons, one of the most important of which is the fact that increased production means lower cost and the ability to offer the public a thoroughly reliable car at a greatly reduced price. Not only is the price of the car being reduced as the result of increased production, but, in laying out the great extensions of their existing plants, the manufacturers are introducing the latest automatic machinery and are adopting those principles of orderly sequence in the construction of the various parts and their assembling in the finished machine, which have so largely contributed to the low cost of certain well-known cheap cars.

The most interesting mechanical development of the year has been the growth in popularity of the multi-cylinder car, as represented by the twin-four and the twin-six, the former mounting an eight-cylinder and the latter a twelve-cylinder engine. The advantages of the multi-cylinder car are so fully dwelt upon elsewhere in this issue, that they need no elaboration here; it is sufficient to mention the constant and even torque, the absence of vibration, the great flexibility of control and the rapidity of the acceleration. Excellent as was the performance of the six-cylinder car, it was realized that for touring in rough, hilly country there was yet something to be desired, and the demand has been met most satisfactorily by the multiplication of cylinders. With the reduction in the size of the cylinders there has come a reduction in the weight of moving parts and a much higher speed of revolution. This has rendered possible a great increase in the horse-power with a relatively slight increase in the weight of the engine. The writer recently witnessed the block test of a twelve-cylinder engine rated at 38-40, which at 3,000 revolutions developed 110 brake horse-power. There has been a greatly extended use of the self-starter, particularly of the electric type; and the prevailing practice is to install a generator for starting and lighting. An interesting development of the year has been the putting in service of a new gas-electric drive which has given excellent results in actual service. This car was described in our issue of Nov. 27, 1915. The engine and electric transmission constitute practically a small generating station, consisting of a six-cylinder gasoline engine, a generator and a motor. The gas engine drives the field of a generator which supplies current to the motor. The current passes through a controller similar in its action to the ordinary trolley car controller. The advantages of the system are that it acts as its own self-starter; it eliminates the change-speed lever; it gives the widest possible range in speed control, and the interposition of the electric transmission between the engine and the rear wheels, provides a cushioning effect which assists in giving the car its smooth-running qualities.

One of the notable developments of the year has been the marked reduction in price of some of the high-priced cars, a tendency to eliminate many of the cheap and over-light cars and substitute therefor a more substantial and somewhat more costly car. It begins to look as though the standard car of the future, when the present process of evolution has been completed, will be driven by a small-bore engine running at an exceedingly high speed of revolution; that it will be of a weight midway between the present heavy and expensive car and the cheap runabout; and that its cost will be about twelve hundred dollars.

Aeronautics

In reviewing the progress of aeronautics for the year that has just drawn to a close, the one fact that stands out from all the rest is the predominating influence of the war. Achievements in general have been more of the nature of substantial engineering advancement than of sensational flights and records such as have characterized former years.

Gigantic aeroplanes have been developed by the fighting nations in an endeavor to secure the command of the air. Biplanes and triplanes of over 100-foot spread are either built or are building, while machines of more modest dimensions, equipped with two or three power plants, have made their appearance on the field of battle. Such aircraft are equipped with one or more rapid firing guns of 1½- to 3-inch calibre, as well as several machine guns. In some of the larger machines the crew numbers six or more, while the amount of fuel, provisions, bombs and ammunition carried exceeds the expectations of the most far-sighted aeronautical constructor of antebellum days.

The demand for bigger machines has naturally reacted on engine construction, with the result that more powerful aeronautical power plants have been built of late. As in the instance of the motor car, the twelve cylinder aeronautical engine is hailed as the final word in heavier-than-air craft propulsion. Motors of this type are being made in sizes ranging from 100 to 250 horse-power. The rotary engine, which dominated the field previous to the past year, is being largely replaced by the stationary cylinder types, due to the fact that the latter have been found more simple, easier to repair and of greater reliability, especially in their improved forms. There has been evinced a sustained effort on the part of the engine builders to follow automobile practice in the design of airship power plants.

The equipment of military aeroplanes has been greatly improved and numerous refinements made in the smaller details of construction. Some of the fighting aeroplanes, particularly the German machines, have proved luxurious in the matter of equipment.

The high rate of depreciation of military aeroplanes has given aeroplane manufacturing a tremendous impetus. Crude methods and equipment of former days have been replaced by labor-saving machines and efficient systems, made possible by quantity production. Particularly in America has this change been most conspicuous, one plant at least being now placed on a basis comparable to that of the smaller automobile shops.

The military efficiency of aeroplanes has been greatly raised during 1915. Aerial raids of unprecedented magnitude have been successfully undertaken. Considerable damage has resulted from some of the raids. On the other hand, dirigibles have failed to prove of military value, although participating in numerous forays.

The transparent aeroplane has, it is reported, made its appearance on the French front, but official confirmation is lacking. However, it is known for a certainty that both the French and Germans have been hard at work developing transparent plane surfaces with more or less success.

The development of anti-aircraft artillery has reached a point where it is decidedly uncomfortable for an aviator to fly at an altitude lower than 10,000 feet. Previous to 1915 the average range of aerial artillery was below 5,000 or 6,000 feet.

Most remarkable of all is the fact that no international records appear to have been broken, while, on the other hand, several new American records have been made. Among these are: DURATION.—Aviator alone, Lt. Byron Q. Jones, U. S. A., January 15, 8 hours, 53 minutes; aviator and two passengers, Lt. Byron Q. Jones, U. S. A., March 12, 7 hours, 5 minutes. ALTITUDE.—Aviator and one passenger, Lt. J. E. Carberry, U. S. A., January 5, 11,690 feet; aviator and two passengers, R. V. Morris, August 10, 8,024 feet; aviator and three passengers, August 10, 8,105 feet. DISTANCE FOR HYDRO-AEROPLANES.—Aviator and one passenger, Lawrence B. Sperry, January 20, 60 miles. DURATION FOR HYDRO-AEROPLANES.—Aviator and one passenger, Lawrence B. Sperry, January 20, 1 hour, 25 minutes. ALTITUDE FOR HYDRO-AEROPLANES.—Aviator alone, Lt. P. N. L. Bellinger, U. S. N., April 23, 10,000 feet; aviator and one passenger, Lt. H. Ter Poorten, August 31, 8,330 feet.

Science

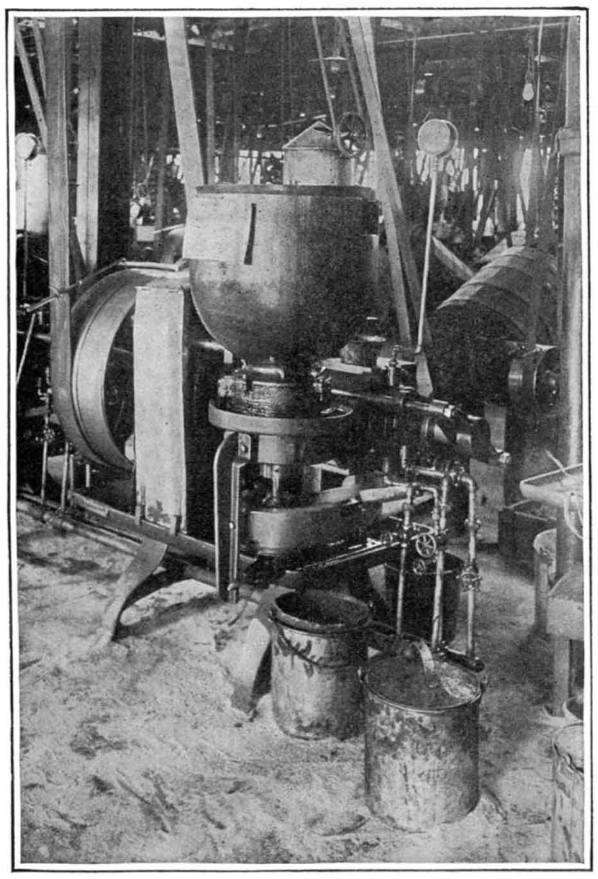
It can hardly be expected that the past year should show a very good record of achievements in the world of pure science, since the upheaval in Europe has drawn many scientific men from their work and has placed the few that remain in an atmosphere far from favorable to the pursuit of science for peaceful ends. Added to this is the depletion of the ranks of typesetters, which, we are told, has caused delay in the publication of some of the work that has been done. The war has not, of course, had a similar effect in this country, and we have one very remarkable record to our credit: the successful communication by wireless from Washington to Honolulu and Paris. Much attention has here been directed towards the building up of some of the chemical industries which are so highly developed in Germany, and for the products of which we have hitherto been largely dependent upon Europe. There is a good deal of work being done in this direction, the results of which have not yet clearly emerged to the surface.

If the war has repressed scientific work in Europe along the usual lines, it has brought some developments arising directly from war conditions. Necessity is the mother of invention. We hear of special efforts in Germany to meet the situation that is imposed upon it by the Allies' navy. The production of fodder from yeast is one of the signs of this activity which we have recorded in our columns.

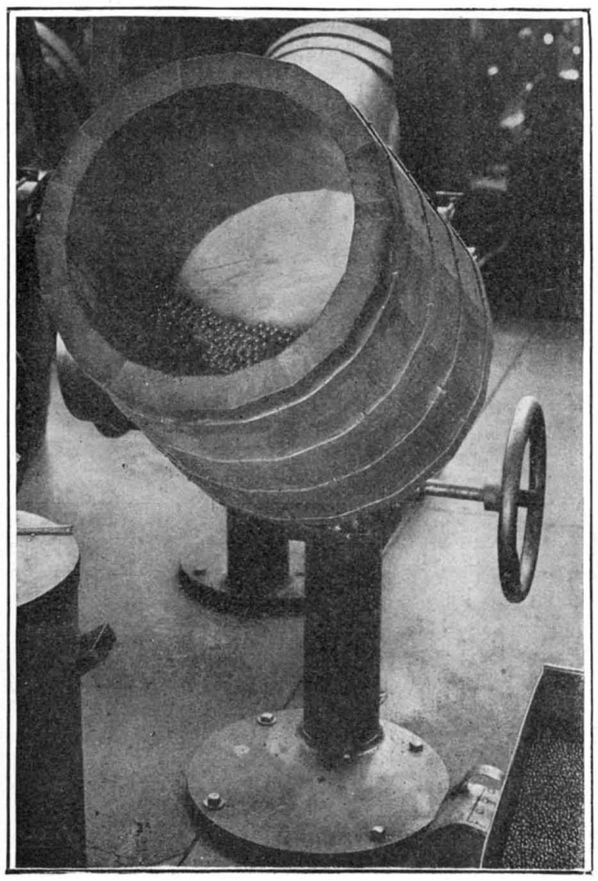
Surgery has found in the field of war the most abundant scope for development, and there can be no doubt that much valuable knowledge has thus been gained. The psychology of the soldier in the field has been found to present phenomena of remarkable interest. Science will be able still to reap some few crumbs of benefit at a time when we are appalled by the losses and destruction wrought by so large a portion of our race.

Astronomy

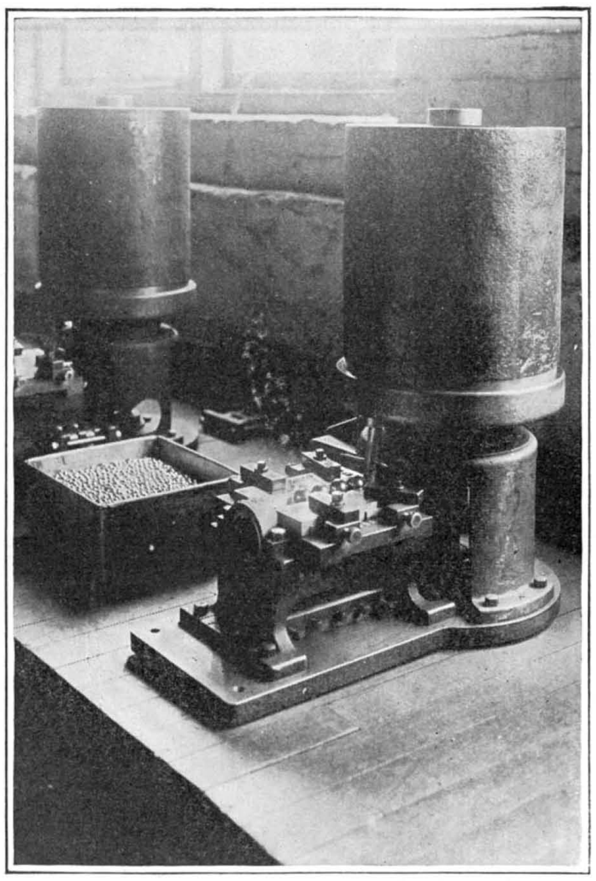
Astronomy probably suffered less by reason of the war than any other branch of science, because this country has always paid particular attention to astronomical research and has provided more elaborate equipment for such study than have the European nations. Despite the war, some work has been done at observatories in the very midst of the fighting regions. The European clearing station for astronomical news was formerly the Zentralstelle für astronomische Telegramme at Kiel. When war broke out this service had to be discontinued, but it has since been resumed at the University Observatory of Copenhagen under the direction of Prof. Ellis Strömgen. About a week before the war broke out the block of glass for the 72-inch Canadian reflector started from Antwerp so that work on this telescope has not been delayed and is now nearing completion. This will be next to the largest telescope in existence, the largest being the 100-inch reflector for the Mount Wilson Observatory. Work on the installation of the latter has been delayed to some extent by the naval activity at the ship building plant where large steel members of the observatory are being made. However, the work should be completed very soon. It is believed that this big telescope will enable us to photograph a hundred million new stars. The year 1915 has not been marked by any special celestial phenomena. There were only two eclipses, both being annular eclipses of the sun. The first, occurring on February 13th and 14th, was seen in the Indian and Pacific Oceans and the northwest portions of Australia. The path of the second annular which occurred on August 10th, was confined to the Pacific Ocean and was visible as a partial eclipse in Hawaii. Five comets were discovered during the year. The last comet of the year was discovered by Taylor at the Cape of Good Hope at the beginning of December. Of the three new comets two were discovered by John E. Melish, of Cottage Grove, Wisconsin, on February 10th and September 13th, respectively. Tempel's periodic comet was rediscovered by Delavan at the La Plata Observatory, Argentine, on May 16th, and Winnecke's comet was rediscovered by Thiele at Hamburg, on April 4th. A matter of considerable popular interest in this connection is the inauguration of a systematic study of meteors in order to investigate their supposed relation to the lost comets. In this research the coöperation of amateur observers has been called for and has met with a ready response. The search for another member of the solar system beyond Neptune is going on and Dr. H. H. Kritzenger believes that there is a good chance of finding a transneptunian planet in Sagittarius or Capricornus this winter. Systematic studies of the sun are being carried on at the Mount Wilson Observatory. Discoveries have been made at that observatory which promise to determine a star's distance by measurement of its brightness and the relative intensities of certain lines in its spectrum,



The machine that does the finish grinding of balls



A tumbling barrel in which the balls are polished



Automatic ball grading and sorting machine

Balls and Ball Bearings

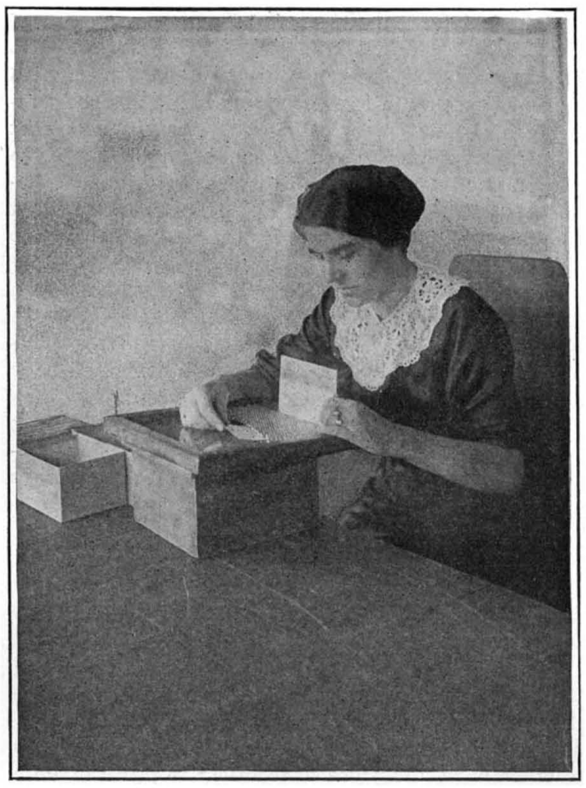
How Devices for Reducing Friction Are Made

FRICTION—the great handicap which all moving bodies have to overcome—has been reduced to a minimum in the rotating parts of an automobile, which amounts to a practical, if not a theoretical, zero. The actual amount of motor power absorbed by the freely revolving ball bearings, used in modern motor cars, is so small as to be unnoticeable by any but the most sensitive detecting instruments. It is not too much to say that the highly-developed ball bearing has made the low-priced efficient automobile possible—it is most certainly true that without the automobile as an incentive to further elimination of friction the ball bearing would not have reached its present preeminence.

Without going deeply into the history of the ball bearing industry, it may be stated here shortly that the bicycle was probably the first cause of the "frictionless" bearing. When the puny power of the human leg was utilized in pushing forward a wheeled vehicle, anything that increased this power by reducing the ever-present friction was sure to be hailed with joy by the great public. And when the bicycle industry branched out into the power-bicycle and the full-fledged automobile, the lessons of rotary friction in place of sliding friction were utilized to the best advantage.

When a shaft rotates in a plain bearing, it slides within this bearing on much the same principle as a sleigh slides over the snow. Rolling friction, as exemplified in the carriage wheel, is far less than sliding friction of the same relative load; and the adoption of the ball bearing really was nothing more or less than the introduction of the rolling type of friction into the wheelhubs—just as the rolling friction of the outside rim of the wheel had impressed the first trading nations with its superiority over the sliding runners of old time sledges.

The modern ball bearing is not a haphazard invention, nor has it reached its present state of almost uncanny accuracy without serious difficulties. Units of measure, formerly employed only in the construction of highly sensitive optical instruments are an ordinary shop-term in the modern ball bearing factory. Fractions as small as one-twenty-thousandth of an inch drop from the lips of shop foremen, as if there were any human eye capable of appreciating such a measure! The lay mind has no conception at all of what one ten-thousandth of an inch represents, and yet this measure is the limit of inaccuracy permitted in a ball bearing, while several manufacturers of steel balls cut even this minute fraction in half, and demand accurate work to within one twenty-thousandth of an inch. Let the reader take a finely graduated steel rule, on which the inch is divided into 64 parts; let him try and imagine one of the small spaces subdivided into 300 sections—and he will have obtained a fraction still slightly larger than the accuracy limit in a steel ball plant!



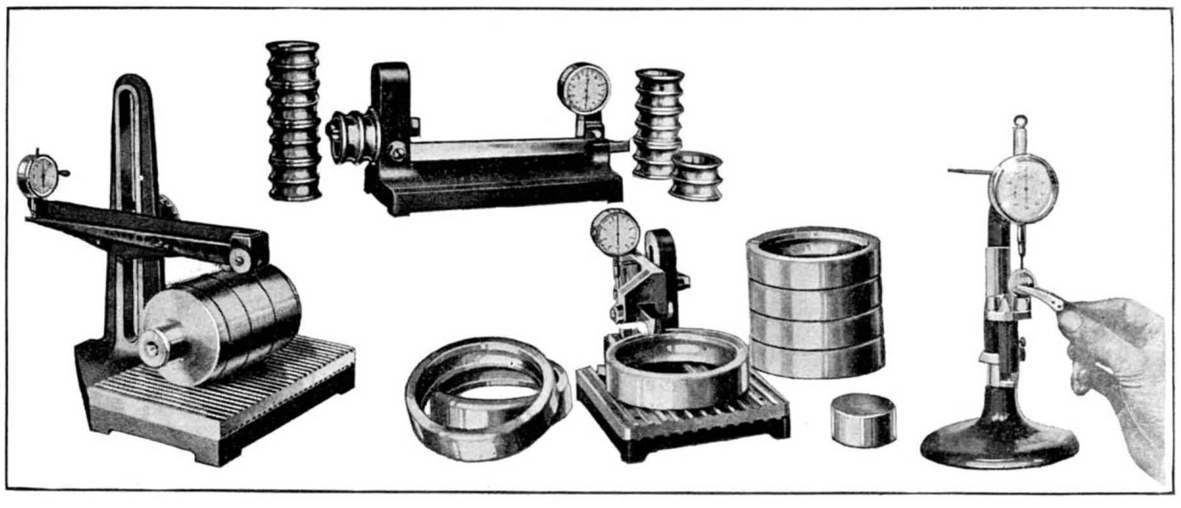
Final inspection on a glass tray for surface blemishes, soft spots and fire cracks. The girl holds a piece of white cardboard in her left hand to reflect light onto the balls

How such incredible accuracy is obtained under the general working conditions of a large machine shop, is one of the marvels of the ball bearing industry.

Among the industries of this country, which were hard hit by the suddenness of the European war, none perhaps received such a shock as the ball bearing industry, and none, to its credit be it recorded, rose so quickly and successfully to the demands placed on it. At the time of the outbreak of the war, one half of America's consumption of ball bearings was supplied by Europe; either as finished balls and bearings, or as the raw steel of special composition, which is required for their manufacture.

The Raw Material.—By far the largest part of all balls in ball bearings are made of chrome steel, compounded and melted according to a formula invented by a German engineering chemist. Germany and Sweden, in particular, made a specialty of producing this kind of steel, and reached such a state of perfection that other nations, instead of trying out and testing their own steel alloys, came to regard these two pioneers as the only available sources of supply. During the years 1910-14 the demand for ball bearings in this country grew so enormously as to surpass the capacities of the European plants, and a rival industry in this country arose which at present bids fair to command the markets of the entire world. Huge plants have been built, still larger ones are proposed, while Europe is unable to attend to its business of steel ball manufacture for bearings—being too busy making iron balls for shrapnel. Sweden alone is in a position to ship balls and bearings to the United States, but its whole output is but the proverbial drop in the bucket, when intended to supply the American automobile industry.

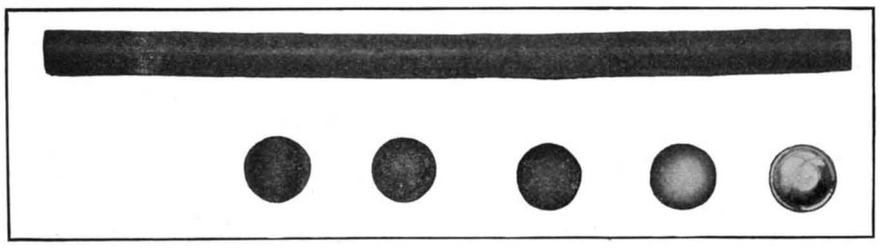
The present output of balls and bearings in this country is not known pre-



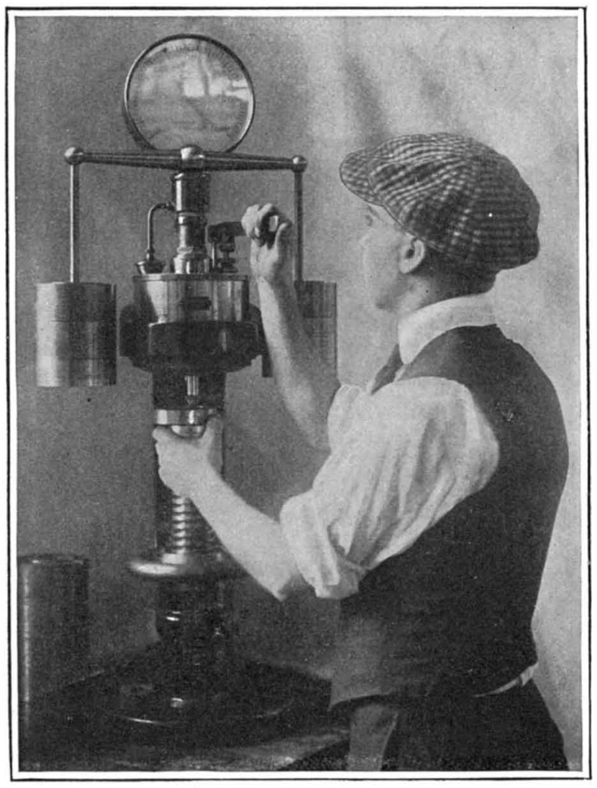
A group of delicate devices used for gaging ball races, in which the indicating dials show variations of a ten-thousandth of an inch. At the right is a Brinell machine for testing hardness

precisely. A fairly accurate estimate places it at 60,000 tons of chrome steel, in the raw form, and not less than 18,000,000 complete bearings in the course of a year. One of the largest manufacturers of ball bearings turns out 20,000 bearings a day, while the foremost manufacturer of steel balls can produce for this purpose 5,000,000 balls a day. The number of balls in each bearing varies from 12 to 38—the first being an ordinary "single row" bearing of the small type, the latter a double-row bearing of the largest size. The number of steel balls mentioned includes those used in bicycles, automobiles, baby carriages, sewing machines, talking machines and other articles bought and used in quantity. The number of bearings given includes only those in the automobile and motorcycle industries.

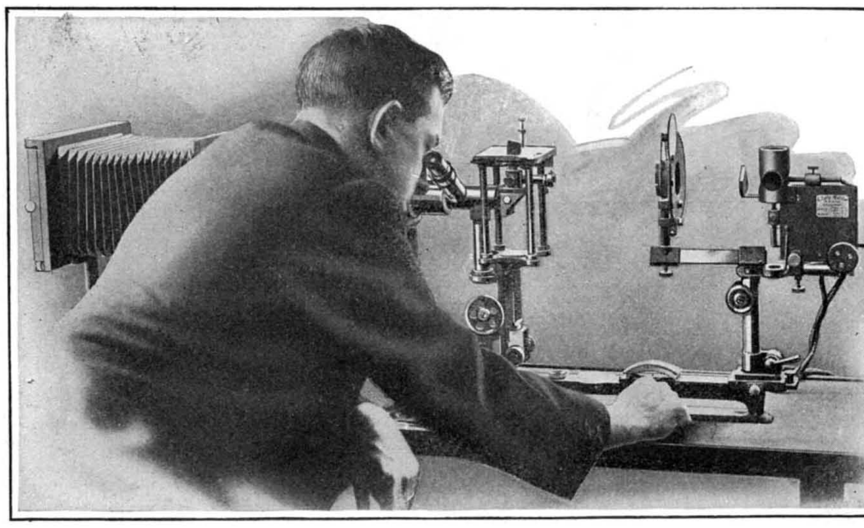
Shaping the Balls.—Although the construction of the entire bearing is based on the greatest possible accuracy, it is in the manufacture of the revolving steel balls that the chief care must be taken. A slight unevenness in the "race ring" or the "raceway"—as the sections of the bearing itself are called—does not have the disastrous results which follow the introduction of an uneven, or slightly larger ball into the race. The ball, because of its inaccuracy, has to carry momentarily the whole load, or is subjected to sudden stresses far beyond its capacity. It cracks—and the whole bearing is ruined unless the damaged ball is speedily removed from it.



The raw material, and balls in their five stages of manufacture



Testing ball bearings with a Brinell machine



Leist photo-microscopic apparatus, used for examining micro-structures as well as the finish of races

The best bearings, however, are so accurately proportioned that each ball carries the same maximum load.

The chrome steel, from which the balls are to be cut, arrives at the factory in the shape of a thick steel "wire"—somewhat larger than necessary for the cutting of the balls. It is re-drawn to size, and fed into a machine which cuts off small cylindrical pieces. These pieces immediately drop into a second machine where they are gripped between two dies and squeezed into globular form. This squeeze leaves the future balls with a ragged "fin" where the two dies have met, and a rough grinding process removes this metal edge, before the balls are sent to the heat-treating furnaces.

These furnaces, gas fired and electrically controlled, are a wonderful sight. More than a hundred are grouped in the factory of one of the largest makers, and every one is directly connected with a switchboard fitted with a potentiometer-pyrometer. This instrument registers the smallest change of temperature in the furnaces, three deg. Fahr. being considered the limit of variation permissible. The furnaces have an average temperature of 1,700-1,750 deg., the exact treatment for each shipment of steel being prescribed by metallurgists after a complete analysis of the composition of the steel, and laboratory tests of its properties. If the temperature in these furnaces varies more than three deg. from that required, a green or red electric light (too cold or too hot) flashes the signal to the furnace inspectors, whose sole duty consists in watching for these signals.

After leaving the hardening furnaces, the balls are placed into hoppers, from which they are fed to vertical grinding discs covered with abrasive material. When the machine is revolved, the balls roll in a V groove, being fed into the center of the discs and travel to the outside over the abrasive, whence they return to the center automatically. This grinding process is extremely slow as the balls are so hard that the time required is from three to five hours, depending on the amount of reduction in size necessary. Every now and then an attendant takes one of the balls from the outside of the discs and checks it on a gauge. When it has reached the required size, the hopper is taken out and the contents dropped into tubs, mounted on shafts inclined 45 deg. to the horizontal. A quantity of small bits of leather is mixed with the balls. As the tubs are revolved the balls roll rapidly over and over against each other, and against the leather until the fine abrasive dust from the grinding has been removed, and the product has taken that highly polished exterior which one unconsciously associates with the commercial bearing balls.

The balls are now ready for mounting in bearings, but there is a considerable variation in their sizes, a variation reaching as much as one five-hundredth of an inch. As the limit of inaccuracy between two balls in a single bearing is one ten-thousandth of an inch, there is still an assorting process to be gone through before the balls are ready.

Assorting the Balls.—Next to the manufacture of the balls, the assorting process is of the greatest interest to the average visitor. Two long, V-shaped, sharp-edged pieces of the hardest steel are mounted *almost* parallel—the width between the extreme ends differing by only a minute fraction of an inch. The balls issue one by one from a hopper, and roll along the edges of the steel knives, until they find a spot which permits them to drop through. Twelve boxes are placed below the assorting knives, and they are so arranged as to receive only such balls as differ from all the others dropping into the same box, by less than one ten-thousandth of an inch. At the extreme ends of the knives are boxes for the "misfits"—that is to say for balls that are either much too large or much too small. The percentage of these wasted balls is very small.

Each box of balls is then turned over for final inspection to girls, especially trained in this work. They are placed, about fifty at a time, in wooden trays, having plate glass bottoms on which the balls are rapidly rolled in various directions. The slightest irregularity in the roll indicates a defect in shape that is instantly detected by the trained inspectors, who also are wonderfully expert in detecting other defects. Quite a number in each box fail to pass the sharp eye of the girl charged with the final testing.

In some plants wonderful automatic devices are employed for this purpose, as machines never tire, and are not affected by the human element.

Assembling the Bearing.—Each box of finished balls is then turned over to the assemblers, who are only permitted to use balls of one box for one single bearing. Under no circumstances must a man take "just the one" ball necessary to complete a bearing from any other box than the one he has been working with. For there may be a difference of one five-thousandth of an inch between the contents of two boxes, or even more, and that would spell disaster to the bearing.

At the assembling tables, the balls are met by the bearings, coming from another part of the plant. The bearing, in the first rough stages, undergoes the same process of cutting off, rough grinding and heat treatment, that the balls pass through. Large rings and races—as the outer bearings are called—are cut directly from chrome steel tubes of the required diameter and then ground and polished. Small races are cut from solid bars, and each race is subsequently bored out.

The method of assembling differs in the various types of bearings. Where the old-style cup and cone for bicycles is used, it is very simple and requires no explanation. Where solid races are used, without even the famous small curved "notch" in the outer and inner races, through which the last few balls in each race are "sprung" while exactly opposite each other, the insertion of the last two or three balls is highly interesting. Specially designed, patented machinery "springs," the last few balls into these races in such a way as to avoid deforming them.

Where soft steel outer shells are used, the assembling sequence is as follows: First the outer race ring, then the center member, the cages and all the balls (one by one), and finally the second outer ring, which is squeezed on. The bearing is then mounted in a lathe and the soft steel shell is spun over the open end. The bearing is completed, but so tight that it cannot be turned. It is now gripped in a chuck, and pressure applied to the outside with a burnisher. The soft steel gives way under the pressure, and "flows" until the outer shell becomes slightly lengthened, and the cups are loosened. A few moments of such spinning makes the bearing run freely in its shell. The outside deformation and discoloration in the burnishing process is removed by grinding and polishing on the outside, while all foreign grit and lint is removed by forcing oil under pressure through the finished bearing. It is then packed in grease-proof paper and ready for shipment.

If the average motorist took one thousandth as much care in the use of his bearings as the manufacturer takes in making them, there would never be any complaint. But bearings are subjected to stresses for which they never were intended, and to abuse, by being run without lubrication, or with broken steel balls. Properly treated, the American ball bearing is at least equal to, if not better than, the foreign-made bearing. Without it, the automobile industry would be in a sorry predicament.

In What Position Does a Pointed Infantry Bullet, Shot Vertically Along a Straight Trajectory, Return to Earth?

When this question was raised seven years ago in the periodical *Schuss und Waffe*, there was no unanimous opinion even among hunters and gun experts. In order to solve the problem, a special shooting stand was erected upon the experimental station of the *Deutsche Jägerzeitung* in Neudam (Mark), the strong roof of which afforded ample protection against falling bullets. Close to this gallery an infantry rifle was clamped in such a position as to send the bullet upwardly in an absolutely vertical direction. The experiments were carried on in the proximity of a lake, the surface of which was frozen. The ice was covered with strong planks. Shots were fired in almost absolutely calm weather and the bullets searched for in the planks upon the ice.

It was shown that an infantry rifle bullet, shot upward, in a vertical direction, passes downward again in the same position in which it passed upward, i. e., it came back again to the earth with its bottom first. Why was it not upset at its culmination point? The bullet was subjected to two forces, the propelling force, and the twist. The propelling force ceases to act at the culmination point, the bullet stands still for a moment, then begins its fall. But the twist has as yet not stopped, and therefore it starts its fall with twist, and that in the same direction of rotation it had when fired.

As the bullet, rotating upon its base plate, offers a greater surface to the air, its fall must be very slow. The damage done to the planks when it strikes the ground is always slight. Even on impact the twist had not stopped, for the warping of the wood fibers in the direction of rotation of the bullet could be seen.

The Automobile of 1916

Prominent Innovations That Distinguish the New Models from Their Predecessors

By Victor W. Pagé, M. S. A. E.

WHEN the many excellent cars produced during the season just passed were first announced, the motorist and those in the automobile industry believed that the development of the modern motor car was reaching a point where improvements would be only a matter of minor detail, and that no radical developments would be announced for the car of 1916. It was believed that the eight cylinder motor marked the practical limit of the multiplication of cylinders, and that no further simplifying of the mechanism was possible or practical. It was conceded by many well versed in automobile construction that the practical limit in weight reduction had been reached. It was thought that further price reduction could not be made without a marked sacrifice in quality.

Contrary to the general belief, the development of the automobile did not reach the final point, because there are just as marked mechanical improvements in the designs offered for the 1916 season as have been previously made in any year since the automobile attained its present general form.

Popularization of the Eight- and Twelve-Cylinder Cars

As a logical result of the eight cylinder movement, the twin-six or twelve cylinder engine stands out as one of the most marked developments of the new season. The adoption of eight cylinder motors by a large number of manufacturers for the coming season is also a surprise, not because the practicability of the V engine having that number of cylinders was questioned, but because the six cylinder engine had been developed to a point where it was thought sufficient for all practical needs. It not only provides smooth running and even application of power with a ready acceleration, but it also provides a power plant that is practically vibrationless and that can be throttled down so a very low car speed may be obtained without shifting gears.

When first introduced it was thought that the eight cylinder engine would be suited only for the larger cars, and that the added complication would make this type unsuitable for use in the moderate priced cars purchased by people of modest means who act as their own chauffeurs. Even this belief was destined to be changed by the introduction of not only small eight cylinder motors, but also small twelve cylinder power plants intended for cars selling around $1,000.

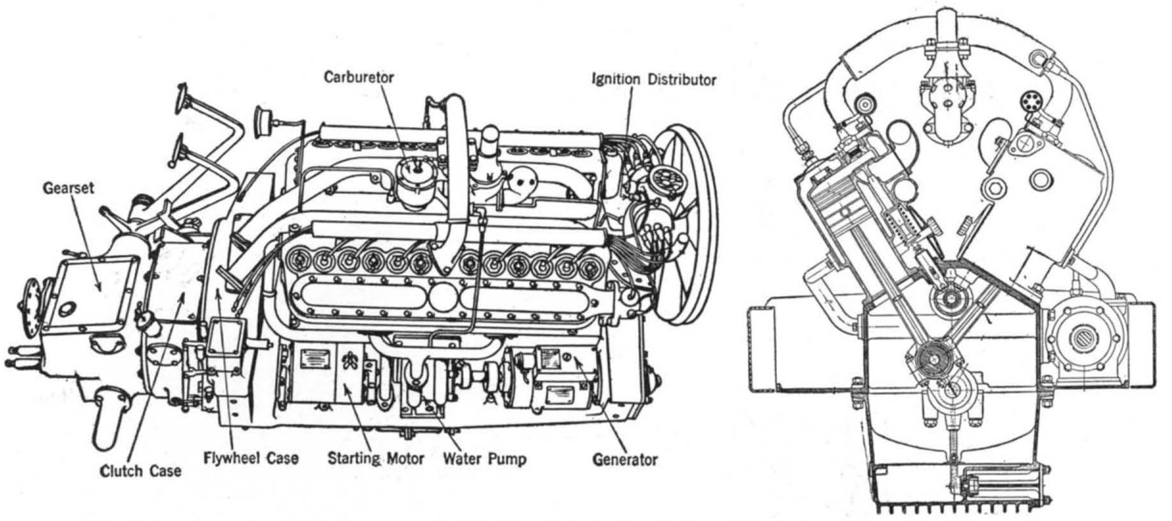
It does not seem to the writer that there is a sufficiently marked advantage in the use of eight and twelve cylinder motors to warrant the added complication in cars intended for the masses. Repair costs cannot fail to increase in almost a direct ratio to the number of cylinders employed as relates to power plant maintenance. Expert repairmen have submitted figures showing this to be true. So the problem resolves itself into the balancing of the advantages and increased maintenance cost of the eight and twelve cylinder cars against the simpler four and six cylinder types, and arriving at a decision in this controversial question.

Improvements in Engine Design

It is not only in multiplying the number of cylinders or arranging them in V form to obtain compactness that the automobile power plant of 1916 has been improved. The speeds of crankshaft rotation are higher than ever before, and many touring car motors run at higher speeds than the racing car power plants of a few years ago. More power is therefore obtained for a given piston displacement than formerly; this being made possible by an increase in valve sizes, changes in compression ratios and the adoption of automatic pressure feed lubricating systems that insure the thorough lubrication of every internal motor part. The great increase in crankshaft speed has been made possible by better balancing and the lightening of reciprocating parts. Aluminum pistons have replaced cast iron members in many motors, as these weigh about one-third as much as the cast iron forms of the same size, while the reduction in the inertia forces has made it possible to increase the engine speed without correspondingly stressing the connecting rods, crankshaft and engine bearings.

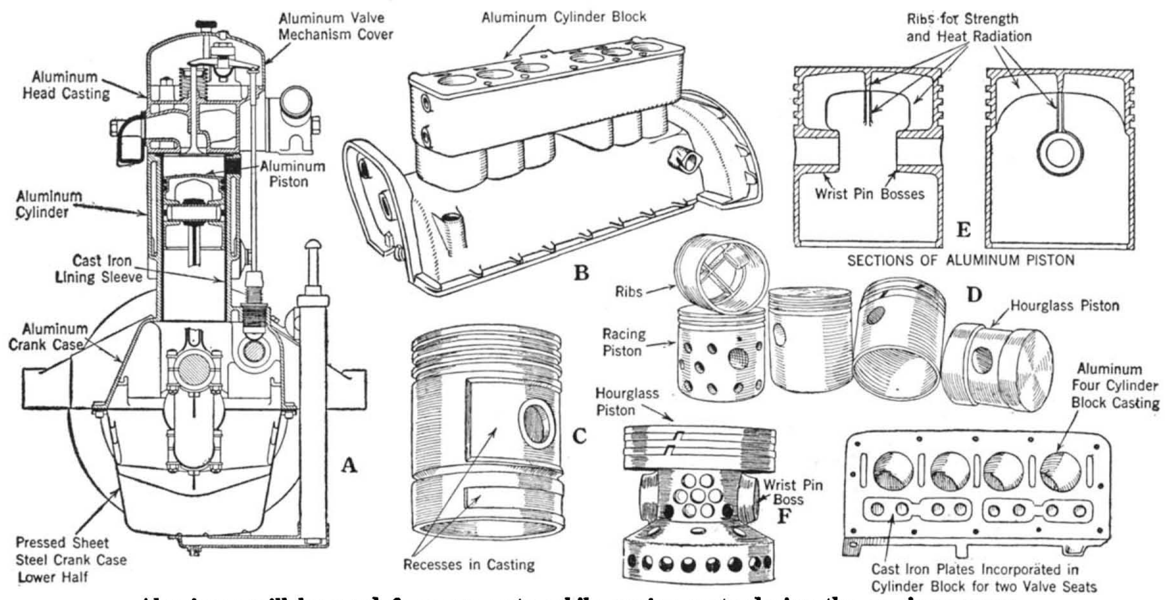
Aluminum has not only been used for pistons, but a number of motors will be built for the coming season that will use aluminum cylinder block castings as well. Of course, the aluminum alloy is too soft to be used as a bearing for the piston, and it will not withstand the hammering action of the valve. This makes the use of cast iron imperative in all motors. When used in connection with an aluminum cylinder block the cast iron pieces are placed in the mould so that they act as cylinder liners and valve seats, and the molten metal is poured around them when the cylinder is cast. It is said that this construction results in an intimate bond between the cast iron and the surrounding aluminum metal. Aluminum has for a number of years been used in many motor car parts. Alloys have been developed that have greater strength than cast iron and that are not so brittle. Its use for manifolds, clutch cones and engine crank and gear cases has been general for a number of years.

At first thought it would seem as though aluminum would be entirely unsuited for use in those portions of internal combustion engines exposed to the heat of the explosion, on account of the low melting point of that metal and its disadvantageous quality of suddenly "wilting" when a critical point in the temperature is reached. Those who hesitated to use aluminum on account of this defect lost sight of the great heat conductivity of that metal, which is considerably more than that of cast iron. It was found in early experiments with aluminum pistons that this quality of quick radiation meant that aluminum pistons remained considerably cooler than cast iron ones in service, which was attested to by the reduced formation of carbon deposits thereon. The use of aluminum makes possible a marked reduction in power plant weight. A small four cylinder engine which was not particularly heavy even with cast iron cylinders was found to weigh 100 pounds less when the cylinder block, pistons, and upper half of the crank case had been made



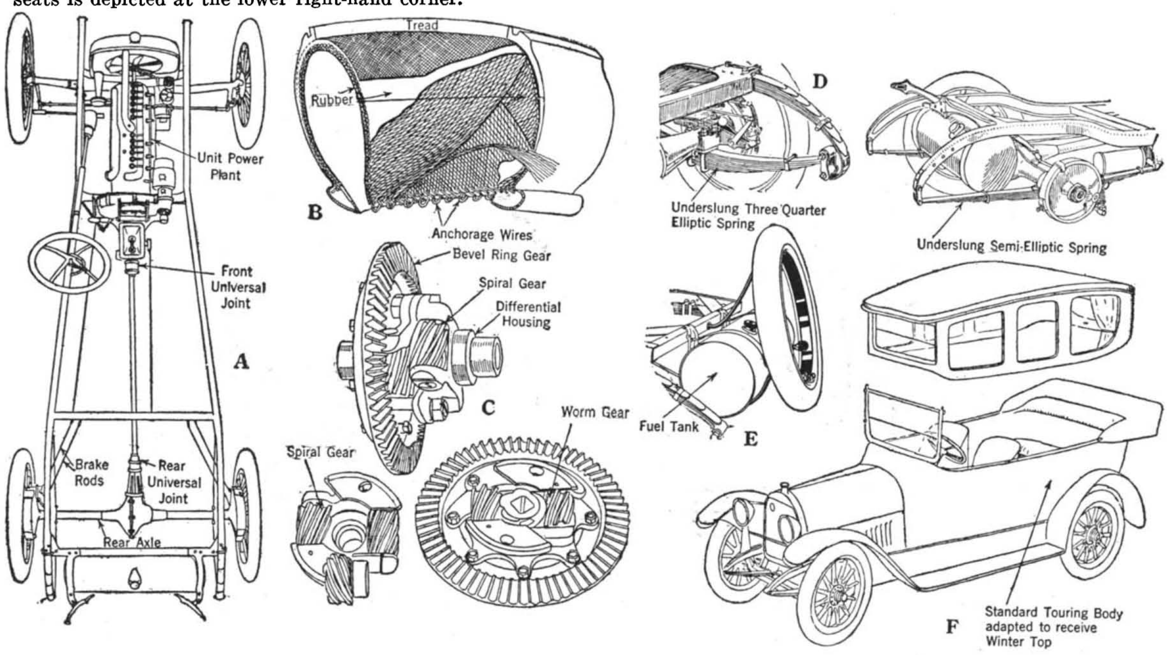
The twin six automobile power plant is the latest development in internal combustion engines intended for motor car propulsion

It will be found on a number of the 1916 models. Note how the relatively small angles between the cylinders make possible the placing of the water pump, generator and electric-starting motor at the sides of the crank case.



Aluminum will be used for more automobile engine parts during the coming season

The sectional view of the overhead valve motor at *A* shows the use of aluminum cylinder block and cylinder head casting. A six-cylinder aluminum block casting is shown at *B*, while various interesting forms of aluminum pistons are shown at *C, D, E* and *F*. Top view of a four-cylinder aluminum block casting showing the use of iron plates for valve seats is depicted at the lower right-hand corner.



Group showing some of the 1916 developments in chassis construction

A—Plan view of chassis outlining simple assembly possible when Hotchkiss drive is used in connection with unit power plant. *B*—Part sectional view depicting construction of cord tire. *C*—Differential mechanism using worm gearing. *D*—Underslung rear springs that promote easier riding. *E*—Vacuum fuel feed makes rear tank location almost universal. *F*—Removable limousine top that will convert standard touring car to one better adapted for winter use.

of aluminum instead of cast iron. Aluminum motors are no longer an experiment, as a considerable number of these have been in use on cars during the past year without the owners of the cars being apprised of the fact. Absolutely no complaint was made in any case of the aluminum motor and it was demonstrated, in addition to the saving in weight, that the motors cost no more to assemble and cooled much more efficiently than the cast iron form. One of the drawbacks to the use of aluminum is its scarcity, which results in making it a "near precious" metal.

The detachable cylinder head which has been used for a number of years by a popular priced car manufacturer demonstrated its practicability in such a marked manner that nearly all of the newly designed engines will use the detachable head construction in connection with block motor castings.

A tendency noted in the 1916 automobile power plant design is the use of overhead camshafts and the provision of almost direct positive valve actuating mechanism. Every part of the valve system is thoroughly enclosed and all parts subject to mechanical depreciation are copiously oiled by forced or stream lubrication. Another tendency is the simplification of the power plant exterior. This end is being attained by the complete enclosure of the valve operating mechanism and by the elimination of the intake manifold and those formerly used for conveying the cooling water, and in some cases even the exhaust pipe has been dispensed with.

Practically all modern automobiles are equipped with power plants of the unit type, in which the engine, clutch and change speed gearing are attached together and the whole assembly supported by three points on the chassis frame. This construction has survived the test of time, and experience has demonstrated that it is not only superior from the point of view of the manufacturer in reducing assembling cost, but that it also works out to the advantage of the motorist by reducing the engine repairs necessary when the older four-point suspension principle was used. The power plant suspended by three points is not affected by the unavoidable frame distortion and deflection as the more rigid supporting method is, and as the engine supporting arms need only be made sufficiently strong to support the weight of the engine, the assembly can be materially lighter than in that construction where the crank case arms must be strong enough to resist displacement of the frame members.

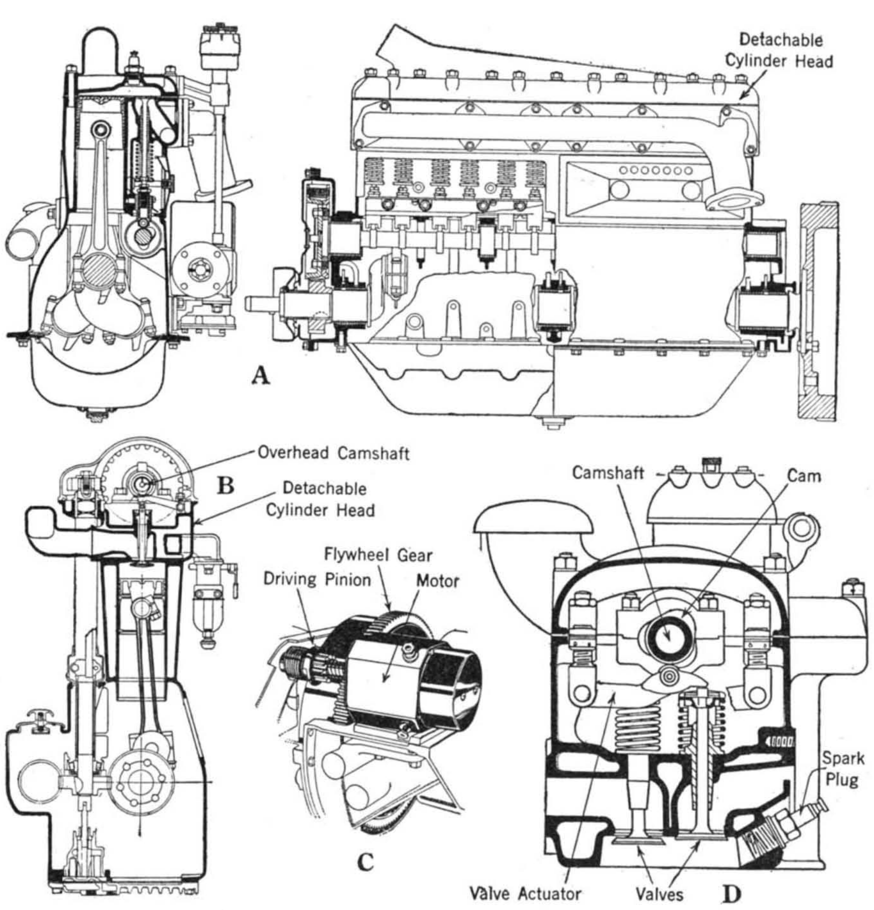
The Trend Towards Battery Current Ignition

With the universal adoption of electric starting and lighting systems has come a marked diminution in the number of firms using high tension magneto ignition. Inasmuch as practically all of the lighting systems operate on the principle of keeping the storage battery constantly charged by a small engine driven dynamo, it is believed that the unfailing source of current provided in this way will result in equally energetic ignition from the battery as from the magneto. The contention made by adherents of the battery ignition system, that this will provide as hot a spark as a high tension magneto will, does not ring true when one considers that designers of all the racing cars in which absolute reliability of the ignition system is essential, and in which maximum power output is required of the engine, continue to use the high tension magneto. Undoubtedly the battery ignition system produces a sufficiently hot spark for all practical purposes.

The increasing adoption of the twin-four and twin-six power plant has not put a quietus on the development of the four or six cylinder forms. A notable improvement has been made in a number of cases in four cylinder motors and very smooth running obtained by counterbalancing the crankshaft throws with small counterweights forged integrally. The same favorable influence obtained by the use of lighter reciprocating parts and higher piston speeds can also be extended to the four and six cylinder forms, and when proper attention is given to the matter of valve timing and valve sizes as is necessary to secure efficient operation of the more complicated forms, the four and six cylinder motors are still forms that demand consideration.

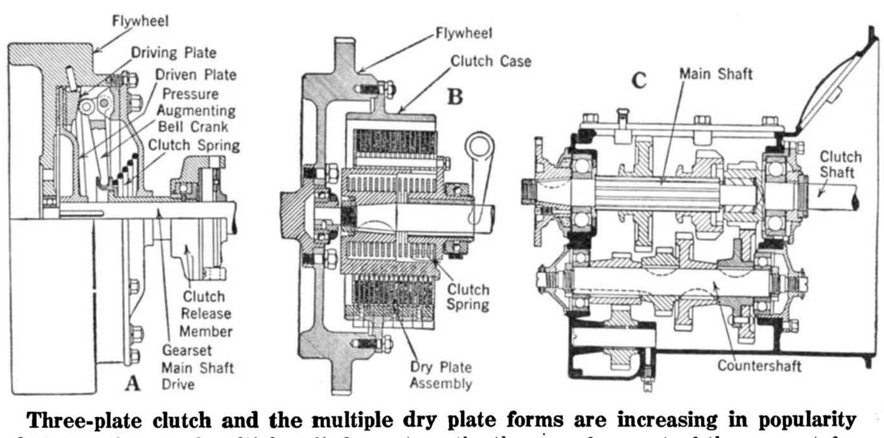
The popularization of the Knight sleeve valve motor by one of our largest automobile producers and the reduction in price of cars equipped with this motor by a number of other licensees of the holders of the Knight patent means that more motorists will be able to avail themselves of the many substantial advantages of this design. Curves that have been made as a result of scientifically conducted power determination have demonstrated conclusively that the Knight type motor gives more power for a given piston displacement than any other form.

Motors having L type cylinders give somewhat less power than those having T head cylinders. This is because larger sized valves are made possible by the latter method of construction. Similarly, valve-in-the-head motors give more power than the other poppet valve forms, although the Knight sliding sleeve type is fully as great an improvement over the most efficient poppet valve type as that is over the other two methods of valve location.



Prominent features of the 1916 automobile engine

The light-weight high-speed six-cylinder engine shown at *A* is a representative form such as is supplied to furnish motive power for many 1916 medium priced cars. The overhead camshaft of the form shown at *B* and *D* is another power plant development. The Bendix drive or automobile pinion shaft shown at *C* is a feature of many electric-starting motors, its use having been popularized by the increased demand for simplified mechanism.



Three-plate clutch and the multiple dry plate forms are increasing in popularity

Owing to the use of multiple cylinder motors, the three-speed gearset of the compact form shown at *C* is replacing the four-speed type.

Innovations in the Power Transmission System

In considering the power transmission system but few innovations have been made. The spiral bevel gear, which received considerable application during the past season, is being used in many more rear axles than heretofore. The spiral bevel driving gearing is not only quieter than the straight bevel form, but it is also better suited for the lower final drive gear ratios made necessary with the higher speed engines that are generally used in the 1916 models. The doubts that were expressed relative to the durability of the spiral bevel form have been dispelled by the successful record of the 1915 cars equipped with these gears. It is expected that this form will receive even more general application as the manufacturing processes are improved, making possible a reduction in initial cost to the manufacturer. There has not been the increase in the use of worm gearing on pleasure cars that was predicted, except in those propelled by electric power. Worm drive gearing has become very popular, however, in commercial vehicles. The reason is that the worm gear is not as well adapted for the high ratios needed in pleasure car service as the less expensive spiral bevel gear is, and there is very little in favor of the worm gearing from the viewpoint of silence, though it is somewhat more efficient as a means of final drive.

But few changes are noticed in clutch and gearset design. There is a general tendency to use the dry plate clutches of the multiple disc and three-plate forms in which one set of the driving members is faced with asbestos frictional material. The cone clutch, however, remains popular because of its simplicity and ease of operation. The multiple disc clutch having a multiplicity of plates running in an oil bath is losing ground in favor of the dry plate form. The four speed change speed gear has been practically eliminated by the increasing use of lower final drive ratios and the multiple cylinder engines of the six, eight and twelve cylinder forms. Three speeds operated on the selective principle are now generally used, because that number is ample where a flexible motor delivering an even torque is used. This has resulted in a marked compactness in gear box construction. The shafts are made short and of substantial proportions. In practically all cases the main shaft of the gear box is mounted on anti-friction bearings, those of the ball type predominating. The layshaft of a number of moderate priced cars revolves on plain or some of the cheaper forms of roller bearings. This is not a point that tends to conserve theoretical efficiency, but it is one of the steps taken to reduce cost of production. The full ball bearing gear set is used by those automobile makers who still place quality and freedom from trouble above low cost of production.

A great increase is noted in the use of the silent chain for camshaft operation, and also for driving auxiliary electrical apparatus. In all power plants where this method of drive is used greater attention is being paid to the provision of adjusting means by which chain slack may be taken up after the engine has been used for a time and the various links and their bearing pins have become slightly worn.

Another point noticed in connection with power plant design, especially in the new eight cylinder and twin six forms, is that greater accessibility of auxiliary components is provided for than was noted in the early designs. This is particularly evident in the twelve cylinder forms, the lesser angle between the cylinders making possible the location of the starting motor, generator and ignition system at the sides or front of the motor, leaving the space between the cylinders for the carbureter.

Marked improvement has also been made in carburetor design, duplex forms having been evolved, consisting of a common float chamber feeding two synchronized mixing chambers, one being used for each block of cylinders. Owing to the continual specific gravity reduction and impoverishment in the grade of gasoline provided for motor car fuel, the use of air stoves around the exhaust pipe connected by means of a flexible tube to the primary air intake to heat the mixture is almost universal. Other features in connection with carburetor improvement are the auxiliary air control and choke valves provided to secure easy starting, and in the carbureter itself the mechanical interconnection of the gasoline regulating or metering valve with the auxiliary air intake mechanism. The use of a dash pot piston acting against a pneumatic cushion or in a bath of liquid fuel to steady the air valve action is also growing in popularity. Most carburetors are being bolted directly to the intake passage cored in the cylinder block, eliminating the inlet manifold. The use of the vacuum fuel feed system, which was first introduced last year, is increasing, which may be taken as an indication that its merits over the old style air pump or exhaust gas pressure feed is now generally recognized. Practically all cars have the fuel tank at the rear of the chassis, where it may be easily reached for filling.

Changes in Chassis Design as Reflected in the 1916 Motor Cars

In connection with chassis design the most evident point is a simplification of detail and the reduction in the number of parts used to operate the brakes or

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On the Lincoln Highway between Tahoe Tavern and Tallac, Lake Tahoe, California

Seeing America and the Lincoln Highway

Necessity of National Coöperation

By Henry B. Joy, President of the Lincoln Highway Association

"SEE America First" is a clever phrase. It is clever inasmuch as it sounds good and means, or has meant, little or nothing. One might just as well advise the ordinary man to "See the Moon First" or "See South Africa First," if the literal meaning of the admonition is to be attempted.

Outside of railroad trains, from which one can really see or learn very little, seeing America first or last is a matter fraught with certain difficulties to those who have a nice discrimination in the matter of hotel accommodations and who value their comfort and frame of mind when at the wheel of a touring car.

But the constant iteration of the phrase is having its effect. Every year it gains in real meaning as the improvement of America's through connecting routes is advanced. The numbers who attempt to follow it grow as the possibilities of long distance touring in this country increase. The tale of the transcontinental trip is still one of interest to the sportsman or woman. For he who starts to tour America in the rough must go prepared to meet all conditions of roads, beds and food; and to him who starts out without this knowledge, the words "See America First" come to have a cynical sound, to be uttered sarcastically as his car sinks from under him in some rainswept bog or as he lies down to a much merited rest between covers none too clean, in an atmosphere which reminds him of home—it is so different.

As has been customary with me during the past six or eight years, I took my annual vacation this year in the form of a trip by automobile to the Pacific Coast over the Lincoln Highway. Two years ago, when I made this same trip, I was doing something out of the ordinary, one perhaps of 50 tourists who took the same journey. This spring I do not believe it an exaggeration to state that I was but one out of 5,000 who essayed to reach the Pacific Coast by motor, and did reach it after a series of experiences which would make the writer of the modern popular thriller blush with shame for his lack of imagination.

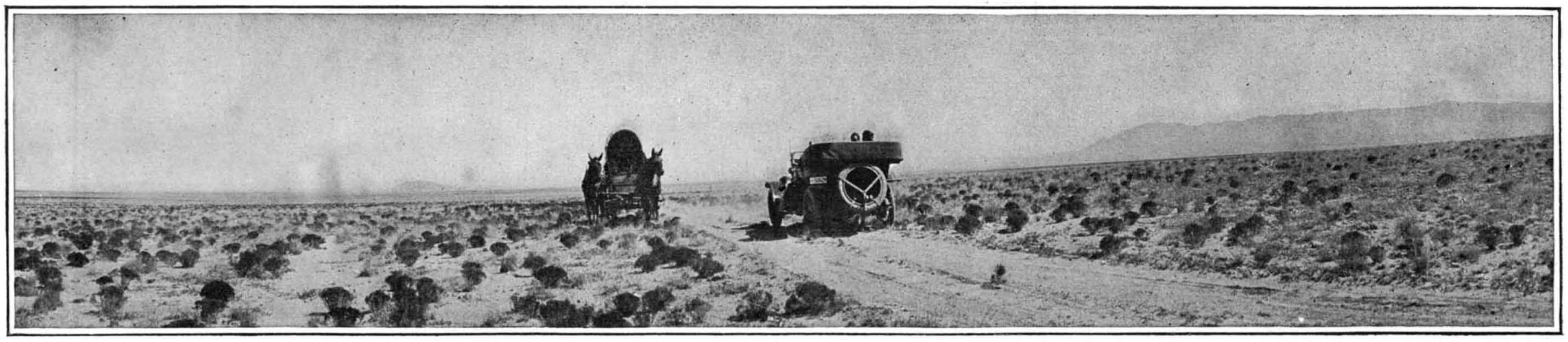
Let him who believes that romance and adventure are things of a dead past get a motor car of any make or stage of decrepitude that his pocketbook will permit and, donning his most ancient suit, head his car west on the Lincoln Highway with the determination to reach San Francisco "or bust." His desire for adventure, experiences, action, color, thrills, scenery, fresh air and exercise will be well rewarded. For, let it be stated here, driving across the Lincoln Highway from coast to coast is a sporting proposition and will be for some years to come.

Stopping for breakfast on the open range west of Big Springs, Nebraska

But in following the Lincoln Highway to-day the transcontinental driver must bear in mind that he is on the first and best of the through connecting permanent routes of travel. A route which, by a process of evolution during the history of the Republic, has been established as the main cross-country highway from the time of the earliest settlers, with their plodding oxen, to the present day. Its course has been traced in blood, the effort which has been expended upon it has been prodigous. It is the best road, the only road, leading from the Atlantic to the Pacific and, from September, 1913, when it was announced as the Lincoln Highway, the attention of the nation, and particularly that of the states through which it passed, has been concentrated upon its rapid improvement and constant maintenance. Yet to the man attempting to see America over this the most practical of all routes, a picture of conditions as they are to-day will be given which will send him home an active, almost militant advocate of nation-wide improved roads.

The amount of work, actual improvement, which has been done on the Lincoln Highway in the past two years since the national propaganda was started, is unbelievable in its extent. To have driven the road then, and to drive it again now, is a lesson in what Americans can accomplish on an undertaking so enormous that in the aggregate it is actually beyond comprehension. And yet this work, which has been the result of the most

A Lincoln Highway "seedling mile" in Nebraska, laid with cement contributed by the Association



On Nevada's desert wastes the modern motorist frequently encounters the creaking prairie schooner of an earlier day

exhaustive efforts of the people along the route, is seen to be such a small proportion of the tremendous force necessary to accomplish the task to which the people have set themselves, that the necessity for a *national* coöperation is appreciated.

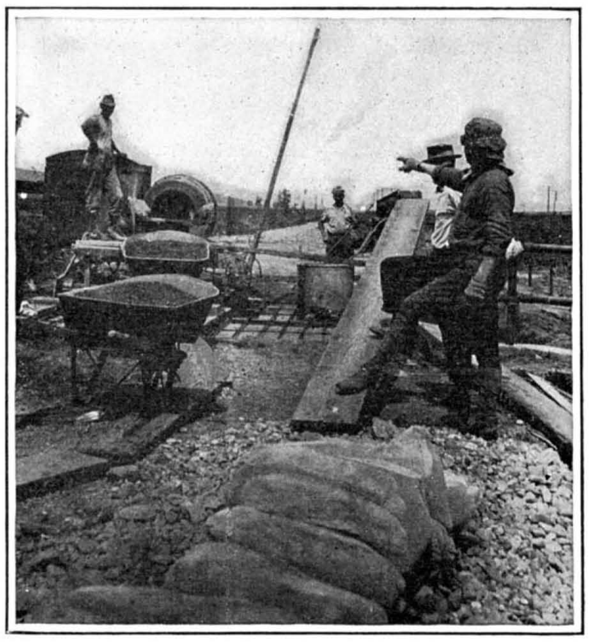
The West is America's great natural playground. From this great, bounteous, healthgiving wonderland of far spaces, glorious scenery, revitalizing air and inspiring vistas of mountain, stream and forest, the crowded population of our East and Middle-West is shut off when it rains, by one of the most effectual of barriers—mud. It has been so long and so completely shut off to all excursion and exploration, except by rail, that people, forgetting that it is there, have, after exhausting the possibilities of the East, followed overseas to the much exploited, easily accessible, but in reality inferior pleasure places and beauty spots of Europe. With them in the past has gone, never to return, an annual contribution to the prosperity of Europe, which has been expertly estimated at over $200,000,000. This year, with the doors of Europe shut, with a mailed fist in the faces of American pleasure seekers, our home resources have been fallen back upon. Our Pacific Coast with its two expositions beckoned the motorist to the beauties of California and thousands answered the call.

To travel by motor car across Indiana, Illinois, Iowa and Nebraska, those great farm states where much of the wealth of the nation originates, during or just after a heavy rain, is to all intents and purposes impossible. If it rains you stop where you are, or in the nearest town you are lucky enough to reach, until it stops raining and the roads have dried off and been again dragged to that boulevard smoothness which characterizes the Lincoln Highway in dry weather. That is, if you are on a pleasure trip you stop. If you are accustomed to hardship and are making a business of getting through, as I was this year, you may go on, making perhaps twenty-five to thirty-five miles a day with a prodigious expenditure of gasoline and effort, driving eighteen hours out of the twenty-four, constantly sunk to the running boards in a mud called gumbo, which is unknown to our East, and which has been characterized as being eighty per cent pure glue. You can go on, wet, cold, sleeping when you can in ditches or wherever you may happen to be stuck when night falls, eating when you can of anything edible procurable at luncheon counters or mediocre restaurants, and subjecting your car to a usage which ordinary driving would not give it in years.

There are not many people who will do this. In fact, during the terrible rains of late May and early June of this year, all across the Middle West, our party was practically the only one in motion, and I was not primarily on a pleasure trip.

Yet the Lincoln Highway is bringing better accommodations along with better road conditions. Increase in tourist traffic alone warrants the proprietors along main routes of travel in bettering the conditions. With any luck, you can sleep in a bed every night of your journey between New York and San Francisco, but you must not be squeamish if you want to do it. Two years ago the transcontinental driver prepared to camp out every night after he got west of Omaha, Nebraska.

The change in conditions is shown by one typical instance. Far out on the edge of the Great Salt Desert south of Great Salt Lake, where the Lincoln Highway clips a cautious edge from the American Sahara, stands one of those ancient stone structures built as a station for the pony express riders back in the days immortalized by Bret Harte and Remington. The old transcontinental trail is dotted with these relics of a day when mail was relayed by daring riders and sweating ponies from St. Joseph to the Golden Gate. Every ten miles of the western journey brings to light one of these crumbling stone huts. The one at Fish Springs, Utah, differs in that it has been continuously occupied and kept in repair since 1853. It is now owned, and has been for forty years, by a character as typical of the old West as the building he occupies. Fish Springs, Utah, consists of J. J. Thomas's ranch. J. J. Thomas has lived on this ranch, surrounded by salt flats and plains of volcanic dust and rock, for fifty years, and he is as hale and hearty to-day as in the days when Horace Greeley stopped when following his own memorable axiom, "Go west, young man, go west." Here the greatest and least have stopped and supped on their way across the desert; here Mark Twain partook of the same fried eggs and good white bread, teamed then, as now, 80 miles across the desert behind ten dusty mules. J. J. Thomas has seen the evolution of the West as no man has. All must stop at his hospitable gate.



The author directing operations "on the ground" in Iowa

What has the Lincoln Highway done for Thomas? Ask him and he will show you careful records which reduce to the simplest terms the development which is taking place in like measure along 3,400 miles of road. Read the penciled figures in the big account book. Cars passing in June, 1913—52. Cars passing in June, 1915—225. An increase of over 400 per cent in two years.

The night we stopped there this summer gave the answer. Eighteen people were gathered in the little stone express station. Six cars stood outside. One was from Oklahoma, one bore an Indiana license, a third was from Salt Lake City, two came from California, ours from Detroit. All but our party stayed for the night in the building which increasing business has forced Thomas to add at the rear. We all took supper, we all bought gas and some oil. And every drop of that gas and oil, every crumb of that dinner, every plank in those buildings were brought by those same ten mules from the nearest railway—80 miles.

This is but one angle of what the Lincoln Highway means to the West. Innumerable examples could be given. The answer to this one is clear. Thomas is making more money than he ever saw before, and he and others in the same position, whether on the desert or in the city, are good enough business men to realize what has caused this tremendous increase in revenue, and are spending part of it in the further improvement of the road and in bettering the accommodations which must be offered to tourists. This is going on all along the line in varying degree from New York to San Francisco.

The eastern end of the Lincoln Highway, like eastern roads in general, does not present much of a problem. You can drive to-day from 42nd St. and Broadway to Chicago in 35 hours of driving time if you want to push your car. It is in the middle and far West that the question of road improvement is a serious one. The Lincoln Highway in New Jersey may be considered perfect; the Pennsylvania section is in the main good, hard-surfaced road, well kept; but a few miles of the Lincoln Highway in Ohio remains to be hard-surfaced. I have driven this section of the Lincoln Highway many times, and so this year my trip over the route started at Elkhart, Indiana. From that city west to Oakland, on the Golden Gate, I did not drive 50 consecutive miles without encountering either actual road work in progress or sections of road which gave certain indication of having recently been worked. I know positively that I must have passed 5,000 men at work on the Lincoln Highway during the 23 days of my trip. I was impressed with the tre-

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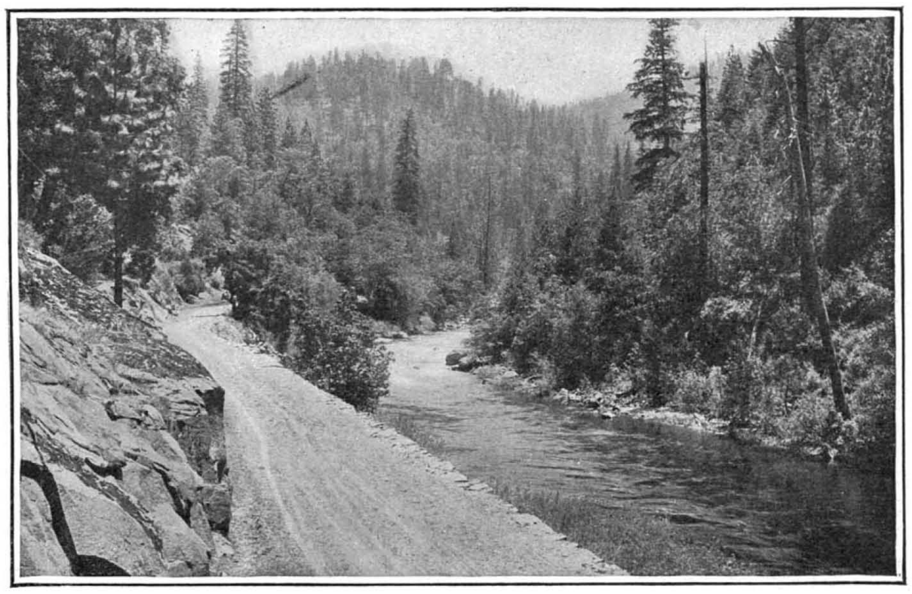
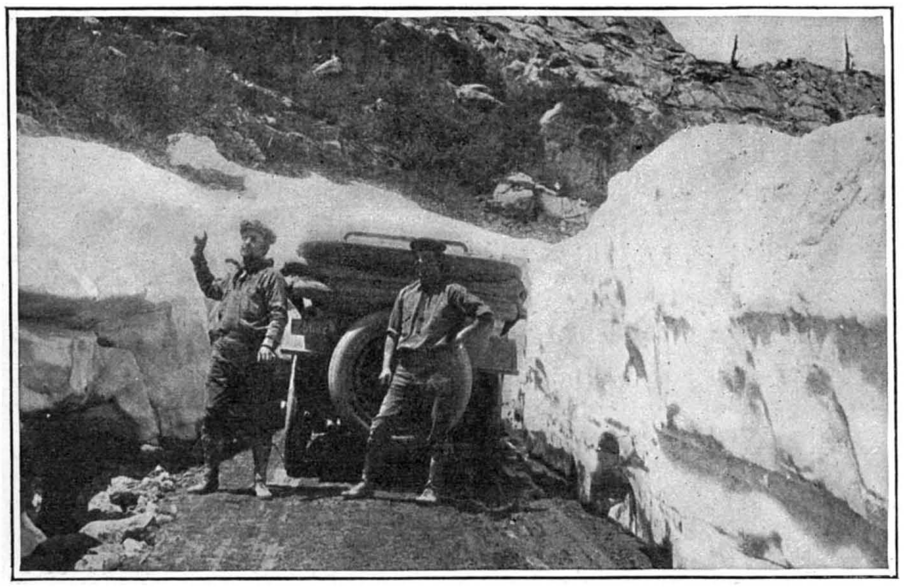
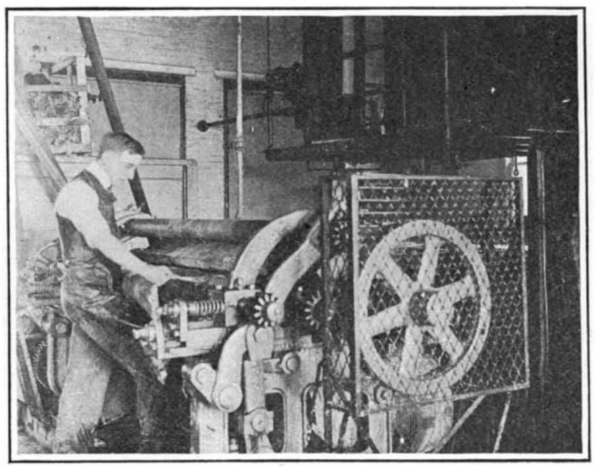


Following the Truckee River between Truckee and Tahoe Tavern

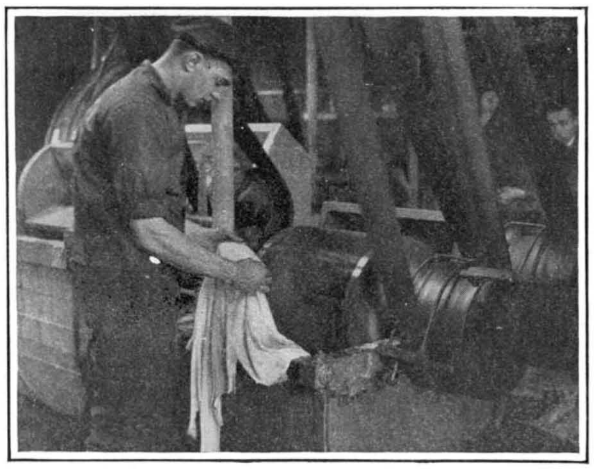


Stopping amid the snow banks of the Sierras before dipping down into sunny California

First stage in the manufacture of leather skins entering soaks



Removing hair after depilating treatment



Bating the skins to produce a soft and open condition

The Effect of Technical Education Upon the Leather Industry

How the Tanning Industry Has Benefited Through the Application of Science

By Allen Rogers, Ph.D.

[Impelled by the exigencies of the war, the United States has ventured into new lines of industry or is considering the advisability of doing for itself many things that were formerly considered beyond its reach. Before us lie opportunities such as we never dreamed of. Dare we seize them? Can we hold them after the war? Can we meet the keen competition that is sure to arise when the vast European armies return to their homes and to their bread-winning tasks? How may we in time of war prepare for peace? These are burning questions.

THE SCIENTIFIC AMERICAN *urges a campaign of Industrial Preparedness for Peace. We are planning to publish helpful articles on our opportunities and how they may be realized; on our wonderful resources and how they may be developed; on our manufactures and how they may be improved; how we may eliminate waste of material and waste of effort.*

The following article tells the story of the practical coöperation between the National Association of Tanners and Pratt Institute. It should be an inspiration to other lines of industry, pointing out, as it does, the benefits that will accrue from a closer association of our industries with our educational institutions. Many of our industries are suffering from a lack of such coöperation. We urge them to enter upon a higher plane of efficiency by means of scientific research.— ED.]

IN an article entitled "The Technically Trained Foreman," which appeared in THE SCIENTIFIC AMERICAN of September 16th, 1911, the writer described at some length the course in Applied Chemistry as conducted at Pratt Institute. In the article reference was made to the coöperation with the National Association of Tanners, but at that time the affiliation of the school with the industry had only just been consummated, so that little could be said as to the benefits that might accrue.

After five years it is now possible to give the reader some idea of the results of practical experience, which it is hoped may serve as an incentive for other lines of chemical industry to take the matter of technical education under more serious and extended consideration.

To gain a somewhat clearer idea of what has been accomplished let us look back upon the history of the undertaking, and then follow step by step the course of events which has led to the establishment of this very novel and efficient method of instruction.

In September, 1905, when the writer accepted the position at Pratt Institute to take charge of the Industrial Chemistry, he was well aware of the conditions in the leather trade, and, therefore, in making plans for the industrial laboratory provided, among other equipment, for practical instruction in tanning. The layout at that time consisted of a small mill and paddle and three small pits, the floor space for which occupied fifteen feet by five feet. It was little thought, however, at that time that this embryo tannery was destined to become the largest and most completely equipped school tannery in the world. During the years 1905 and 1906 several articles by the writer appeared in the *Shoe and Leather Reporter*, as a result of which two young men applied for admission to the school for the purpose of specializing in leather. Further articles appeared in this and other trade papers and in *The Journal of the American Leather Chemists' Association*, all of which may have had a tendency to create interest in the undertaking.

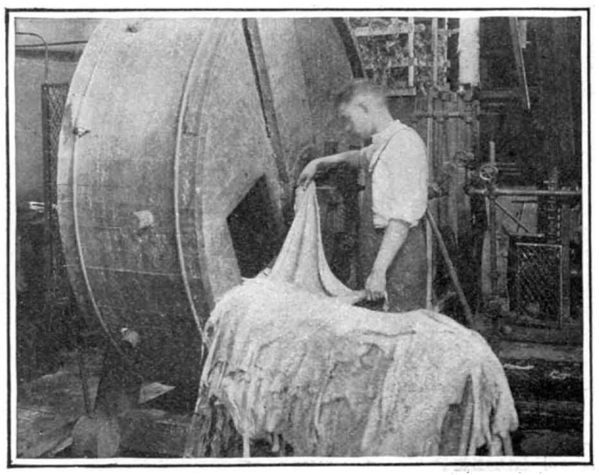
Each year a few men entered the school for the purpose of making a special study of leather, and in 1909 it became apparent that the marked growth along this line would warrant a little extension of the equipment. Two machines were therefore added, consisting of a rolling jack and a set of buffing wheels, the floor space being extended to fifteen by fifteen feet. The classes of 1910 and 1911 were thus provided with better facilities for practical instruction than were the previous classes.

At the end of five years from the founding of the course in applied chemistry, the first epoch in the development of tanning instruction in America, there were about eighteen graduates at work in tanneries throughout the country, all of whom were holding positions of responsibility and trust. The good work had thus been started and a certain amount of progress made.

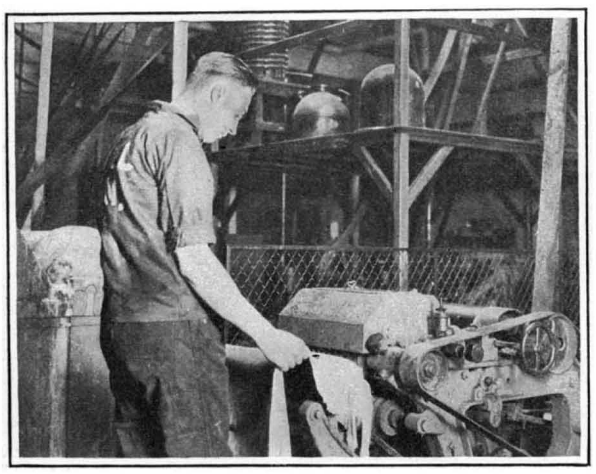
About the same time that these activities were going on at the Institute, there was a movement on foot to establish an association which would bring the tanners in closer touch with each other. As a result of this movement The National Association of Tanners came into existence. One of the first questions to come before this new organization was that of providing for the most practical and efficient education of the future American tanners. During the year 1910 a committee was appointed to consider this matter and to get into touch with educational institutions. To cut a long story short, the committee eventually visited Pratt Institute, and was so impressed with the work already being done that it unanimously voted to enter into a five-year agreement. Pratt Institute, for its part, was to provide the building, equipment and instructors. The National Association of Tanners to furnish sufficient funds for scholarships, inspection trips, outside lecturers, publicity and investigations. This extension of the work made it necessary to increase the equipment, so that the floor space was again enlarged to twenty by eighty feet, more and larger mills, paddles and pits were provided, and a number of new machines added. It should be said in passing that several of the new machines were donated on an indefinite loan by the manufacturers of the machines.

Having made the necessary provision and arrangements for the practical instruction, the question as to the character and scope of the instruction was next considered. This phase of the problem was left very largely to the judgment of the Institute, and when the plan of procedure was suggested it met at once with hearty endorsement from the association. The proposition was to provide for two courses, one of which was to be known as the Tanning Course. This course would aim to fit young men for practical positions in the plant, such as foremen or heads of departments. In the conduct of the course there would be included only those subjects which would be directly beneficial to the man in the works. In other words, the technical instruction should have a direct relation to the practical operation. The other course of instruction, to be known as the course in Applied Leather Chemistry, was to be open to young men who had already graduated from an approved course in chemistry. In this course they were to be given more advanced chemistry as applied to leather manufacture, and were to become familiar with the practical side of the industry. By this means it was thought that they would become more efficient leather chemists.

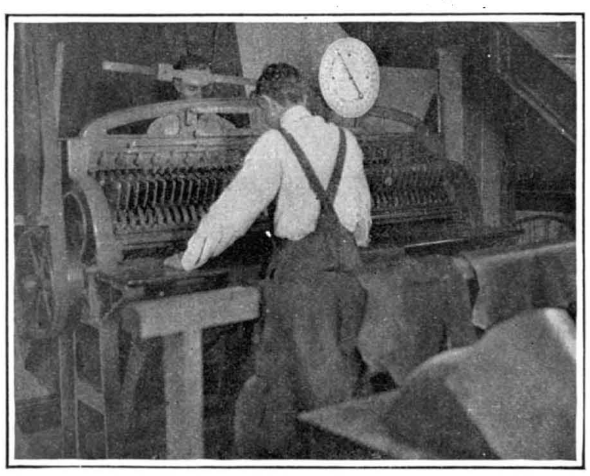
During the school year of 1910 and 1911 the work of installing the new equipment and other details were completed, so that in September, 1911, everything was in readiness for the new undertaking. The first class to enter consisted of eighteen in the Tanning Course and seven in the Applied Leather Chemistry Course, thus making the limit of twenty-five, which is all that can be accommodated. These young men were drawn very largely from the tanneries, although a few en-



Chrome tanning



Shaving the skins before coloring



Measuring the finished leather

tered who had no previous practical experience. It may be of interest in passing to mention that one of these men who had never even been inside a tannery before entering the school is to-day assistant superintendent in one of the largest sole leather tanneries in the country. Four classes have been graduated from these courses, and of these graduates over eighty per cent are at present employed in the trade. They are holding positions which range in responsibility from assistant foremen, foremen, assistant superintendents, superintendents, chemists, and even managers of plants. As a matter of information it might be mentioned that of those not employed in tanneries about half of them are from the first class. The demand for these young men has been on the increase each year, while more concerns are sending their promising young men to take the courses offered. This latter state of affairs is very gratifying, as it shows that the manufacturers are interested. When the factory sends a man to school and, as is often the case, pays his expenses, you may rest assured that they expect to get a full return for the money invested. Whether or not it has been a paying investment may be judged from the fact that several concerns have sent more than one man. One concern, in particular, had a man in each class for three years, and are to send two men next fall. The three men from this plant are now holding superintendent positions in three of the numerous tanneries controlled by this organization. Not only are the manufacturers sending men from their plants, but many of them are sending their sons to take the courses offered.

In the development of the chemical courses it seems that radical changes are apt to take place at five-year periods. This year, which marks the fifth year of the special tanning courses and the tenth year since the inauguration of the chemistry course, opens up another epoch in the growth of the Institute in its relation to the leather trade. The changes of the present year are due to the fact that the equipment provided in 1910 and 1911 had become inadequate for the demands placed upon it. More room, therefore, has been made available, so that the new tannery, which has been installed by the students themseles, when completed, will occupy a floor space of 40 by 100 feet. More pits, mills, paddles, and machinery have been added, so that when the work is finished we will have in this country a school tannery which will be second to none in the world. This new arrangement gives a capacity of 100 dozen skins and one dozen hides per week. The larger output, which is already in operation, will give more and better experience than it has been possible to obtain in the past.

That the courses provided by the Institute have met the requirements of the industry and that the National Association of Tanners feels satisfied with the results already accomplished is shown very conclusively by developments which are now under consideration. These latest developments have to do with the establishment of a research laboratory to be conducted in conjunction with the tanning courses. The plan already adopted provides for a thoroughly equipped laboratory, which will be under the direct supervision of the best leather chemist it will be possible to secure in the world, who will devote his entire time to the study of such problems as are of general interest to the industry. To carry out the work on a sufficiently large scale he will have as his assistants two graduate chemists and a bacteriologist. One of the requirements of the assistant chemists is that they should have first taken the course in Applied Leather Chemistry. The financing of the undertaking is entirely in the hands of the National Association of Tanners, and that sufficient funds are available is already assured.

The establishment of this laboratory is very significant in pointing out a future policy, which not only applies to the leather industry, but which, no doubt, will be taken up in other lines of manufacture. This industry, however, has brought to a successful issue the establishment of special courses for the betterment of the factory conditions, and is now about to venture upon a new enterprise which aims to promote and develop the industry by means of extensive research work and scientific investigations. What the future has in store for the American tanner remains to be seen. We cannot help but feel, however, that we are on the right road, and the future certainly does look promising.

In closing this article the writer would like to point out that the phenomenal success of this undertaking is due to the hearty coöperation of all concerned, which includes The National Association of Tanners, Pratt Institute, the American Leather Chemist Association; the various trade and scientific journals; the manufacturers of machinery; extracts, oils, chemicals and dyestuffs; the graduates from the courses; and the students themselves.

The Motorboats of the Volunteer Patrol Squadron

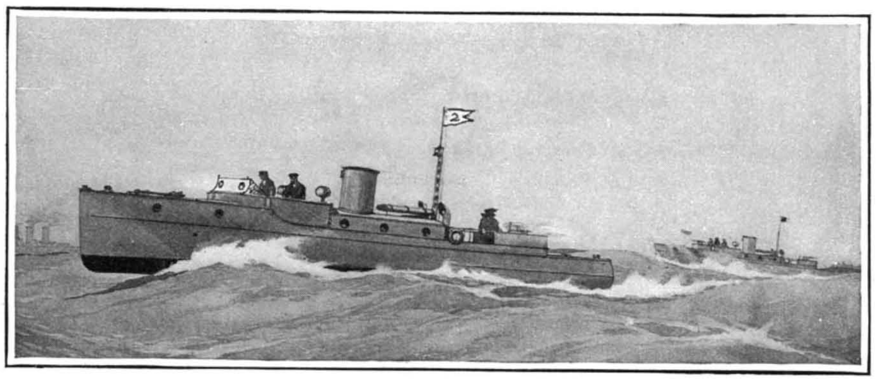
VERY much like the Plattsburg movement, the Volunteer Patrol Squadron is the first real substantial move of private individuals to train themselves for a naval reserve in this country. The organization is an association composed of, at the present time, five 40-foot boats, with a crew of four men to each boat, each crew to consist of a captain, two signalmen and one engineer; also the commander of the squadron, who is Mr. Stewart Davis of South Hampton, Long Island, N. Y., a squadron quartermaster, a squadron surgeon and a supervising engineer. All are members of the association, and all serve without pay and pledge themselves to one month of actual duty with the squadron every year, besides being subject to calls from the commander at any time, either in winter or summer.

The boats are about finished now, with the exception of the installation of the engines, which are on their way to the yard; so that they will be ready and in commission the first of the spring, when it is proposed immediately to take a trip south, through the canal, to Washington and the Chesapeake, illustrating thereby just how quickly a fast fleet of dispatch or patrol boats can cover the distances along the coast.

Except for the month that the squadron is together, the boats will cruise separately, being assigned by the commander to different stations along the coast; and when the fleet goes out of commission they will be kept at all times with everything ready, so that they can be put in commission at a few days' notice. Some special work has already been decided upon for the squadron, which will be published at a later date.

These boats were designed by Mr. A. Loring Swasey, the construction engineer of the fleet.

Their general dimensions are 40 feet over all, 8 feet 9 inches beam, 30 inches draft, and they have five 135 h.p. engines, which will give them a speed of 23 to 24 miles an hour at sea. They are also built, in case it is found necessary, so that their speed can be increased to 30 miles an hour by the substitution of larger engines.



Boats of the first Volunteer Patrol Squadron

A separate boat is already being built with the squadron for the purpose of demonstrating the higher speed of 30 to 32 miles an hour, with the larger engine in a hull of the same design.

The design of these boats was decided upon owing to the remarkable speed and seagoing qualities of the 40 foot "Houp-La" built last season, which yacht has had a number of very severe trials along the coast and was found to exceed all expectations in her wonderful seagoing qualities and smartness under all conditions. Before this boat was built it was hardly believed possible that boats of this type could live in the ocean in a bad storm; but with their special construction it was found that they were more seaworthy than the larger and heavier boats.

Cereal Dust Explosions

THE various dusts made in the handling and working up of grain into food products are not only inflammable, but also more or less explosive, and have given rise to many serious accidents. These occur in cereal, flour and feed mills, grain elevators, starch and glucose factories, and on farms, in connection with the use of threshing machines. In view of the growing number of such accidents, an investigation of the conditions under which they occur has recently been undertaken coöperatively by the U. S. Bureau of Chemistry, the U. S. Office of Public Roads and Rural Engineering, the U. S. Bureau of Mines, and Pennsylvania State College. Some results already obtained in this investigation were reported by Mr. D. J. Price of the Bureau of Chemistry, in an address before the convention of the Fraternity of Operative Millers of America, at Cincinnati, May 26th, 1915.

Mr. Price presented an analysis of a series of explosions which have occurred since 1905, and in which at least 80 men have been killed, 125 injured, and property destroyed to a value of more than $2,000,000. In eight cases the explosions seem to have been due to sparks produced in the machines during the grinding process; one was attributed to static electricity; while ten arose from unknown causes.

The present and previous investigations indicate the following causes of such explosions: 1. Introduction of foreign materials into grinding machines (such as particles of gravel, flint, metal, etc., which may produce a spark when coming in contact with the plates of the machine). 2. Use of open lights or naked flames, such as oil lamps, torches, gas jets, matches, etc. 3. Property fires. 4. Electric sparks from motors, fuses, switches, and lighting systems. 5. Static electricity, produced by friction of pulleys and belts, machinery parts, grinding machines, revolving reels, etc.

For the sake of studying the dangers arising under heading No. 1, an experimental mill has been installed at Pennsylvania State College. It is hoped that definite knowledge may thus be obtained regarding the relation between sparks produced by foreign substances in the machines and a suspended dust cloud. An important question relates to the amount of dust necessary to propagate a flame. It is believed that a sack of flour suspended as dust in 4,000 cubic feet of air (equivalent to the capacity of an average room in a dwelling-house) would, if ignited, produce an explosion sufficient to throw *2,500 tons 100 feet high.* It appears, from preliminary experiments, that many cereal dusts have lower ignition temperatures and produce higher pressures than coal dusts.

In connection with explosions due to static electricity, it is worth noting that these have been prevented in some cases by the expedient of grounding the grinding machines. Experiments have shown that the friction of a very small pulley and belt will produce enough static electricity to ignite natural gas.

The disastrous series of fires and explosions which occurred last season in threshing machines in the northwestern states involved a loss aggregating at least half a million dollars. These fires, which were attributed to "smut dust," were described in the SCIENTIFIC AMERICAN of January 23rd, 1915, page 79. The U. S. Department of Agriculture undertook an investigation of this subject during the past summer.

Chemical studies are now under way to ascertain what factors especially determine the inflammability of the various cereal dusts, involving the relative importance of the amount of volatile matter in the dust, the percentage of moisture and ash, the rate, or ease, of oxidation, and the fineness of the dust.

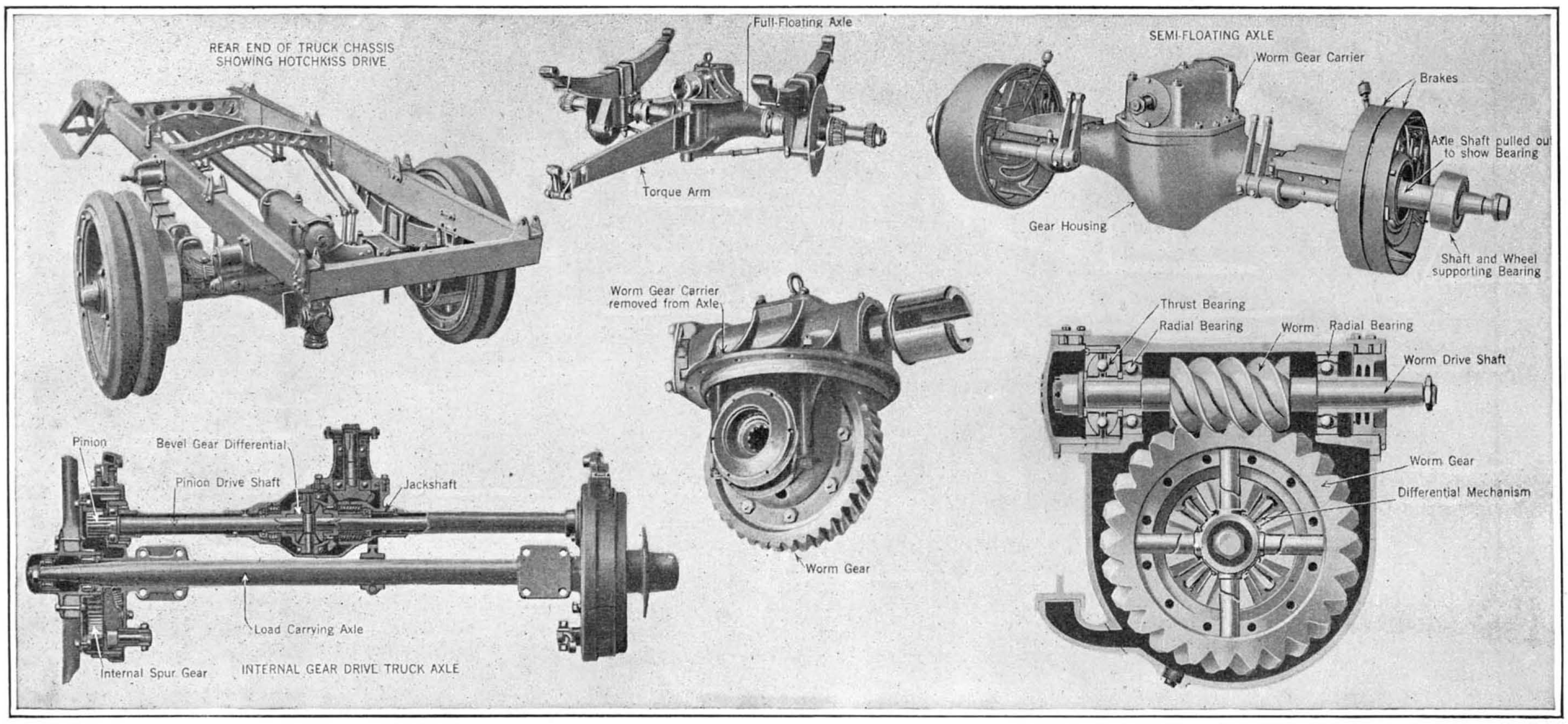
The principal precautions thus far suggested are: Avoid the use of gas jets and the practice of lowering lanterns or open lights into grain bins or dust-collecting systems. Do not allow dust to accumulate unnecessarily. Electric lamps exposed to danger of breakage should be enclosed in wire guards; fuses, switches, starting-boxes, motors, etc., should be located, so far as possible, in places where dust is not present. Grinding machines, pulleys and shafts should be grounded, to carry away static electricity. Small bins limit the possible violence of explosions.

Trouble with Fusible Tin Boiler Plugs

BOILER plugs are set in the wall of a boiler about one inch above the danger line of low water. As long as they are surrounded by water they remain solid but when the water falls below them the temperature rises to the melting point of the plug, usually tin, and the steam blows off. Too-frequent boiler explosions caused the U. S. Bureau of Standards to investigate a thousand plugs, 100 having seen some months service. A startling number were filled with a close network of tin oxide whose melting point is much higher than that of tin and too high for a safety device. Analysis showed the presence of from three tenths to four per cent of zinc. The zinc was corroded by boiler water softened with too much soda and oxidation of the tin was then rapid. Pure Banca tin will not oxidize.

Gives Claims Broadest Interpretation

THE Court of Appeals of the District of Columbia, speaking through Justice Robb, in Kirby v. Clements, says "In an interference proceeding we must give to the claims the broadest interpretation which they will reasonably support, and we are not at liberty to import limitations therein to meet the exigencies of a particular situation. The reasonable presumption is that an inventor intended to protect his invention broadly, and consequently the scope of a claim in an interference proceeding should not be restricted beyond the fair and ordinary meaning of the words."



A collection of views showing the construction of worm-drive and internal-gear-drive truck axles and the method of application to the chassis

Development in Commercial Vehicle Design

Prominent Features and Tendencies in Present-Day Motor Truck Design

THE growth of the motor truck industry has not been as spectacular as that of the pleasure car; neither have improvements in design been heralded so widely. The development of American motor truck design can not be said to have reached finality, nor has it become generally standardized. Considerable difference of opinion still exists regarding the best type of truck to be used and widely diversified designs are offered the purchasing public. There is one point, however, upon which practically all truck makers agree, and that is in the main chassis design which is now patterned largely after European practice.

When the motor truck industry was in its infancy in this country, it was established on a firm basis abroad, notably in England and France. The first motor truck built in this country had the power plant placed under the body, which time proved to be poor practice as is also the construction in which the driver sat on an elevated platform under which the power plant was placed. At present practically all American trucks have the motor compartment in front of the driver's seat, just as in pleasure car practice and in accordance with the system of construction which is universally used abroad.

Accessibility of the Power Plant

Power plant accessibility is an important item in a commercial vehicle because the factor of lost time must be reduced as much as possible. Truck manufacturers have not been slow in realizing that a relatively inaccessible power plant is apt to be neglected. When it is placed at the front end of the chassis under an easily removable hood, there is no excuse for neglecting the periodic inspection, cleaning and lubrication that are necessary to maintain power plant efficiency. Other engineering features that have been found practical in pleasure car application have in turn been applied to truck construction. A conspicuous example of this development is found in the adoption of the unit power plant and of the entirely enclosed final drive systems.

New Final Drive Systems and Their Advantages

Considering first the development of the final drive system, because this is really the most marked divergence from previously accepted truck standards, we find that the completely enclosed final drive systems provide a method of power transmission that is claimed to be in every way superior to the jack shaft and double side chain and sprocket drive. While the latter method of power transmission was very efficient when new, it was apt to be neglected by those who had charge of the upkeep of the trucks with a result that depreciation was rapid. In most designs the chains were exposed because of the difficulty involved in enclosing them in a simple and practical manner. Unless the chains were kept constantly lubricated and were cleaned at frequent intervals, they were apt to depreciate rapidly, and this deterioration of the sprocket teeth and chain links resulted in extremely noisy operation as well as inefficient power application.

During the first few years, or what we may call the development period of the American industry, it was natural to expect American engineers to follow closely the work of the foreign builders, and inasmuch as the field of British development was the easiest to study, it was to be expected that many of the features of design that had proven practical in England would be adopted in this country. It is to the influence of the English designers that the popularity of the worm and worm gear driving system can be traced. Police regulations abroad were such that noisy trucks were barred from the streets. The rules established by the larger English municipalities, especially London, were so drastic that many double-chain-driven omnibuses were condemned by the authorities because they could not be made to conform with regulations.

Experience with worm gearing developed a form of gear drive that was not only remarkably enduring, but which was silent in operation and which did not become noisy in service. The completely enclosed worm drive was also found to be more reliable in the hands of the average motor truck operator than the chain drive it superseded. The importance of having a "meddle-proof" construction cannot be over-estimated when one considers that many companies who disposed of their horses and wagons in favor of motor vehicles employed mechanically inexperienced drivers for operating their trucks. This was the logical thing for these firms to do inasmuch as their old drivers were undoubtedly more familiar with their peculiar business conditions than new and perhaps more mechanically proficient employees would be.

It is stated that the London General Omnibus Company has operated something like 3,000 large worm driven busses on the streets of London and has found it utterly impossible to strip the gearing, due to the unusually strong form of tooth presented to the high tooth pressure necessary in driving these heavy vehicles. As far as endurance is concerned, it is important to note that an average of 80,000 miles has been covered before any appreciable wear was discernible in the worm gears.

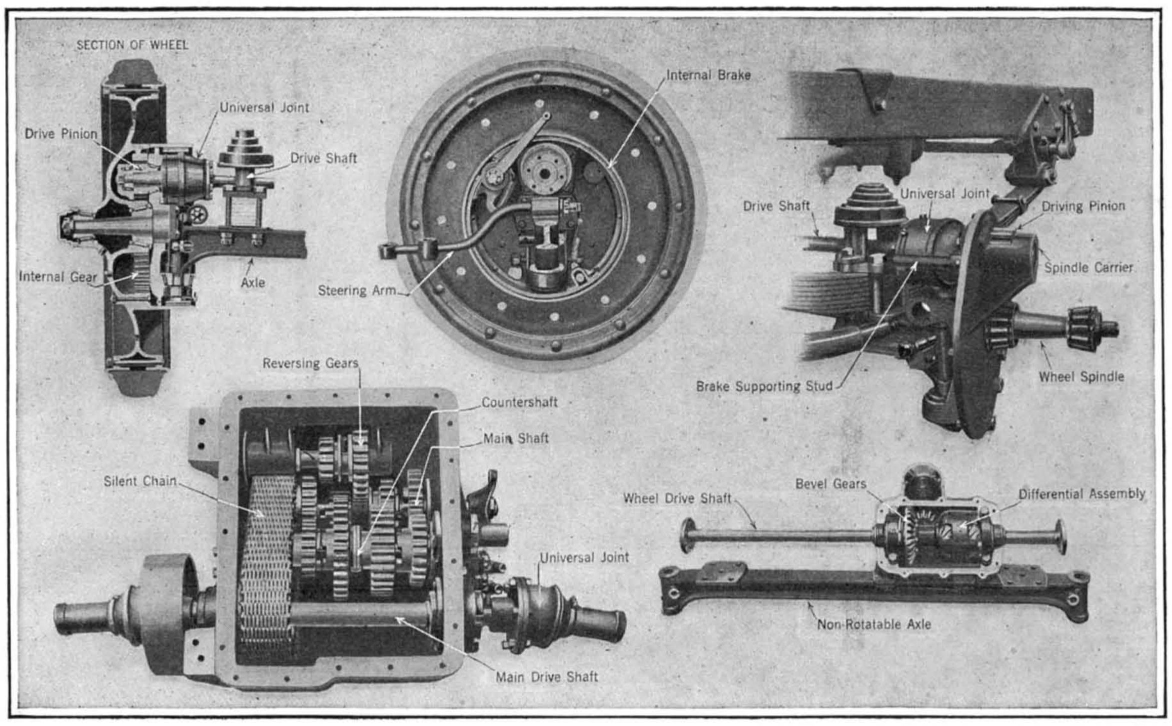
Worm gearing is not only enduring and noiseless, but is remarkably efficient, as actual tests have demonstrated that from 90 to even as high as 97 per cent of the horse-power applied to the worm driving shaft has been delivered to the road wheels. The sectional view in one of the accompanying illustrations clearly shows the method of supporting the worm shaft by anti-friction bearings and the way the worm gearing is applied. In all cases the worm is made of hardened steel and is either triple- or quadruple-threaded, having a lead angle sufficiently acute to provide the factor of reversibility, which is essential in automobile service. To one familiar with mechanics it will be apparent that, while it is possible to exert great power and secure a great ratio of speed reduction with a gradual pitch worm, the construction would be almost irreversible. This factor of irreversibility, while very desirable in such mechanism as automobile steering gears, would not be practical under those conditions where the worm wheel must become the driver as in coasting.

The worm gear assembly, which is ordinarily combined with the differential gearing, is nearly always attached to a carrier member which fits into the main axle housing. Such an assembly is shown just above the sectional view of the worm gear. The reason for this construction is that it is essential that the worm gearing be accurately adjusted and that this adjustment be maintained. It is not only important that the worm should mesh properly, but the center line of the worm must coincide exactly with the center line of the worm gear or considerable friction and actual depreciation will ensue. It was fortunate, indeed, that in the automobile applications the gear ratios desired, ranging from a reduction of 8 to 1 in the lighter trucks to 15 or 16 to 1 in the heavier vehicles, were not so low as to demand gradual pitch single-threaded worms. As the worm gearing is invariably carried in a casing that may be filled with lubricating oil, and as there is no opportunity for grit or dirt to enter, it will be apparent that long life is assured.

Another form of final drive system that is receiving considerable attention at the present time is a double reduction axle of the type in which a primary reduction in speed is obtained between bevel gears, while a secondary and final reduction in speed is secured by driving the wheels through the medium of internal gearing. It is conceded that internal spur gearing is the most efficient form, and when it is applied properly to rear axle construction one obtains advantages that are worthy of consideration. An internal gear-driven axle, as can be readily ascertained from inspection of the part sectional view, is a form in which the jack shaft, which is ordinarily placed on the chassis frame in the chain and sprocket drive system, is attached to the axle—in this instance a non-rotating member on which the wheels revolve freely. Instead of sprockets at the end of the live axle shafts small spur pinions are mounted which mesh directly with the large internal gears bolted to the brake drums, which in turn are securely fastened to the wheel hubs. The worm axle is a built-up form and must be made very strong because the housing for the driving gearing and axle shafts must be heavy enough to carry the load as well as enclosing the transmission members. On large capacity trucks, a live axle construction becomes of necessity very massive and correspondingly heavy.

Reduction of Unsprung Weight

It is considered good engineering practice to reduce the unsprung weight of any motor vehicle as much as possible, as this lessens tire and mechanical depreciation. While it is considered essential to use light rear



Constructional details of wheel, axle and change speed gearing of four-wheel drive, steer and brake truck

axles in pleasure cars, this is necessary on account of the high speed these vehicles are capable of attaining. The live axle construction on a pleasure car is not stressed as much as the similar construction would be on a truck because it is supported by relatively light wheels provided with pneumatic tires. This argument of minimum unsprung weight is advanced by those engineers who favor the internal gear drive axle. It is said that the load-carrying axle can be made very strong without being heavy as this need not be anything more complicated than a solid round or square bar of standard cross section, and if made of chrome or nickel alloy steel it need not be large in diameter. It is also possible to considerably reduce the weight of the jack shaft. When this is mounted on a chassis it must be strong enough to withstand some of the unavoidable twisting to which the motor truck frame is subjected. When mounted directly on the axle the only consideration is that the jack shaft be strong enough to transmit the power, since it is not subject to any other strain.

Another advantage in favor of the internal gear drive system is that it provides more ground clearance than can be obtained with worm drive axles, even those of the overhead worm type. On the other hand, owing to the employment of three sets of gearing for transmitting power, instead of one set, as in the worm-driven axle, its efficiency is not as high as that of the worm and worm wheel.

A tendency noted in connection with final drive systems is the simplifying of the truck chassis by eliminating radius rods and torque members that were formerly required with the side chain drive systems. When the worm drive axle is used, only one torque rod is necessary if that construction is followed, as this is usually mounted so its center line coincides with that of the worm gearing as illustrated. This one member, which is of substantial cross section, may take the place of four that were required in some cases with the chain drive axles. Experience has demonstrated that, by paying proper attention to spring design, no torque or radius rods are needed, as not only the driving but also the braking torque can be properly taken care of by the springs, if these are of suitable proportions and mounted correctly. This provides the Hotchkiss drive which is now becoming so popular on pleasure cars.

Four-Wheel-Drive-and-Steer Motor Trucks

About three years ago, or two years before the start of the great European War, the United States Government concluded a series of exhaustive tests on motor trucks for army use. While the rear drive truck of commerce proved adequate for doing much of the work incidental to army transport service, its efficiency was found to rapidly decline when the highways were poor or entirely lacking as in cross country work. The standard four mule army team was taken as a basis of what a motor truck should be able to accomplish. The result of this development, which was made with the coöperation of the engineers of a pioneer automobile manufacturer, was that the Government experts decided that the four-wheel drive principle was the only system of power transmission capable of doing all of the work demanded of a motor truck on the field of battle as well as in the more prosaic duty of transporting supplies. A truck was evolved in which all four wheels were dirigible for steering and were also driven by the engine power. A special form of differential was used that differed from the conventional type in that it delivered the power to the wheel or wheels that had the most traction instead of to those having the least traction as accomplished by the ordinary forms.

The only respect in which the four-wheel-drive-and-steer truck differs from the two-wheel drive is in the construction of the power transmission system and of the axle. These details are clearly shown in the illustration. The important point is to have a system of power transmission to the wheels that will make it possible to swing the wheels around for steering without interrupting the drive or reducing the efficiency of the braking functions. This is easily accomplished by mounting the wheel on a spindle of special form, this member being provided with suitable bearings for supporting a spur-driving pinion and also having the retaining studs necessary for carrying the braking mechanism. The special wheel carrier member incorporates a yoke of the inverted Elliot type which swings on a one-piece drop forged axle member similar in construction to that used on practically all cars. The differential and drive gearing is secured to the non-rotating axle member. The power is transmitted from the differential gear by means of shafts attached to universal joints which drive the small pinions carried by the wheel spindle carrier plate. These pinions mesh with internal gears attached to the wheel. The universal joint permits the wheels to be moved for steering and at the same time transmits the power in a positive manner.

A special form of change speed gearing is necessary as outlined. This follows the construction of the ordinary form of positive clutch gear, having the gear teeth always in mesh except that it has a supplementary shaft driven by a silent chain from which power may be

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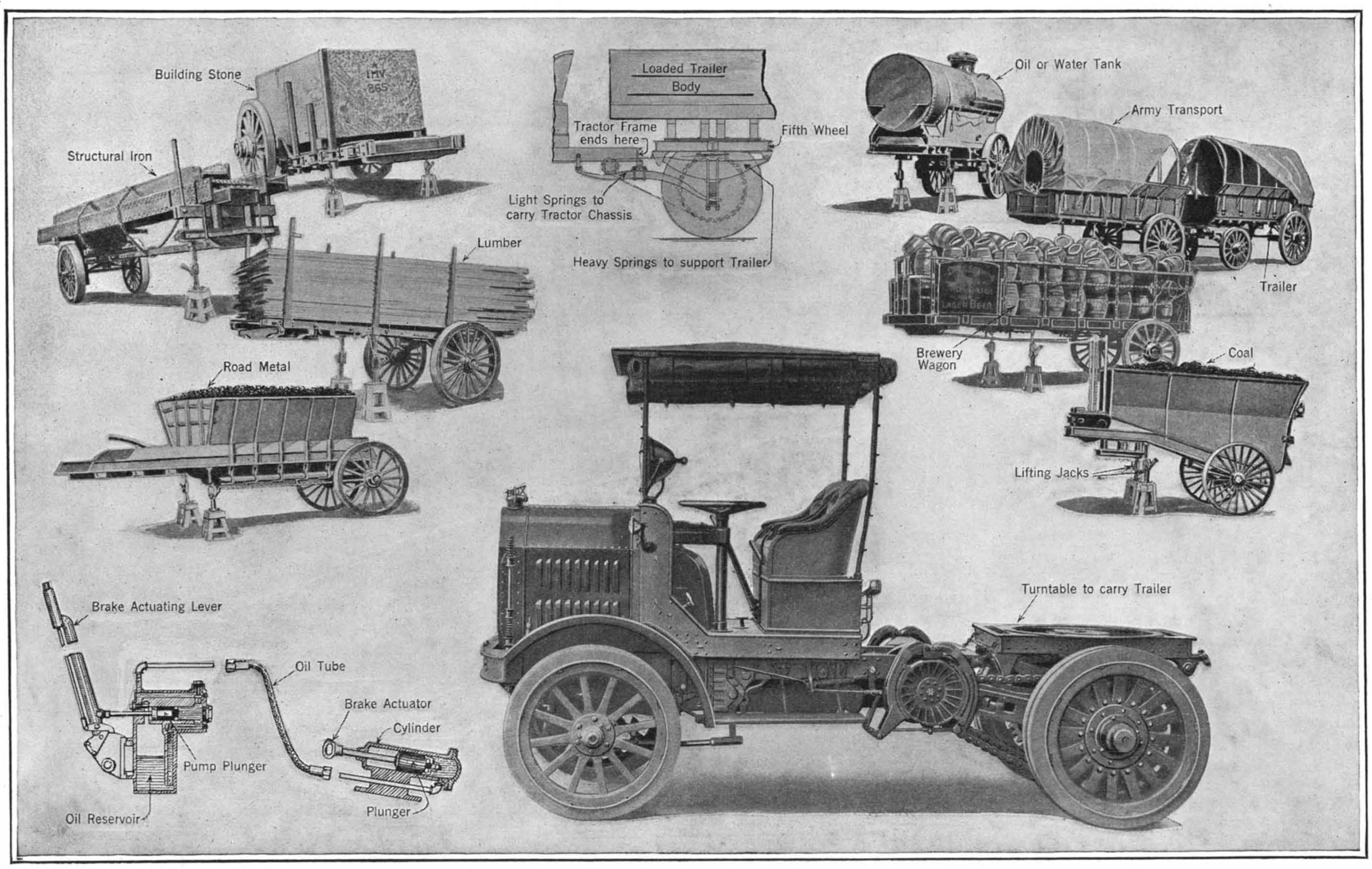


Representative road tractor and some of its novel structural features, as well as typical trailers that may be drawn by a single tractor unit

Saving the Car by Careful Driving

Some of the Evils of an Excess of Caution

By H. S. Whiting

ALMOST any person of average intelligence can learn to drive a car—that is he can steer it, increase its speed, slow it down, and stop it fairly well. No particular gift is required to master the various controls; in fact, the large increase in motor car accidents may be due to this very ease with which a modern motor car may be made to obey its masters.

But, simple as may be the essentials of driving, the control of a car in its most perfect form—that which will save the mechanism, reduce the danger of accidents to a minimum, and which will result in a smooth, steady flow of power without jolt or jar—is only to be obtained after a thorough study of the car and an experience based on a practical knowledge of its mechanism.

There may be two kinds of driving: that which saves the car and its mechanism, and that, which, by its very conservatism, reduces the possibilities of mishaps to a minimum. The two should go hand in hand. The driver who is careful of his mechanism should be equally careful of human life. But such is not always the case; the driver who applies his brakes suddenly from very excess of caution may make matters far worse by causing the car to skid, when careful driving would have brought it to a stop with less danger to the occupants and less wear and tear on the mechanism.

It is well for every driver to remember that the gasoline engine is a high speed machine; it can develop its maximum power only at a rate of speed varying from fifteen hundred to twenty-five hundred revolutions per minute, and to expect it to duplicate the performance of a steam engine or electric motor is absurd and indicates gross ignorance on the part of the driver. It is to overcome this inherent defect in a gasoline motor that the various speeds or gear ratios are provided. By means of these, the engine speed may be maintained at a fairly constant rate for various speeds of travel of the car. Obviously, therefore, these speeds, or gear ratios, were intended to be used whenever the load to be overcome by the rear wheels reaches a point at which the motor begins to labor. But the remarkable performances of some of the modern cars on high gear have caused many amateur drivers to believe that their cars also should be capable of similar performance, with the result that there seems to be an antagonism toward gear changing that is, at best, a harmful superstition from the viewpoint of the motor, gears, rear axle and other parts subjected to the greatest strain.

When the newly-initiated driver operates a car, he feels that the first point to remember is the operation of the brakes, so that it may be brought to a stop quickly. It may seem to be a simple matter to follow the instructions of his teacher and "push with both feet, and grab the emergency brake lever," and doubtless some of the expected results will be accomplished. But, as in all other departments of motor car driving, there is a right and a wrong way to operate the controls and to time the relative actions with each other.

In bringing the car to a stop in this manner the amateur driver is not only inducing undue wear on the brake linings, but is losing a most valuable ally. The motor itself when allowed to slow down of its own accord, as it will do when the foot is removed from the accelerator and is placed on the brake, will serve as a drag on the car that, without the creation of undue friction, will materially assist in bringing the vehicle to a stop. Therefore, the expert driver will *not* push out his clutch until the car has been brought down to the speed at which it would be driven with the motor running in its throttled condition. With the majority of cars such a speed will be in the neighborhood of five or six miles an hour. Below this speed continued application of the brake without release of the clutch would stall the motor and would represent the dead line at which the driver would demonstrate his inexperience rather than his expertness.

The effect of the motor when used as a brake must not be lost sight of when conditions are such that a skid is liable to occur at any moment through inexpert handling of the car. The majority of skids occur when the rear wheels are locked, due to the sudden application of the brake. Naturally, the rear wheels lock more easily on a slippery surface when the traction is greatly reduced than is the case on a hard and dry surface, but the wheels cannot lock if the clutch is engaged and the motor is still revolving. Consequently, this method of stopping the car without releasing the clutch will reduce its speed quickly, the motor in the meantime acting as a drag, but without allowing the dangerous lock to take place.

But, if the use of the motor as a brake to prevent skidding is advisable on a level, it is more so when coasting down a hill, the road of which is liable to be slippery. A hill of moderate incline will need only the braking effect of the motor in high gear to hold the car speed down to the proper limit, without applying the brake severely. If the hill is somewhat steeper, however, the motor will serve as a more effective brake if the second gear is engaged for as the power at the rear wheels is increased through the medium of a lower gear, so is the resistance offered by the motor at the rear wheels increased in the same proportion. Few hills there are which, with the transmission in lowest gear, will cause the car to coast faster than seven or eight miles an hour even without the application of the service or emergency brake. On long hills, the use of the motor as a brake in this manner will not only give the driver perfect control of his car, but will prevent dangerous skids on short turns and will save the linings of both emergency and service brakes.

Regardless of the astonishing performances of multi-cylinder motors on high gear, the transmission will always be a part of the gasoline propelled automobile; although shifting may be reduced, it can never be eliminated. The clutch is the connecting link between the motor revolving at any given speed and the transmission, which may, at times, be inert. When this is the case, or when the difference in speed between the motor and transmission is great, the clutch should be engaged gently. But by so manipulating the throttle and the gears that the car speed and engine speed always bear the proper relation to each other, shifts may be made almost without releasing the clutch, or at least so quietly and gently that the occupants of the car would scarcely know that a gear entered into its construction. To drive in this manner, however, the operator must bear in mind that the motor turns rapidly for slow speeds of car travel on low gear; that the speed of the motor is somewhat lower for the same speed of the car in second gear; and that on high or direct drive the car travels faster for the same number of revolutions of the motor. The difficulty that many motorists encounter, when shifting from a high to a lower speed, is due to the fact that the momentum of the car from the previous high gear driving is so great that the rear axle is turning faster than the gear about to be meshed, which is driven by the motor. A change to second gear should never be made when the car itself is traveling faster than ten or twelve miles an hour, and even under these conditions the motor should be speeded up somewhat before the change may be made without the danger of stripping the gears. Similarly, a change to low gear should never be made when the car is traveling faster than four or five miles an hour. And even the driver who believes that at the end of a long coast, when he has disconnected the motor by throwing the transmission in neutral, he can again start it by throwing into high, will find that such a practice is attended with the danger of broken gear teeth, for the transmission itself under these conditions is not revolving at sufficient speed to accommodate itself readily to the speed at which the car is coasting. If a starter is employed, the motor may be run and speeded up slightly to the required point to correspond to the speed of the car at the time that the transmission is again engaged.

One of the most difficult points connected with the proper operation of a car is the proper setting of the spark for different conditions of operation. Some cars are provided with a set spark which permits of no variation, while others are equipped with a device which causes the time of the spark to change in accordance with the speed of the car. The last named, or automatic type, however, is also provided with a control by means of which the driver may exercise some authority over the time at which the charge is ignited. The spark should be kept in its advanced position whenever the motor is driven fast, provided the rear wheels are not overloaded. As soon as the motor begins to labor, however, due to the existence of a grade or mud, the spark should be retarded to the point at which the motor runs smoothest. It is especially necessary to retard the spark when climbing a hill on high gear if the momentum of the car at the beginning is not sufficient to enable the motor to maintain its speed. The spark should also be retarded before accelerating the car if it is to be run slowly on high gear, for the increase in speed represents an added load on the motor, which cannot be cared for if ignition occurs too early in the stroke.

It was pointed out in a preceding paragraph that the worst skids occurred when the rear wheels are locked. The brakes of a modern car are so well designed that the wheels may be locked by the sudden application of both the service and emergency brakes, even though the road surface be hard and dry. On any road surface, however, if the emergency stop is necessary, it is well to apply both brakes simultaneously and then to release them slightly in order that the continued tension will not cause the wheels to slide. The temporary release of the brakes and their subsequent application will serve to keep the wheels revolving with the aid of the motor so that the car may be brought to a stop on even the slipperiest surface without great danger of skidding.

The man who can operate his car principally with the steering wheel and throttle, using the brakes and clutch only for usual conditions, such as a sudden stop, shifting gears, and the like, is the man who not only will obtain the longest service from his car, but who will have the smallest number of accidents recorded against him. If the throttle is closed in time, the car may coast to a stop in about double the distance that would be required to bring it to a standstill were the brakes jammed on. The fifty or a hundred feet gained by maintaining the speed of the car until necessary to apply the brake suddenly will be more than offset by the wear on tires, brake bands, gears, and other moving parts of the motor.

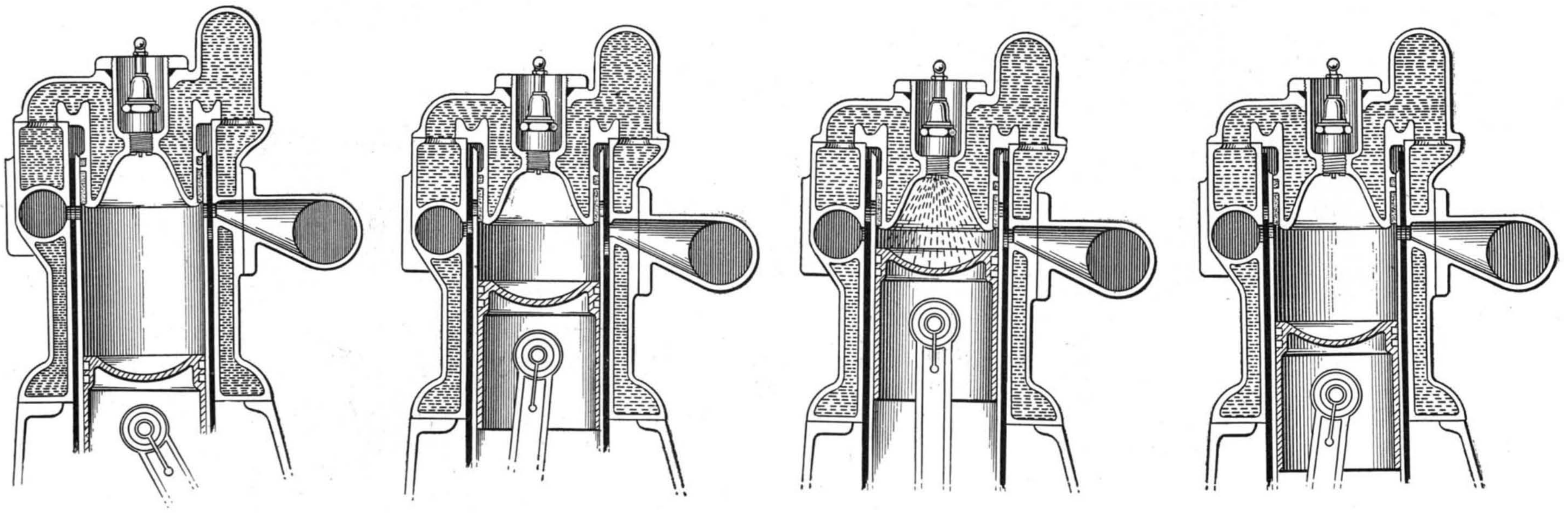
The Current Supplement

AN interesting story in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2087, January 1, 1916, tells about *Building a Big Earth Dam* in California, and there are several excellent illustrations showing some of the methods employed. *A Psychological Analysis of Stuttering* is an attempt to explain this annoying defect in speech, that may lead to preventative and curative methods. *French Life-saving Helmets* illustrates and describes the ancient piece of armor that has been recently revived among the armies of Europe. *The Transformation of Pure Iron* discusses certain physical properties of the metal in relation to the theories of allotropy. *Protective Coatings for Metals* is a useful review of the various processes in use for protecting metals from oxidation. *Some Noted Zoölogical Parks* tells something of the history of the gardens of the Zoölogical Society of Philadelphia, and is accompanied by a number of attractive pictures and a plan of the grounds. *The Hardwood Distillation Industry* gives an outline of the processes employed, and points out what the technical chemist has done in its development. *A New Method of Mining Coal* describes and illustrates the surface working method that has recently been adopted in several parts of the country, and calls attention to the devastation that it is responsible for. *Rifle Fire* illustrates how small arms are employed in attack and defense. *Electric Activity in Ore Deposits* describes the complicated conditions that prevail underground, and which would have to be met in any system of electric exploration. There are also articles on *The Effect of Smoke on Trees*, *A Method of Detecting Various Mineral and Alkaloid Poisons in Water*, *The Electrical Universe*, *The Cause and Cure of Pellagra* and other valuable matter.

Preserve Your Papers: They Are of Permanent Value

Boring for Oil in Australia

IT is probable that at an early date the oil produced from the shale deposits in the Gladstone district of Queensland will be available. The particular area on which the operations are being conducted is in the neighborhood of Lowmead, near Baffle Creek, in the Gladstone district. Bores are now being sunk for a company which has leased the land. At 173 feet in one bore a thick bed of shale was penetrated. An American company has offered to build a plant for recovering crude oil from shale.



Intake stroke—intake port open | Compression stroke—all ports closed | Firing stroke—all ports closed | Exhaust stroke—exhaust ports open

Sectional diagrams of a sleeve-valve motor, showing position of valves during the different periods of the cycle

The Knight-Type Sleeve-Valve Motor

A Revolutionary American Invention That Has Been Widely Adopted

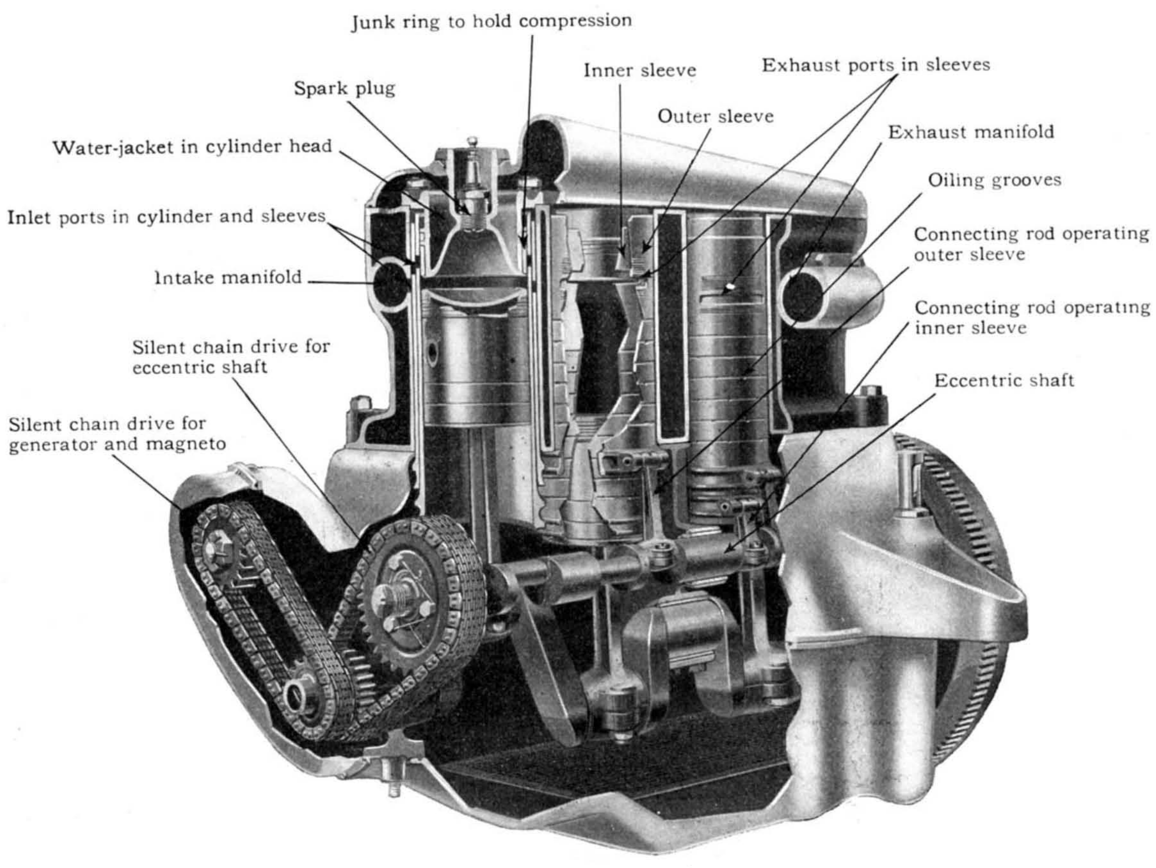
THE first sleeve-valve motor was constructed by Charles Y. Knight in Chicago in 1903. The inventor sought to devise an internal-combustion engine with positively actuated valves, instead of relying on cams and springs, as in the case of the present-day poppet valve, or upon a combination of suction and poppet valves, as was common in the early period of gas engine development, having in mind the basic principle of the steam engine—positively operated valves. To use this principle in a gas engine, he developed a sleeve that moved up and down between the piston and cylinder wall, and had openings or ports cut in the sleeve registering with ports of equal size in the cylinder wall. The opening and closing of these ports, with relation to the position and direction of travel of the piston controlled the distribution of the gas.

This first motor using the single sleeve principle was fairly successful, but some trouble was encountered because of the uneven operation of the sleeve. To provide the proper timing it was necessary to give the sleeve extremely rapid travel between valve openings, yet to greatly reduce the speed when the ports were in register. Because of the difficulty in providing sufficiently large openings it was found advisable to use an auxiliary exhaust port in the lower part of the sleeve, the piston uncovering this port while traveling down on the explosion stroke. After many attempts to overcome the difficulties presented by the single sleeve design, Knight conceived the idea of using two sleeves, and in 1904-1905 produced the engine much in its present form. During the two succeeding years he further developed his engine, and endeavored to interest American manufacturers. In this he was unsuccessful, but during 1905-1906 produced 150 complete cars, which by their successful operation vindicated the sleeve-valve principle.

American manufacturers, however, were not impressed, and in 1907 Knight went abroad upon the invitation of the Daimler Company, Ltd., Coventry, England, which company the following year placed the Knight car upon the market, utilizing Knight's principles and ideas with but minor changes. The action of the Daimler Company was followed shortly by the adoption of Knight's invention by a number of European manufacturers.

The sleeve-valve motor differs from the ordinary automobile engine in four distinct ways: the valving, the shape of the combustion chamber, the location of the spark plug, and the machining of all surfaces forming the combustion chamber. In practically all other respects, the sleeve-valve and the poppet valve have much in common. The sleeve-valve designer has the same freedom as the poppet-valve engineer in the bore and stroke of the motor, the number of crank-shaft bearings, the type of lubrication system, the choice between timing chains and gears, thermo-syphon, or pump cooling, etc., and has a very great advantage in that the size of the cylinder does not limit the size of the valves.

The sleeves of the Knight type motor are concentric shells of cast iron, of the same material as the cylinder. The outer sleeve is surrounded by the cylinder and the inner sleeve becomes the active cylinder wall, the inside diameter of the inner sleeve being, of course, the effective bore of the motor. The inner sleeve is 9/64 inch in thickness, the outer 7/64 inch. The sleeves are driven by small connecting rods actuated by an eccentric shaft, which shaft takes the place of the cam shaft in the ordinary L-head design of poppet-valve motor. The eccentric shaft runs at one half crank shaft speed, and the travel of the sleeves is less than one ninth that of the piston. In the case of an engine having a stroke of 4½ inches, the sleeves travel 29/32 inch to each up-and-down stroke of the piston, which, of course is 9 inches for this engine.



Sectional view of the Knight-type sleeve-valve engine

The valve ports are the same size in both sleeves, which register exactly at the time of full opening. The fit of the sleeves, while snug, is not tight enough to present any difficulties either in manufacturing or assembling.

A feature of the Knight type motor is the wide expanding ring (known as the junk ring) located in the cylinder head, and pressing outward against the inner sleeve. This junk ring plays an important part, for it seals the combustion chamber on the compression stroke, protects the valves at time of explosion, and carries off the heat of the inner sleeve when the latter travels to position behind the ring. Above the junk ring is located a smaller ring, intended to prevent further passage of any gas which may have been forced through the opening in the junk ring during the period of compression.

The intake opening results from the operation of the two sleeves only, the inner traveling up, and the outer down, the upper edge of the inner sleeve port, and the lower edge of the outer sleeve port traveling away from each other, and calling into play the full opening of the port, the valve opening at 6½ deg. after top center, and closing 45 deg. after lower center. The intake port when closing, however, depends upon the action of the inner sleeve in its relation to the junk ring, the outer sleeve taking no part in closing the valve, as it travels behind the inner sleeve. The travel of the lower edge of the port in the inner sleeve to its position behind the junk ring closes the port, and the pressure of the ring against the inner sleeve seals the combustion chamber. From this it will be noted that the sleeves, in so far as their relations with each other are concerned, have nothing whatsoever to do with retaining the compression. The junk ring seals the chamber above, just as the piston rings seal it below (the inner sleeve being also the active cylinder wall), and the outer sleeve serving merely as an auxiliary in the proper functioning of the valves. In this connection it is interesting to observe the assistance which the inner sleeve gives to the piston on the two strokes or cycles, during which the piston is called upon to perform its greatest work—namely, compression and explosion. During compression when the piston is laboring to compress the gas, and hence exert-

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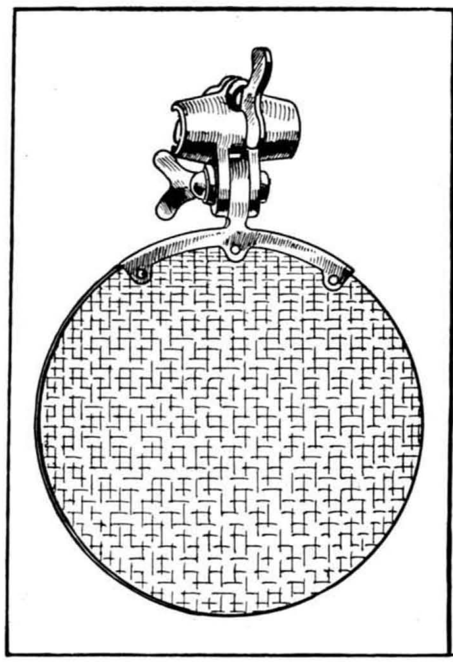
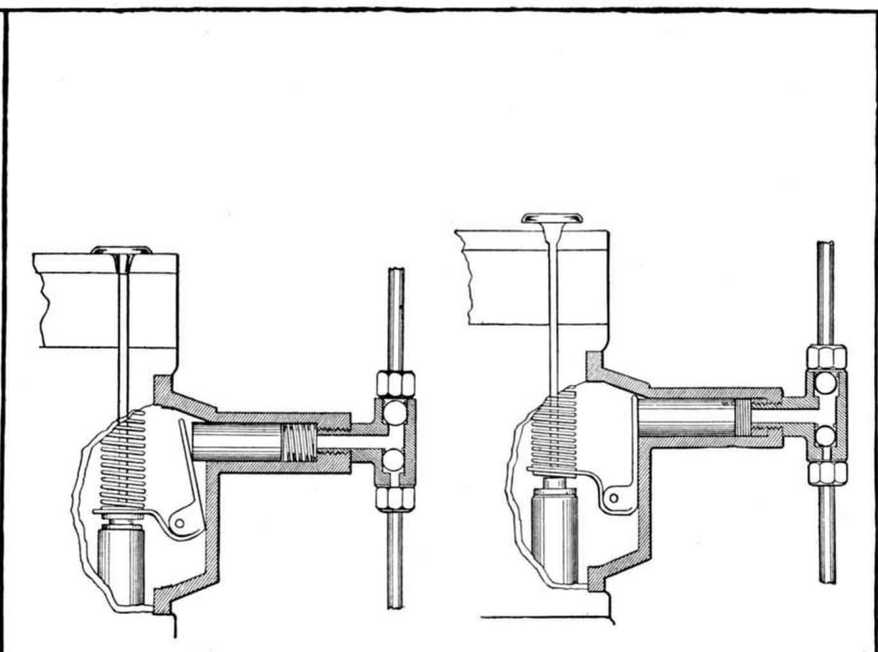
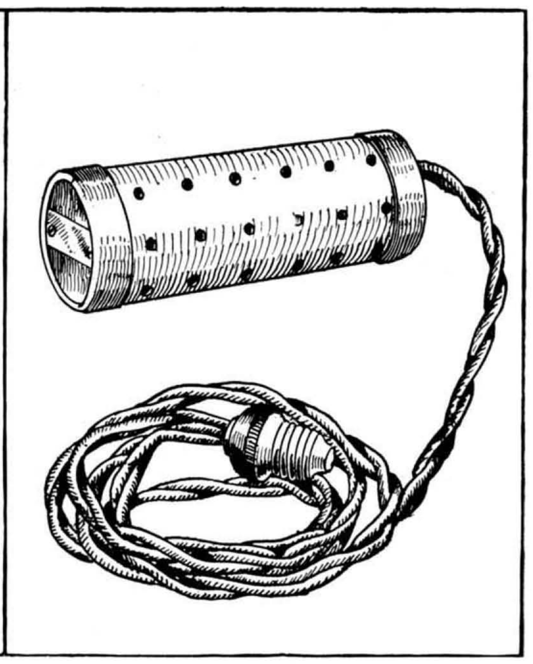


Adjustable color screen for protection against headlight glare



Sectional views of an oil pump, driven by the valve mechanism of an engine, showing the parts at the moments of intake and pumping the oil



An electric heater that is designed for warming the power plant of an automobile

New Accessories for the Automobile

Offerings for 1916 as Numerous and Diversified as Those of Previous Years

AUTOMOBILE accessories for the 1916 season may be said to be as numerous and ingenious as those of any previous year. While the greater part of the offerings are in the form of improvements over existing articles, not a few may be considered distinct novelties.

While practically all the large and many of the small cities have ordinances forbidding the use of blinding headlights, in many parts of the country, along open roads, there is no prohibition, and consequently night driving is often made dangerous by the headlights of approaching cars dazzling the driver. To prevent this, a goggle manufacturer is making a goggle the upper half of which is colored, so that when bright lights approach the driver has but to tip his head slightly to bring the colored portion in the line of vision. The lenses are of glass, in one piece—not two pieces cemented. The same company also makes a goggle of a transparent composition, colored above. The composition is like celluloid, but will not burn.

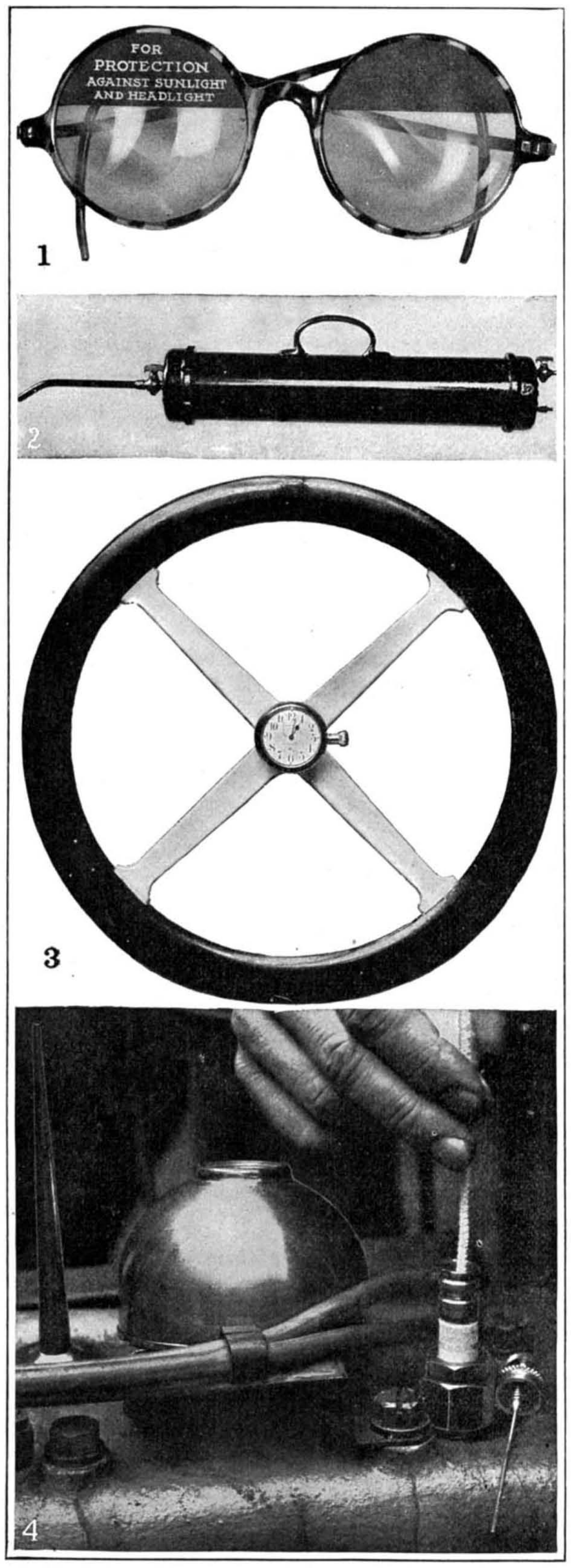
Another form of protection against the blinding headlight uses the same principle, namely, that of a color screen. This accessory, however, is put on the windshield and consists of a circular amber colored disk of glass that is clamped to the top of the windshield in front of the driver. When a car approaches at night, it is only necessary for the driver to bring the disk in position between his eyes and the coming headlights. The device is easily attached to any windshield by means of a screw clamp.

Use of one of the valves of the automobile motor for driving an oil pump is made by a western company. The device is designed for a car that does not have a force feed system of oiling, nor any very convenient way of driving an oil pump. It is attached to the side of the motor in place of one of the valve cover plates and has a small pump piston. The piston is operated by a levered rocker arm, which in turn is operated by an arm attached to the valve stem. As the valve goes up and down, the rocker arm drives the oil pump piston in and out, circulating the oil.

It is fully possible to heat a closed automobile and even a touring car, when the rain curtains are down, from the exhaust of the motor. One of the large parts manufacturing companies is now introducing an exhaust heater which has proved successful in use this winter. The heater simply consists of a copper tube radiator installed in the floor of the tonneau, through which part of the exhaust gases pass. A valve is provided to regulate the flow of the gases. There is also a vertical radiator to place against the heel board of the seat in the case of a coupe or runabout.

Another new device is one for keeping the motor warm. It operates by electricity and consists of a small metal cylinder containing an electric heating element. It is simply placed under the hood of the car and the current turned on. The heater is 2½ inches in diameter and 6 inches long, and consumes 100 watts. It may be attached to any lamp socket. At ten cents per kilowatt hour, it costs one cent per hour to operate, and on lower rates a corresponding lower cost.

Air may also be used to fill the grease cups and transmission and differential cases with grease, and among the new accessories two different devices employing this agent are offered. One is a conventional grease gun in shape and construction, but instead of having a rod and handle connected to its piston, it has an air chamber. When pressure is applied by means of air, the grease is forced out without any effort on the part of the operator. The rapidity of flow depends on the viscosity of the grease and the pressure of air, but it is stated that comparatively little pressure is necessary.



Four popular automobile accessories

1. Goggles designed for protection against headlight glares. 2. Grease gun operated by air pressure. 3. Time piece that may be mounted on the steering wheel frame. 4. Spark plug of ram-rod design.

When a man drives a car, it is virtually impossible for him to take out his watch to ascertain the time. Even when there is a clock on the dash it is not always easily seen, especially at dusk or in the night. There is now on the market a watch that is screwed directly in the center of the steering wheel, where it may be seen at a glance. To the back of its case is fastened a nut, similar to the one on top of the steering post, and the new nut bearing the watch is simply substituted for the old.

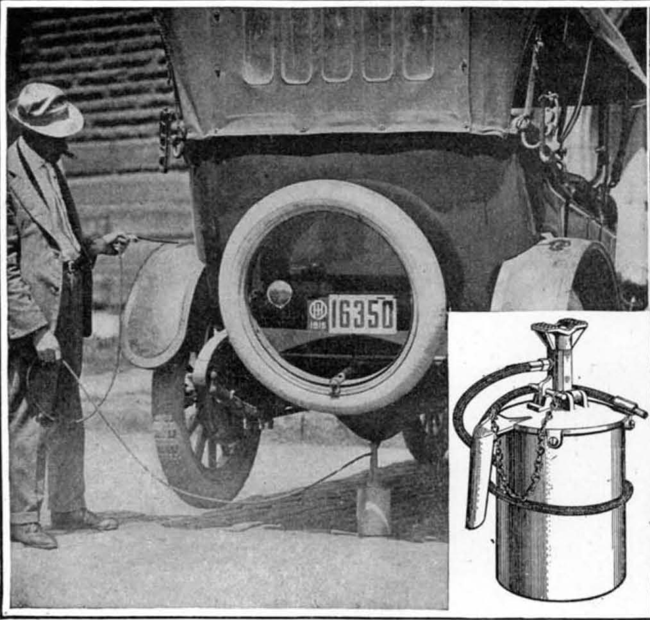
Spark plugs must have their points cleaned of carbon occasionally, and often it is necessary to prime the motor. These two operations are combined in one in a new spark plug of unusual construction. It has its central electrode in one piece and removable from the plug shell by simply giving it a short twist to open a lock joint. The electrode may then be removed, just like a ramrod from a gun. There is then presented a clear passage into the motor cylinder for priming with gasoline, and the central electrode may be easily cleaned in the hand. To clean the points on the plug shell within the cylinder, an ordinary pipe stem cleaner is moistened in gasoline and run through the shell. The plug greatly facilitates cleaning and priming.

Now that air pumps driven by the car motor have placed at the disposal of the motorist a plentiful supply of air at high pressure, air is beginning to be used for purposes other than the inflating of tires. In addition to furnishing a means of cleaning the upholstery, air may now be used to jack up the car. An air jack made for this purpose will lift the heaviest car with only 80 pounds pressure to the square inch from the air pump. Even when a power pump is not on the car, a hand pump may be used. It is stated that seven strokes of the usual hand pump will lift the average car. The jack weighs six pounds and is only four inches in diameter.

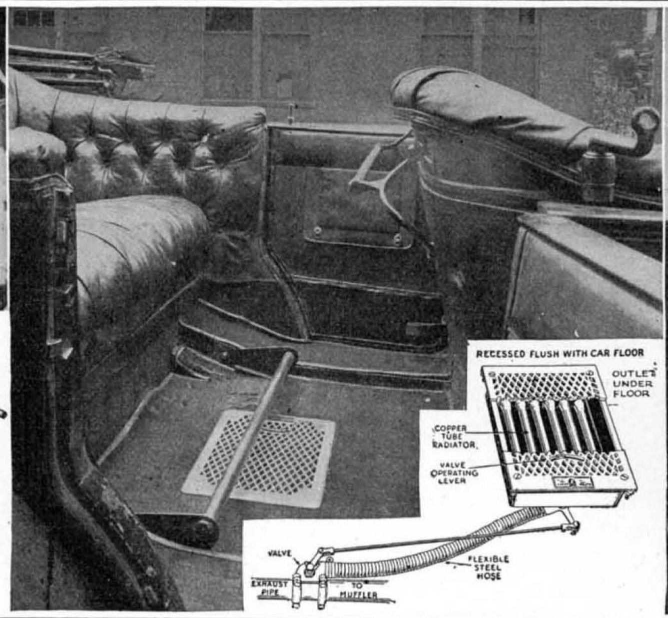
Because it is a nuisance to carry into the restaurant or theater or office or home all the coats, robes, suit cases and other articles that are carried in an automobile, many motorists leave them in the car. This gives an opportunity that the sneak thief is not slow to take advantage of. In order to prevent his making off with such things, there is a robe lock that clasps about the robe rail and anything that may be on it. It has jaws that grip tightly and that lock in any position. An easily-operated combination dial releases the jaws.

Complete protection for all but the head, shoulders and arms of the driver of the open car is afforded by a new robe that covers the top of the driving compartment from the top of the dash to the back of the seat. It thus allows full freedom of movement for the driver's feet and also an air space for the heat from the motor in front to warm through the dash. The robe is provided with straps and fasteners by which it is held tightly to the dash and the side of the body.

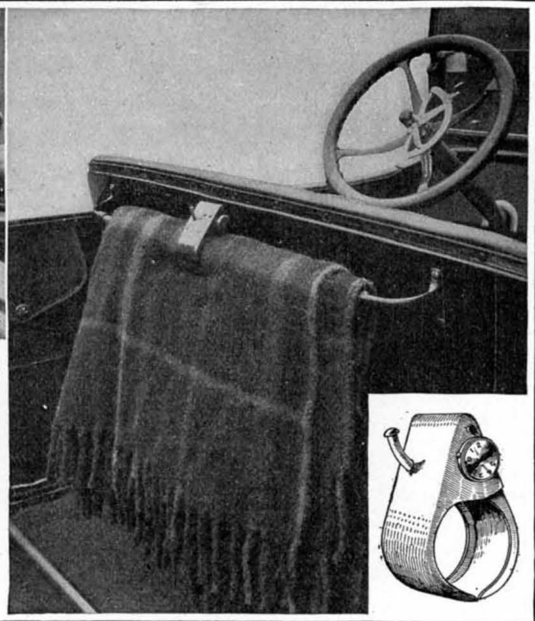
Many a man's wife drives his car just as well as he does, but with much inconvenience in reaching the pedals which may be just right for the husband but



Automobile jack operating on 80 pounds air pressure supplied by the car's power pump



Heater utilizing the exhaust gases of the power plant, installed in the tonneau floor



Combination lock that may be used for safeguarding robes, coats, luggage and other articles

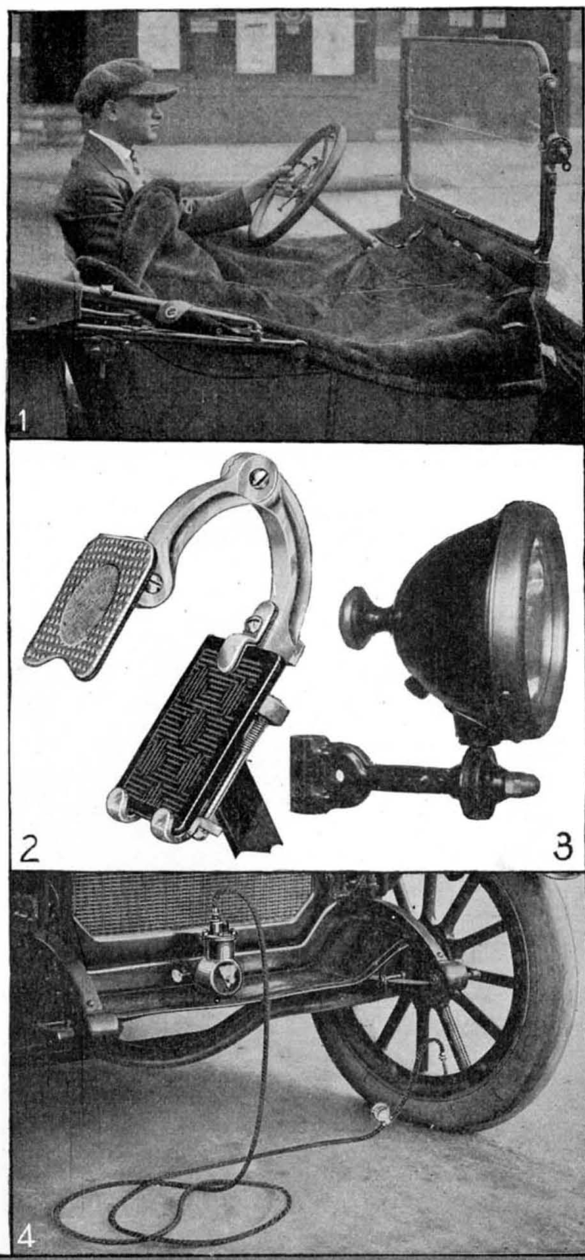
almost out of reach for the wife. Such couples are offered an ingenious double pedal attachment in which a second pedal may be placed above the original pedal at any desired height. The device is simply clamped to the original pedal without any drilling of holes. Both pedals are left free for use by the two persons. When the wife drives, she takes the upper and higher pedal pad, and when her husband is at the wheel, he uses the original pedal.

Due to the almost universal condemnation of blinding automobile headlights and the consequent dimming of them, they have become almost useless as long distance touring aids at night. The dimmed headlight will not throw a sufficiently strong beam. This, coupled with the need for some movable searchlight, has brought forth the hand searchlight, which almost disappeared when electric headlights became powerful. The present searchlights, however, are not like the old clumsy ones of a few years ago. They are small, high power lamps, utilizing nitrogen-filled bulbs of high candle power but low current consumption. It is claimed for one of them that it gives such a strong, hot ray that is so well focused that a cigarette may be lit in it.

Many motorists would install motor-driven air pumps on their cars were it not for the expense of applying them to the motor, due to the difficulty of finding a suitable base on which to mount them and of providing a practical means of driving them. A most simple motor-driven air pump has just appeared. It takes the place formerly occupied by the starting crank, which is now absent in most cars, due to the use of self-starters. The pump is simply inserted in the crank hole until a clutch on its driving shaft meets the end of the motor crankshaft. It is then tightened in place by means of an expanding sleeve. The pump will develop over 100 pounds pressure and may be had in models to fit any car.

A novel device in which air is used to deliver grease takes the form of a bucket in which air pressure is created by screwing down a handle attached to a threaded rod bearing a piston. The bucket is most versatile, as it has two compartments in which two different kinds of grease may be carried. In addition to discharging the grease contained within itself, it may be used to suck out the used and dirty grease from a differential or transmission case and deliver it into a third receptacle. The bucket is also self-measuring and will dispense grease by pounds and heavy lubricating oil by quarts.

It is always a problem to dispose of the sixth passenger in a five-passenger car and the ride is never a matter of comfort for the sixth person and his or her companions unless an extra seat is carried. One of the newest seats is unusual in that instead of being placed loosely on the tonneau floor, it is hung on the side of the body or on the door. This gives it a firm support and prevents it from dancing about as the car bounces over uneven roads. The seat is strongly made and has its frame well padded where it fits over the door, to prevent marring the varnish or leather. When not in use it folds into a small space and can be put away.



The original mechanical automobile starter worked by air pressure, yet it is startling to hear that a leading company in the automobile industry is returning to air pressure as a starting agent at this time when electric starters reign supreme. The new starter, which is sold separately as an accessory, is distinguished in that it simulates hand cranking in its application of power to the motor crankshaft. Instead of turning the motor over continuously until it starts, it spins it only a few revolutions at a time. This is due to the use of a so-called "bat-wing" piston, which travels around in a ring-shaped cylinder, from one side of a stationary head to the other. An air pump and tank are parts of the system.

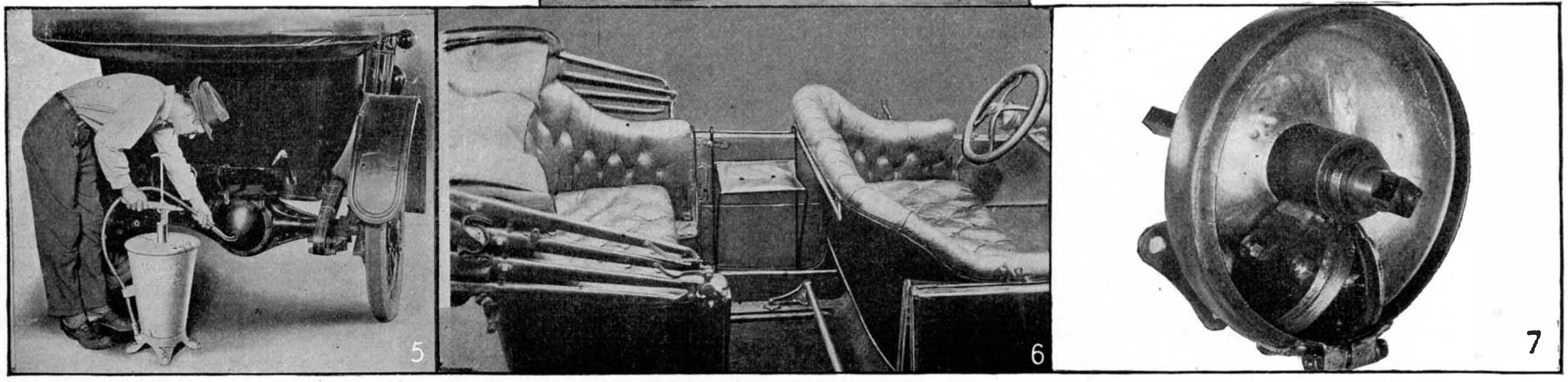
New Dry Dock for Rotterdam

AN automatic dry dock for a ship building concern at Rotterdam has been recently completed and transported to its destination. As the dock was too bulky to pass the locks of the North Sea Canal, it has been built on land at Schellingwoude, outside the Orange Locks, and after completion towed to Rotterdam by way of the Zuider Zee, past Helder.

The dock consists of three sections, coupled together and admitting of being uncoupled. Its end sections are pointed. It has eight water-tight cross bulkheads, three water-tight bulkheads lengthwise, and four water-tight coupling bulkheads, constituting the two coupling chambers. The dock will be provided with three main pumps of 90 horse-power each permitting of joint or separate operation. Besides these there will be three wash pumps, each provided with a motor of 35 horse-power. All pumps are of the centrifugal type with vertical axle. The pumps are to be worked from a service building on the dock of the air compartment of the middle section of the dock. Here, also, are the main switchboard, the water indicator, and the air compressor with its motor. The new dock has a lifting capacity of 12,500 to 13,000 tons and can accommodate ships measuring up to 13,000 registered tons.

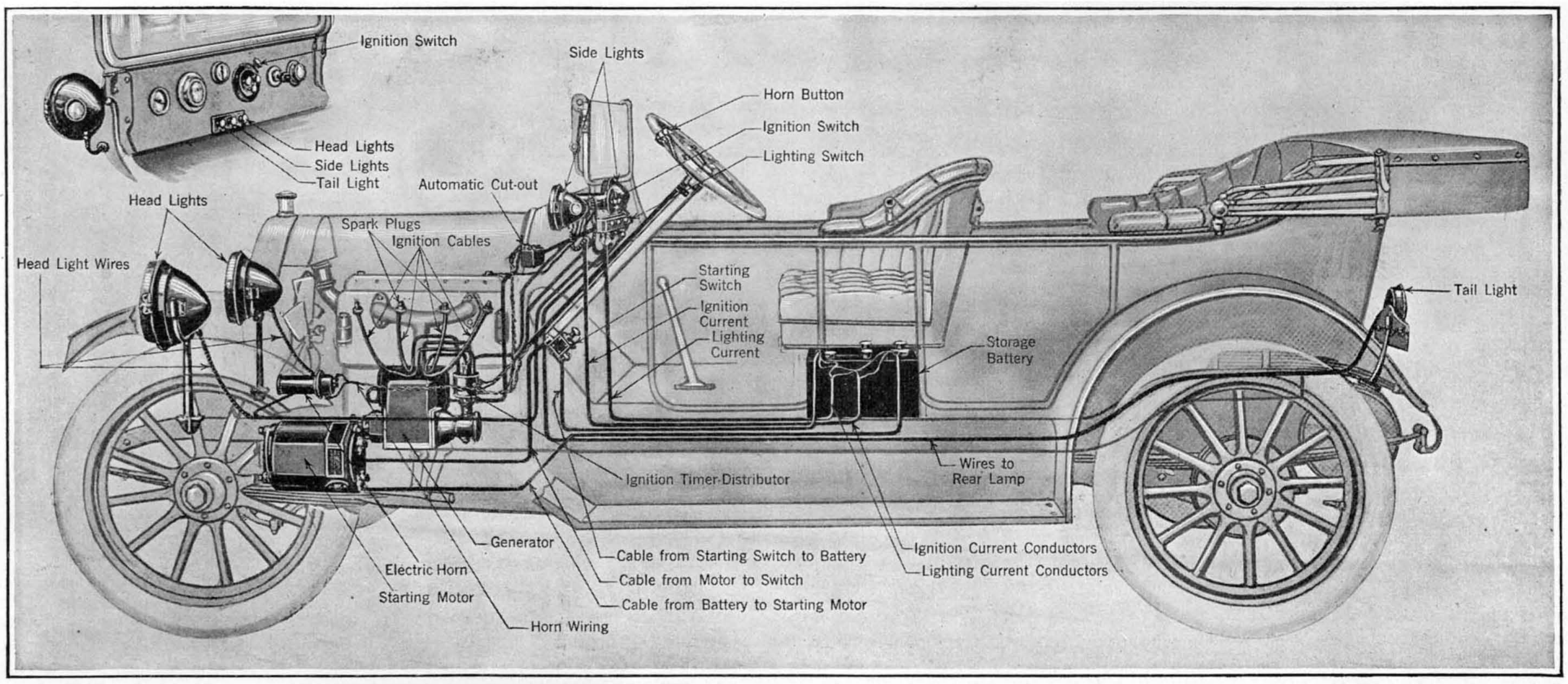
Content of Gasoline Vapor in Air Determined

TWO methods of determining the content of gasoline vapor in air have been the subject of experiments and a report by the United States Bureau of Mines. In one the mixture is introduced into an exhausted glass vessel, is cooled at the temperature of liquid air, the air is removed, and, finally, the partial pressure of the gasoline vapor is measured by means of a manometer attached to the liquefaction bulb. The second method consists in burning the gasoline vapor in oxygen and from the contraction and carbon dioxide produced calculating the percentage of gasoline vapor.



Seven of the most novel accessory offerings for the 1916 season

1. Special blanket for the driver of an open car. 2. Auxiliary pedal for facilitating the driving of cars by women. 3. Adjustable electric searchlight. 4. Power-driven tire pump that occupies the place of the discarded crank handle. 5. Bucket pump for filling or removing grease and oil in differential cases. 6. Folding seat that may be attached to the automobile body without tools. 7. Working parts of compressed air engine starter.



Phantom view of an automobile, showing typical two-unit starting, lighting and ignition system to indicate the relation of the various components to each other and to the car mechanism, as well as outlining the various circuits

Electric Starting and Lighting Systems

Their Proper Care and Maintenance by the Motor Car Owner or Driver

BEFORE considering the subject of starting and lighting system maintenance, it may be well to outline briefly the characterization of the main classifications into which the legion of such systems may be grouped. Though many different forms and combinations of devices have been contrived to secure the automatic motor starting feature, practically all of the systems operate on the same basic principles. If the features of the leading systems are described it should not be difficult for the autoist or mechanic to familiarize himself with the arrangement of any system that differs only in points of minor detail.

Essentials of an Electric Starting and Lighting System

The standard equipment must include three main components—namely, the current producer which is a small dynamo driven by the engine, and which is used to generate electricity for charging the storage battery; a specially constructed secondary battery to act as a reservoir for the current generated by the dynamo, and a starting motor which may be mechanically connected with the engine and electrically coupled to the storage battery when it is desired to turn the engine crankshaft through the initial phases of its cycle of operations.

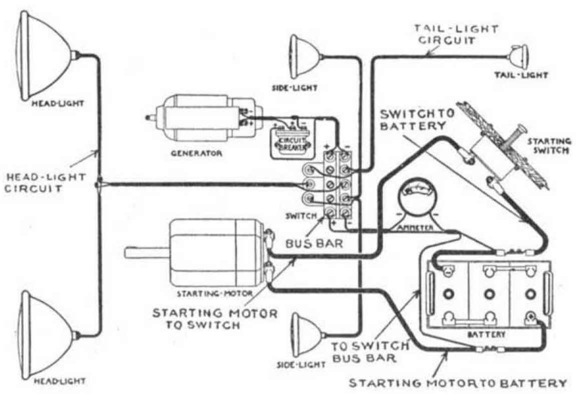
It is possible to combine the current producing and engine starting functions in one instrument. This may be a single machine, having only one set of windings on the armature and one commutator, or it may be a combination instrument having a double wound armature and two commutators. Either of these are called "one unit" machines. If the starting motor is one device and the generator a distinct appliance, the system is called a "two unit" type. Some forms have been devised in which the generator is mounted in the same casing as the starting motor, and these have been erroneously called "one unit" machines. It will be evident that in any system where the starting motor and current generator are electrically distinct, we have a "two unit" system.

In addition to the three main components just named, various accessories are necessary to control or distribute the electric current. These include switches, current measuring meters, connectors and wiring, protective circuit breakers or fuse boxes, automatic voltage regulators, cut-out relays, and the current consuming devices.

The electrical starting and lighting systems that have received general application usually operate on 6-volt current, although some of the one unit systems require 12- or 24-volt storage batteries. The 6-volt system is generally favored, because the lamps designed to operate on that voltage use more substantial filaments than those of higher voltage and are not so fragile and subject to breakage from the inevitable vibration that is present in an automobile. Another advantage of a 6-volt system is that it is much easier to obtain replacements if any of the units become defective through wear or accident.

The One Unit Type of Starting and Lighting System

In referring to a system as a "one unit" system of lighting, starting and ignition, one means that all of these functions are incorporated in one device as shown in one of the accompanying illustrations. The feature here is the combined motor-generator which is an instrument having one set of field magnets and a double-wound armature provided with two commutators. When the armature is driven from the engine the device generates electric current which flows to the storage battery. An overrunning clutch is interposed between the driving shaft and the armature at both engine and starting ends. If it is desired to start the engine, an intermediate reduction gear is moved into engagement with a large gear cut on the flywheel periphery and simultaneously a brush is pressed on the motor commutator which permits the storage battery current to flow through the machine and make it an electric motor. In this case the armature revolves at a high rate of speed and the forward overrunning clutch breaks the driving connection that normally exists between the pump shaft and the armature. Similarly, as soon as the engine starts, an overrunning clutch mounted in the intermediate reduction gearing releases the drive and permits the clutch at the front end of the machine to become operative and drive the armature at the slower ratio of speed necessary to generate current for charging the storage battery. As will be apparent this system is simpler, both mechanically and electrically, than the "two-unit" system, which is also illustrated. The latter is depicted in such a way that the relation the various parts bear to each other and the automobile chassis parts can be easily recognized.



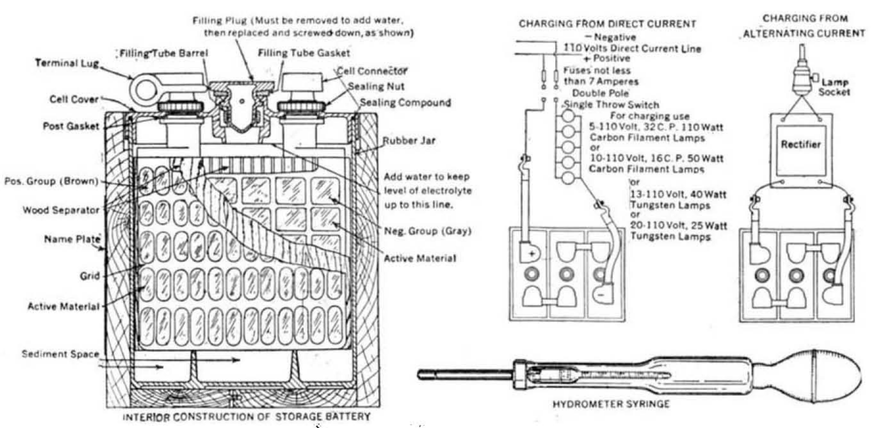
Simplified wiring diagram of two-wire, two-unit starting and lighting system

Practically all the time that the automobile power plant is in action, current is being produced by the generator, and delivered either to the storage battery or to the various current consuming units, such as the ignition system, electric horn and lamps. The surplus current is accumulated in the storage battery and is kept in reserve for starting the engine or lighting the car when the power plant is not in operation or for ignition and lighting when the car is being operated at such low speeds that the cutout of current regulating devices do not permit the current from the generator to flow to the storage battery or to the current consuming units.

Storage Batteries for Automobile Use

The storage batteries devised for engine starting purposes or for car lighting systems must be of special design and large capacity in order to withstand the high discharge rate necessary to operate the starting motor and at the same time capable of rendering efficient service under the severe vibratory stresses and unusual operating conditions incidental to automobiles. It is important to install the storage battery in an accessible location in order that it may receive the attention necessary. The best practice is to set the storage battery in a substantial carrying case under the front seat, on the running board or under the tonneau floor boards.

Practically all cells are provided with an expansion chamber, which receives the gas evolved during the charging or discharging process, and also a combined gas vent and filling plug to prevent the accumulation of gas pressure. This filling plug is removable to permit inspection of the battery interior and to make possible the additon of electrolyte if the cells are emptied or distilled water to replace the liquid lost by evaporation. As will be noted in the illustration, the hard rubber cell jars are carried in a substantial



Sectional view of a heavy duty storage battery for automobile starting and lighting service, the method of charging such a battery of six-volt rating, and a hydrometer syringe

wooden case and after the cell covers have been put in place the entire top of the wood box is sealed with a compound of pitch and other ingredients which not only acts as an electrical insulator, but which also prevents escape of gas or the splashing of liquid, as well as forming an intimate bond between the cells that prevents movement of these relative to each other or the carrying case.

The Electric Starting Motor

The starting motor which replaces the ordinary hand crank is usually a series-wound machine of simple design. The construction of the starting motor is practically the same as that of a dynamo except for the size of the windings which are designed for the passage of the large amperage current necessary to produce proper starting torque. In other respects the starting motor and dynamo operate on practically the same principles except that one instrument is a reversal of the other. In order to obtain a high power output from a small low voltage starting motor it is necessary to revolve the armature at a rate of speed ranging from 2,000 to 2,500 r.p.m. As it is not necessary or, in fact, possible to turn the engine crankshaft faster than 150 to 200 r.p.m. when starting the engine, a speed reduction gearing is introduced between the starting motor and the engine crankshaft. The reduction is usually about 20 to 1, which means that the starting motor armature will revolve 20 times to produce one revolution of the engine crankshaft. The wiring to the starting motor is simple but is of heavy cable because from 50 to 150 amperes current must pass through the motor windings. The starting switch is always interposed in the motor-battery circuit.

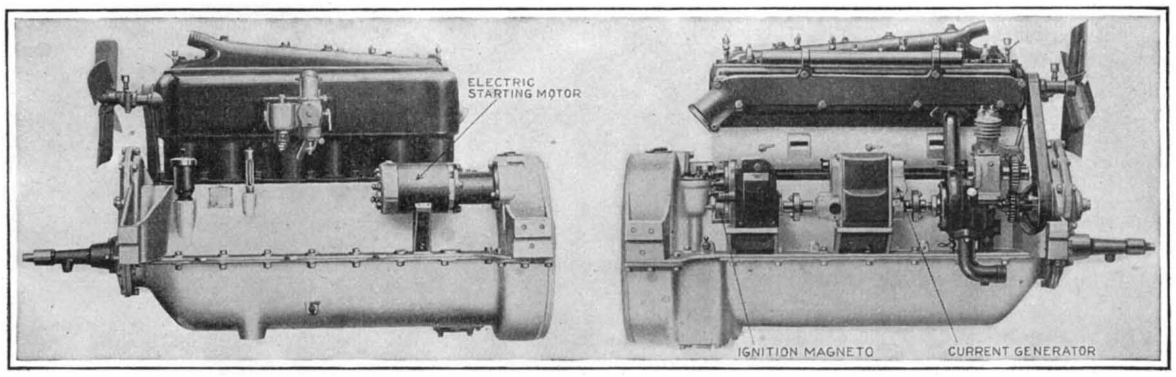
Automatic Control Devices in Self-Starter Circuits

It is evident that electric starting and lighting systems would not be practical for the use of the average motorist unless they incorporated automatic control appliances. A number of mechanical and electrical controls are needed to attain this end. These include the circuit breaker, a governor or voltage regulator, which may be either mechanical or electrical, and the operating switches. Circuit breakers are of two forms, viz., those termed protective circuit breakers are safety appliances that perform the same function as a fuse, while the automatic cutout relay, which is sometimes called a circuit breaker, is a device having a different function. The automatic cutout is used to keep the current from flowing out of the storage battery under those conditions of operation during which the battery current is stronger than that delivered from the generator. If no circuit breaker is provided, when the engine speed is reduced to a point where the generator voltage is less than that of the battery, the current flows through the generator windings and is wasted. The cutout circuit breaker is a very simple device and is operated by an electro magnet. In some cases it is combined with the generator or mounted thereon, although it may be placed in any convenient part of the car. The protective circuit breaker usually forms part of the combination switch in the single unit systems with which it is used.

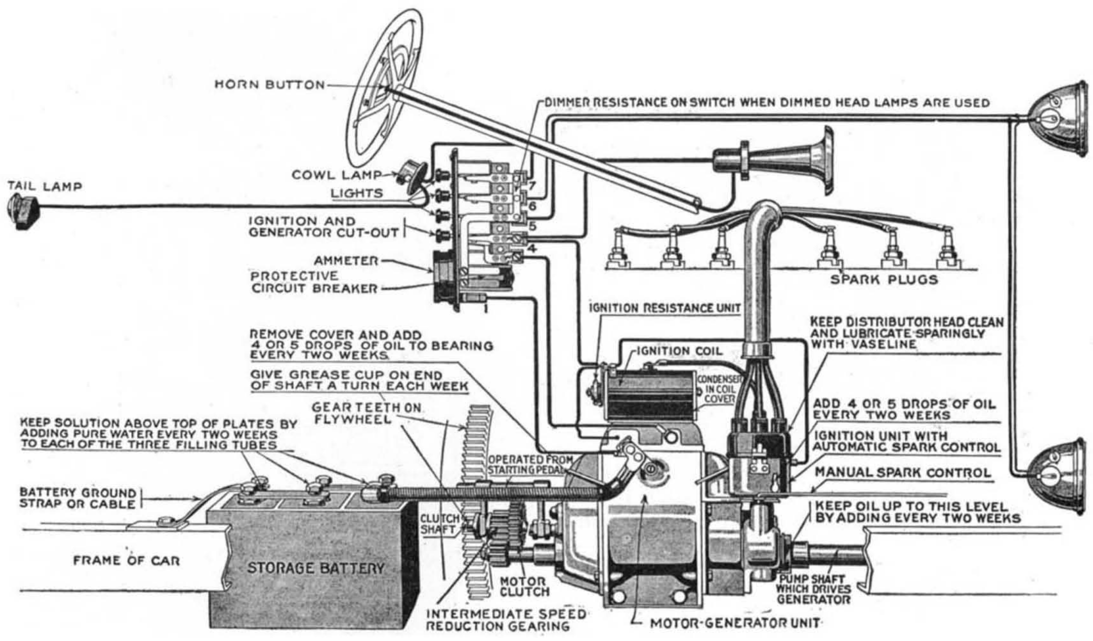
The voltage regulators or their mechanical equivalents are required to prevent an excessive current output from the generator when the power plant is running at extremely high speed. Two types are used, the mechanical form being a centrifugal governor mechanism, though the electrical method may operate on the third brush excitation principle which provides inherent regulation, or by a resistance-relay system which reduces the strength of the field magnet by interposing resistance in series with the field coil. The mechanical type is usually a friction driven mechanism attached to the driving end of the generator and having a clutch to transmit power to the generator armature shaft. The combination of the centrifugal governor and clutch automatically limits the speed of the dynamo armature to a predetermined number of revolutions. This results in the current generated being held to a required amount independently of the speed of the engine or car. The governor minimizes overheating the generator or overcharging the storage battery at high engine speed. The electrical system of governing does not materially influence the generator speed but controls the current output by means of armature reaction, a bucking coil or resistance or a reversed series field winding. Regardless of the system of governing used, these usually permit a maximum generator output of from 10 to 12 amperes, though the normal charging current is less than this.

In practically all systems an ampere meter is mounted in connection with the operating switch or at some convenient point on the dash where it may be readily inspected by the operator. This is joined to the storage battery in such a way that it indicates at all times the amount of current being delivered to the battery or the amount drawn from that source. If the indicating needle of the ampere meter points to the left of the zero on the scale it means that current is being furnished to the consuming units and that the battery is discharging.

Another important element is the lighting switch which is always mounted at some point within convenient reach of the car driver. A common location is on an instrument board in connection with the other registering instruments.



Two sides of an automobile power plant, showing how the ignition, current-generating and engine-starting units are installed, using the unit system



Complete wiring diagram of a typical "one-unit," grounded-return or one-wire starting, lighting and ignition system that has received wide application

The Care of the Storage Battery

The storage battery is the part of the lighting and starting system that requires the most attention and unless this receives periodical inspection it is apt to be seriously damaged. The first point to observe is cleanliness of the battery and interior of the battery compartment, which must always be clean and dry. All small articles, especially of metal, must be kept away from the battery. All terminals and connections should be kept coated with vaseline. If any electrolyte has spilled out of the battery, it should be wiped off with waste wet with ammonia and the bottom of the battery compartment covered with a small amount of slaked lime to neutralize the acid. It is essential that pure water be added to all cells regularly and at sufficiently frequent intervals to maintain the solution at the proper height above the plates. This height varies in different batteries, but the important point to observe is that the plates are always covered with solution. The solution should never get below the top of the plates.

The vent plugs are removed to add the distilled water, which may be introduced with a syringe, and should always be screwed down tight after filling. In warm weather, the battery cells should receive distilled water every week and once every two weeks in cold weather. Never add acid to the solution and do not use any water known to contain even small quantities of salts or mineral matter of any kind. If distilled water is not available, melted artificial ice or fresh, clean rain water may be used. The water should be added at regular intervals as recommended even though the battery may apparently function correctly without it.

The best way to determine the condition of the battery is to test the specific gravity of the solution in each cell with a hydrometer. A convenient time to do this is when water is added, but the reading should always be taken before any water is introduced into the cells. Specific gravity readings are made with a hydrometer syringe of the type shown. To take a reading with this instrument, insert the end of the rubber tube in the cell, being sure to place it below the level of the electrolyte. Squeeze the bulb, then slowly release it to draw up enough electrolyte from the cell to float the hydrometer. The reading is taken from the graduated stem of the hydrometer at the point where it emerges from the solution.

The gravity reading is expressed in "points," the difference between 1.275 and 1.300 being 25 points. After testing, the electrolyte must always be returned to cell from which it was taken. When all cells are in good order the gravity should test within 25 points of being the same in all cells. A reading above 1.200 indicates the battery is more than half charged. The nearly complete charge is indicated by a reading of about 1.275. A reading below 1.150 indicates that the battery is completely discharged. The complete charge is indicated by a reading anywhere between 1.275 and 1.300.

In charging from an outside source, which is often necessary if the car is operated extensively at night and very little in the daytime or if the engine starts hard, there are two possible methods. Only direct current can be passed through the battery, although, of course, the current flowing through the mains may be either direct or alternating. The most convenient method of charging when a direct current is available is to use a lamp bank resistance as indicated in one of the accompanying sketches. This limits the current to the proper charging rate in amperes depending upon the number of lamps used. The ordinary 6-volt battery will be properly charged if five 110-volt, 32-candle power carbon filament lamps or ten 16-candle power carbon filament lamps are used. It will take thirteen 40-watt tungsten lamps to accomplish the same results.

Always connect the positive terminal of the battery, which is that marked "P" or indicated with a plus sign, to the positive charging wire and the negative terminal to the negative charging wire. If connections are reversed serious injury to the plates will result. The charging wires may be tested for positive or negative polarity by trial with a voltmeter or by dipping the ends in a glass of water containing a few drops of electrolyte This will indicate the negative wire by the bubbles formed upon it.

Any storage battery which is to stand idle should first be fully charged. A battery not in active service may be kept in conditon by giving a freshening charge at least once a month, but it should also be given a thorough charge before it is replaced in service.

In order to avoid freezing the battery it should always be kept in a fully charged condition. A discharged battery will freeze at 20 degrees above zero, while one

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The "Blind Turn"

Its Dangers and Various Methods of Solution

By Chas. F. Barrett

NO railroad president would sanction the passage of one of his trains from the "down" to the "up" track without first making sure that there was no train approaching in the section of track to be traversed. Yet that same railroad president along with many other ordinarily careful people is daily taking precisely the same chance in his automobile on "blind turns," which he would not permit his train crew to make under penalty of discharge.

What is the greatest menace of the "blind turn"? Not, as most people would believe, the danger of a simple head-on collision between two cars approaching from opposite directions, due to carelessness in not keeping far enough to the right. Such accidents are all too prevalent, but by far the most common trouble is due to the mixed traffic of slow and fast moving vehicles. Fig. 1 illustrates the usual conditions occurring on "blind turns," which are likely to result disastrously. In this diagram it will be noted that a wagon is slowly passing around the turn, while an automobile is approaching from either end. If the turn is long and the automobile driver, going in the same direction as the wagon, is in a hurry, as is usually the case, the temptation of the latter to swing over to the left and pass the wagon on the curve becomes very great. This maneuver throws him directly in the path of the other automobile approaching and makes a collision most imminent.

It is this sort of risk that the railroad president allows his chauffeur to take almost daily with many a hairbreadth escape. It takes more patience than the average American has, to stay patiently behind a slow plodding team until safely around the curve. Few can hold themselves back from "taking a chance." And the tragic part of the proposition is that the poor fellow who gets bumped into may be the most careful, painstaking sort of a driver, and although exercising the utmost precautions himself in keeping far to the right, running slowly, etc., he may be more seriously wrecked than the reckless driver. Moreover, the team is very likely to get mixed up in the crash also, in the strenuous efforts of the automobile drivers to avoid each other when a collision seems imminent.

This traffic condition and the resulting accidents are a daily occurrence, particularly in the eastern part of the country where heavy automobile traffic and frequent "blind turns" are common. With the rapid increase of automobile traffic on the trunk lines, it would seem that some solution of these menaces must be found without delay.

In considering the possible remedies for partially or entirely overcoming the dangers of this condition, we find two general methods of attacking the problem; one, by changes in the character, location, curvature, banks, etc., of the road itself; and the other, by the use of automatic signaling devices or other independent features for the traveler's protection.

On a careful inspection of actual conditions as they are found in most localities, it is surprising to note how many of these death traps could be shorn of much of their dangerous character by resorting to simple methods under the first classification. Take as an example, the high, wooded bank which forms the most usual "blind turn" condition. In many cases of the latter, the simple expedient of cutting off the brush and keeping it clear will make the turn over 50 per cent safer, if not entirely so. Sometimes, removing a little of the bank at the height of the line of vision and just at the middle of the turn will accomplish wonders in this regard. Traffic conditions have now arrived at a point where the failure to adopt all such comparatively inexpensive means of making the roads safer will be held as inexcusable. In some cases where rebuilding of a roadway is being undertaken it is possible to avoid bad turns by a complete relocation of the roadbed. This has already been done on many trunk lines with commendable results.

A rather curious feature of the "blind turn" is that those of short, sharp curvature are safer than those with longer curvature as a rule. This is because the automobile driver is usually content to remain behind the slow-plodding team until safely around the short turn, whereas he loses patience on the long curve and attempts to dodge around the obstacle with the risky consequences. Also, he must reduce his speed on the quick turn, but not necessarily on the other to keep the equilibrium of his car.

When it seems impossible to change a bad turn, the mixed traffic can sometimes be done away with entirely by sending the slow moving vehicles over an alternate route or vice versa. In many cases it would be possible to construct a special, parallel carriage road around the turn, on which the horse vehicles would be compelled to pass.

As far as signaling devices are concerned, there are, of course, a great variety in use at the present time on the cars themselves, but many of them are too small to be effective under bad conditions. Theoretically, horns and similar devices should give sufficient warning on bad turns, but in actual practice, there are likely to be so many other confusing noises, such as the rush of the wind past the ears, noisy motors or gears, rattle of teams, etc., that they often go absolutely unheeded. Also, the loud, harsh tones necessary to secure effective response are constantly growing more and more of a nuisance to those unfortunates who reside near places requiring such strenuous horn signaling.

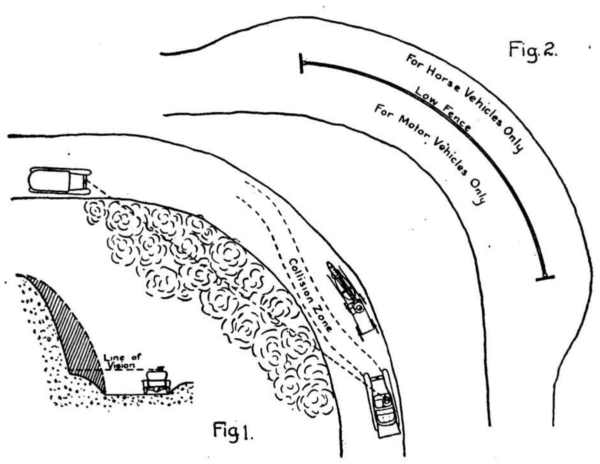
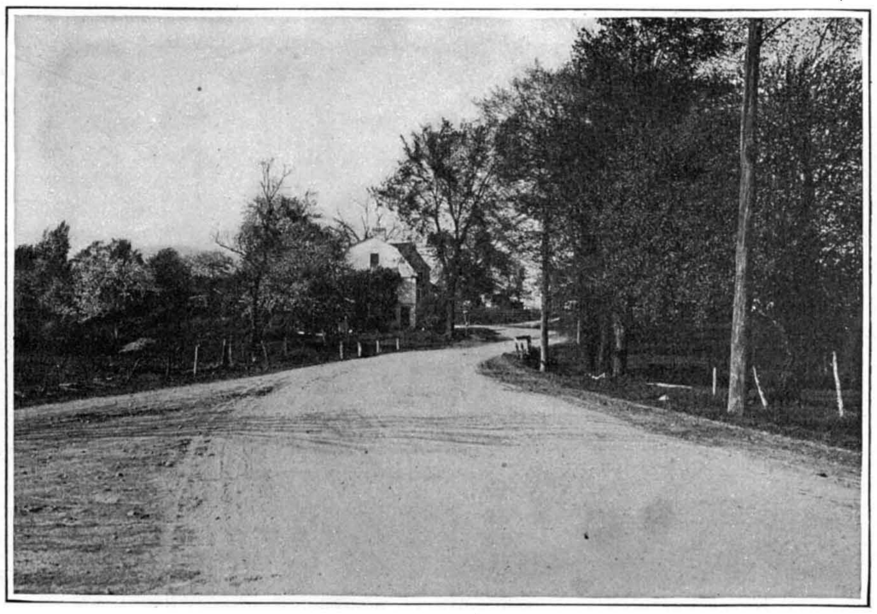


Fig. 1. A bad turn, and how the bank should be cut away to make it safer. Fig. 2. Complete separation of horse and motor traffic



A bad "blind turn" of the "S" type. The operator has only 150 feet clear sight around the turn. Fig. 5 shows how it was eliminated

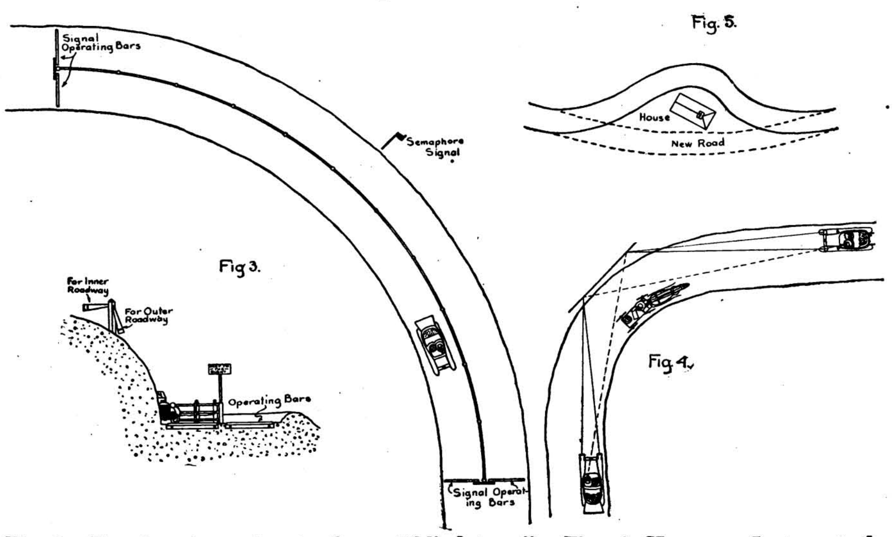


Fig. 3. Signal system of protecting a "blind turn." Fig. 4. How a reflector at the outside of the curve would aid traffic. Fig. 5. Dotted lines represent the new road built to eliminate the curve shown in the photograph

On main trunk routes, where the amount of traffic will justify the cost, a form of semaphore signal, similar to those used on railroads, would be very effective. The signal would have two arms operated by a mechanical tripping device placed across the road at the proper distance from either end of the curve. The tripping bar could be set in a concrete or metal channel, projecting above the roadbed just enough to make a satisfactory connection for an electric actuating mechanism when depressed by the weight of as light a vehicle as a bicycle. Such a signal would have to be used in connection with a dividing fence, and the tripping bars would also be divided, one for either roadway at both ends of the curve. Passage of the vehicle over the first bar would set the signal while the next bar would release it, just as in railroad work. The mechanism would have to be arranged so that if a second vehicle passed over the first operating bar before the vehicle immediately ahead of it had reached the end of the block, the latter could not release the signal. Such a device would be particularly useful where there was much mixed traffic, as it would safeguard against both head-on as well as rear-end collisions. It could be easily installed.

Finally, the suggestion has been made, of a form of inexpensive mirror, placed at the center of the curve, so that it would clearly show an approaching driver what he would encounter around the turn. In fact, a metal surface with sufficient reflecting power to transmit the headlight glow in daylight would be sufficient, as it would give the driver all he needs—a warning. With the almost universal use of electric lights it would be very easy for the driver thus to protect himself, were such a device installed, and if an inexpensive, satisfactory reflecting surface could be found for this purpose, no simpler remedy for the perils of the "blind turn" would be needed.

Father Time the Only Official Tester

By Alexander Winton

"WONDERFUL flexibility and perfect control at all speeds, absence of vibration, quiet running, greatest of hill climbers, and record-breaking speed."

One might easily suppose that these words sum up the merits of a 1916 model—a model that has reached new heights of excellence.

Yet I do not quote them from current automobile literature at all. Quite to the contrary, the quoted paragraph is more than 12 years old, and it tells a very truthful story of a car that, in spite of its super features, is to-day practically out of existence. I refer to the steamer.

The smooth, continuous power stream of the steamer, and its soft, velvety, flexible application have never been equalled in any other type of car. None has ever approached its superb demonstrations. It had the speed of a ghost, and hill-climbing ability that won contest after contest from gasoline cars with plenty of margin to spare. It was unquestionably the smoothest, swiftest thing on wheels.

Yet all these merits could not keep steam in the running. To-day the steamer is chiefly a memory. And that fact furnishes an important lesson.

Let me recall another instance of similar importance. In the earlier days it was a vital question among gasoline car makers whether the two-cycle motor would not put every other motor out of business. For the two-cycle produced power twice as often as the four-cycle (which is the only type now on the market). Where the usual type of gasoline motor had but four power strokes, the two-cycle had eight power strokes. And where the usual type had but six power strokes, the two-cycle had twelve. And inasmuch as power is what motors are built to produce, it was clear that the two-cycle had a 100 per cent advantage.

But where are two-cycles to-day? I do not know of a single manufacturer who is now producing them—in spite of their apparent 100 per cent advantage. And the reason is that the power advantage of the two-cycle was more than offset by numerous disadvantages that car owners sooner or later discovered—at their own expense and annoyance. I need not go into details. Father Time is the only official tester of

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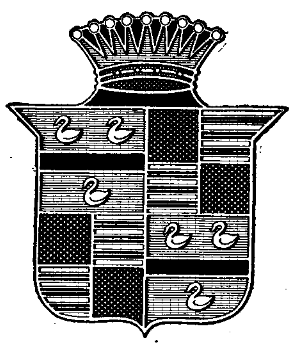
Cadillac
Standard of the World

There is a real risk in waiting too long to order your Cadillac



THE COAT OF ARMS OF ANTOINE DE LA MOTHE CADILLAC WHO FOUNDED IN 1701, UNDER COMMISSION FROM LOUIS XIV, THE COLONY ON THE SITE WHERE NOW STANDS THE CITY OF DETROIT.

THE TYPE 53 CADILLAC CAR IS DISTINGUISHED BY THIS COAT OF ARMS MOUNTED UPON ITS RADIATOR.

EACH year we have urged the public to guard against possible disappointment.

And each year, in spite of this warning, many have had to content themselves with some other car because they could not get a Cadillac.

In spite of steady increases in production, the annual Cadillac shortage is almost a mathematical certainty.

There is every indication that the current season will see that condition materially emphasized.

There is the steady, stable, year-in-and-year-out Cadillac demand to begin with—a very large number who automatically repeat.

And then, there is the large—and steadily growing larger—element of increase in new Cadillac ownership.

This has been strikingly marked ever since the advent of the Cadillac "Eight."

Thus far its sales have reached the impressive total of more than twenty-one thousand cars, amounting in value to more than forty-seven millions of dollars.

The vogue of the Cadillac Eight has never been perceptibly checked or challenged by any other car.

True, there may have been, from time to time, cars which—in advance—gave promise of comparable charm.

But their appearance served rather to stimulate admiration for the Cadillac and to emphasize its inimitable qualities.

Cadillac prestige is based on the universal esteem for the soundness of Cadillac policies and the soundness of Cadillac principles of construction—and the feeling that the new Cadillac exemplifies the most luxurious form of motoring yet evolved.

Cadillac prestige is steadily growing greater—the Cadillac demand will go right on expanding in volume and in enthusiasm.

Therefore, when we urge you to assure yourself of Cadillac delivery, it is that you may guard against disappointment.

If you can secure a Cadillac now, protect yourself, and take it.

If you cannot do better than to arrange for delivery in a month or two, we urge you to take that precaution.

Styles and Prices

Standard seven passenger car, five passenger Salon and Roadster, $2080. Three passenger Victoria, $2400. Four passenger Coupe, $2800. Five passenger Brougham, $2950. Seven passenger Limousine, $3450. Berlin, $3600. Prices include standard equipment, F. O. B. Detroit.

Cadillac Motor Car Co. Detroit, Mich.

Development of the American Motor Car That Has Led Up to the V-Type Multi-Cylinder Motor

By J. G. Vincent

To a person who has not made a close study of the many engineering problems involved in motor car design, the reason for the present decided trend toward V-type multi-cylinder motors is probably more or less obscure and he might well wonder whether future development of the motor car is going to call for a still greater number of cylinders.

Engineers are, of course, directly responsible for the development of the motor car, but practically every step taken by the engineers has been in response to some insistent demand by motor car users, but I doubt whether any large percentage of these users have any very definite idea regarding the underlying principles of engineering that have been followed in producing a more satisfactory vehicle, and with this thought in mind I would like to briefly discuss the development of the motor car in a more or less untechnical manner.

In the early days of the motor car, practically nothing was known about gasoline engineering, and the pioneer engineers were confronted by many difficult problems at every turn. It was necessary for them to grapple with unknown quantities in carburetion, ignition, valve arrangement, valve timing, lubrication, and various other details of construction which, while they look simple now, were nevertheless very difficult problems to solve at that time. The problem at that time was to make a motor that would run and give a reasonable degree of power and reliability.

The Elementary Motor

The simplest form of gasoline engine is, of course, the single cylinder, and it was with this type of engine that most of the experimental work was done in an endeavor to solve the above mentioned problems. As soon as these problems had been partially solved and the single cylinder engine had been made a reasonably reliable piece of mechanism, the demand from users for more range of ability, greater smoothness and less noise began to be heard, and although engineers have accomplished rapid and consistent improvement year by year, still the same demand has continued.

First Efforts to Improve

Fig. 2 shows the arrangements of the two cylinder opposed engine, which type was finally adopted for this number of cylinders after the public had given its verdict against two cylinder engines with the cylinders side by side. Two arrangements of the latter were tried out; in one the cranks were opposite and the working strokes both occurred in one revolution, leaving

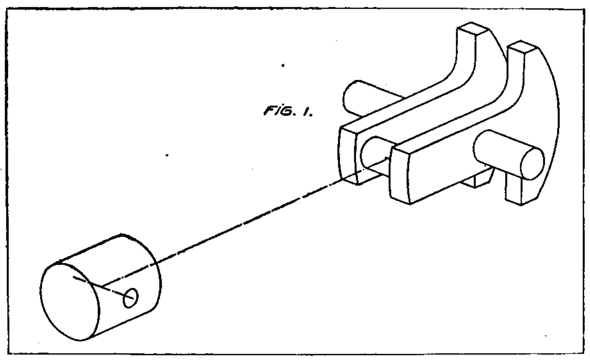


Diagram illustrating the relations of the piston and crank of a single cylinder motor

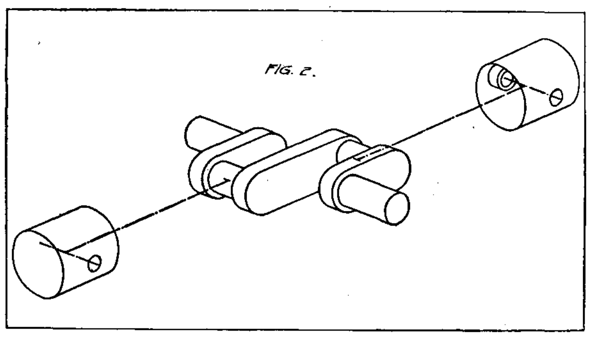


Diagram illustrating the relations of the pistons and cranks of a 2-cylinder opposed motor

The Driving Train Developed

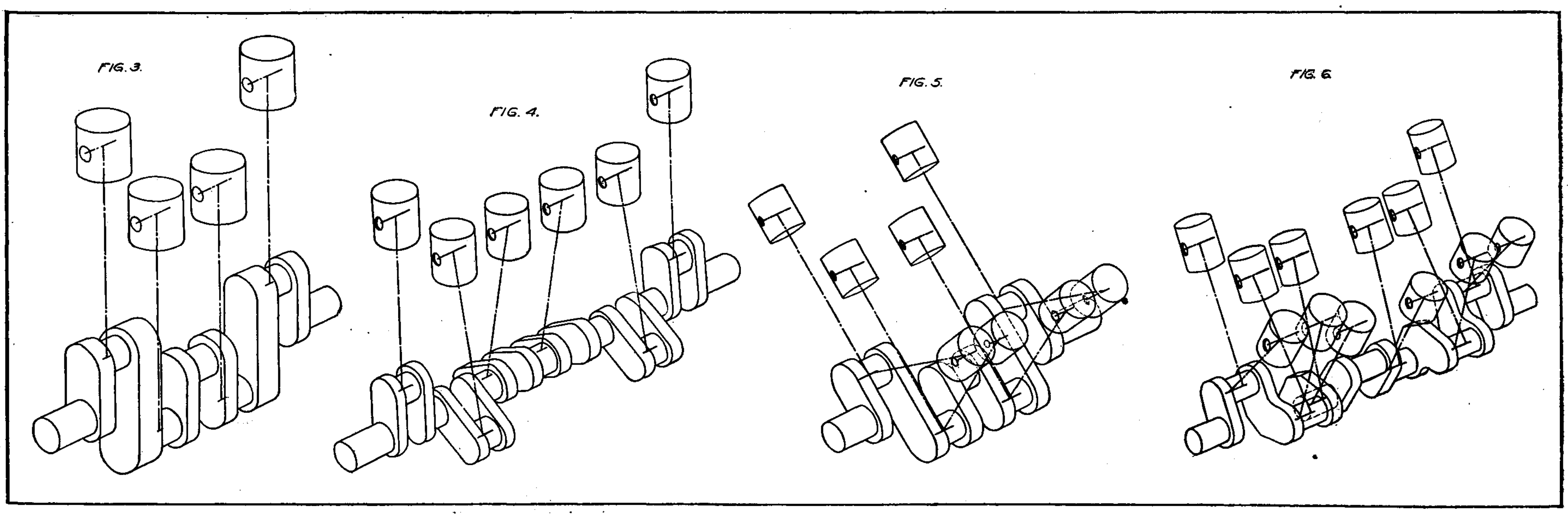
With the definite standardization of position for the crank shaft, the entire driving train of the car has been developed accordingly. This consists of a clutch immediately in the rear of the motor; then a change speed gear box, with a universally jointed shaft, to take care of rear spring action, either between it and the clutch or between it and the bevel gears; next, the bevel gears, worm bevels or worm and wheel which change the motion to rotation parallel to the axles. Differential gears, which take care of the difference in speed of the rear wheels when turning corners, are located within the driven bevel gear. In the early stage of development the driven bevel gear was on a jack shaft which drove the rear wheels by means of side chains. This simplified the engineering problems, inasmuch as the twisting strains were not combined with the bending strains in the rear axle resulting from the weight of the car. Engineering progress has, however, taught us to combine these functions satisfactorily and the side chains have now been generally discarded with the result of less noise, greater durability and less complication.

A small four cylinder engine, when carefully constructed, is without disastrous vibration and capable of rotative speeds as high as have ever been obtained. On these motors practically perfect synchronism of ignition was first generally obtained by the use of the magneto.

The First Efficient Motor

Comparative quietness was first possible with four cylinder motors and in consequence many details were first refined in this type of motor.

Although high speeds are obtainable with a small motor of this type and, as mentioned above, it has no rocking couple, still it has a secondary vertical vibration which gives an impression of roughness and is objectionable in motor carriages. This is caused by the movement of the combined center of gravity of the pistons, due to the angularity of the connecting rods. This principle is somewhat involved and I will not attempt to explain it here.



Diagrams illustrating the relations of the pistons and cranks of a 4-cylinder, a 6-cylinder, an 8-cylinder V-type and a 12-cylinder V-type motor, respectively

The principal moving parts of a single cylinder engine are indicated in Fig. 1. They were appropriated from stationary engine practice, in which variability of speed, high speed and saving of weight were no object. In consequence the reciprocating parts were very heavy and vibrated so badly that what would now be considered as comparatively low rotative speeds were impossible. Counterweights were used as a crude device for reducing the vibration, but reciprocating parts connected to a crank by a pitman or connecting rod cannot be balanced by revolving weights, and the result was unsatisfactory. On the other hand, the limit of low speed depended upon the size of the flywheel, which had to be made extremely large, because each cylinder makes only one working stroke in two complete revolutions, and the flywheel, therefore, had to drive the car three quarters of the time; consequently, the progress of the car at low speeds was very jerky because of the varying torque delivered. The public understood these simple things, and the most momentous question to be decided was whether the increase in range or ability, smoothness and reduction of noise, which every one knew could be accomplished by adding a second cylinder, would justify the complication.

the flywheel to drive the car for the next revolution. In the other arrangement the working strokes or impulses were equally spaced, but this required the cranks to be side by side and the vibration of the reciprocating parts was just as bad as in the single cylinder engine. In the two cylinder opposed engine, on the other hand, the impulses were equally spaced and direct vibration due to main reciprocating parts was entirely eliminated. The only vibration remaining was what is known as a rocking couple. This rocking couple was not very bad; in any case the general effect was so much more smooth than that obtainable with the single cylinder engine that the rocking couple was not seriously objected to. This is the only form of motor which contains a rocking couple that has at any time had the general approval of the American motoring public. The rocking couple, however, resulted in condemnation of the three cylinder vertical engine and many other engines which have never got beyond the experimental stage.

Fig. 3 shows the vertical four cylinder engine, which completely revolutionized the construction of practically the entire automobile. This is the standard motor to-day for commercial vehicles and small inexpensive motor carriages.

To sum up the situation as it stood after the four cylinder motor had been thoroughly developed, we find the following:

We had arrived at a standardized general arrangement of the different motor car units. We had arrived at very satisfactory carburetion, ignition, lubrication, valve action, cooling and various other details of motor construction. We had arrived at a reliable form of motor giving a fair degree of smoothness, providing such motor was not made too large or run at too high a speed.

More Ability Demanded

The public, however, was still calling for more range of ability, greater smoothness and less noise, and an attempt was made to give more range of ability, by making the four cylinders larger, but it was found that the increase in secondary vibration, due to the increased weight in the larger pistons and connecting rods was prohibitive, and it was also found that there

(Concluded on page 43)

The Heavens in January

The Coming Lunar and Solar Eclipses

By Prof. Henry Norris Russell, Ph. D.

THE principal event of this month, from the standpoint of the amateur star-gazer, is the eclipse of the moon, which happens on the morning of the 20th. The eclipse of the sun, which follows, on February 3rd, may also be described this month, for otherwise our account might not reach our more distant readers until after the eclipse was over.

The lunar eclipse is partial—only about one-seventh of the moon's diameter being immersed in the earth's shadow. The moon first reaches the penumbra, or outer fringe of the shadow, with which a part of the sun appears to be concealed behind the edge of the earth, at 1:05 A.M., Eastern Standard time, on the morning of January 20th. Though for an observer at the proper point on the moon's surface, at the southeastern edge of her visible disk, an eclipse of the sun would begin at that moment, the terrestrial observer will see nothing unusual for some time later. The reason for this is that at first only a small portion of the light of the sun is cut off, even from the advancing edge of the moon, and the diminution of the brightness of the lunar surface is correspondingly small. But as the moon gets deeper into the penumbra, and more and more of the sunlight is cut off, the darkening of her surface on the eastern and southeastern side becomes conspicuous. Finally, at 1:55 A.M. her southeastern limb reaches the edge of the umbra, or shadow proper, and gradually dips deeper and deeper into it.

The center of the earth's shadow is so far south of the moon that she hardly more than grazes it; but at the middle of the eclipse, which occurs at 3:40 A.M., the gap "bitten out" of her southern edge will be big enough to attract attention even at a casual glance. On account of the action of the earth's atmosphere in refracting sunlight into the shadow, this obscured region will not be wholly dark: but it will be so faint, compared with the directly sunlit portion of the disk, that it will be visible only with difficulty.

As the moon recedes from the center of the shadow, the gap bitten out of her edge slowly shrinks, and its last traces disappear at 4:24.

The darkening by the penumbra now on the southwestern side persists for some time longer, but it will become imperceptible to the eye considerably before the last traces of it, theoretically, disappear, at 5:14 A.M.

The solar eclipse of February 3rd is a much more important affair, being total along a path some 9,000 miles long, and from 50 to 100 miles in width. Beginning far out on the Pacific, this track runs over the ocean—here barren of islands—and the first land it reaches is the South American coast, about 200 miles south of Panama. Crossing the northern portions of Colombia and Venezuela in a northeasterly direction, it escapes into the Caribbean Sea, not far from Curaçao, and reaches the West Indian Islands, passing over Guadeloupe. From there onward its course lies again over the unbroken ocean, missing the westernmost of the Azores by only a few miles, and leaving the earth, as the sun sets, a couple of hundred miles south of Iceland.

The duration of totality is about two minutes and a half, both in South America and the West Indies, with the sun high in the sky, so that this eclipse is as favorable for observation as many which astronomers have traveled thousands of miles to see. On account of the present European situation, it is not probable that any party will cross the Atlantic to observe it; and little or nothing has been heard of any plans for expeditions from this country. Any one who is planning a trip to Caribbean waters this winter, however, though the veriest novice in astronomy, will do well to arrange his itinerary so as to be in the zone of totality on February 3rd. Even with unfavorable weather, the mid-day darkness is impressive; and, with clear skies, the spectacle is one of the most magnificent which nature affords.

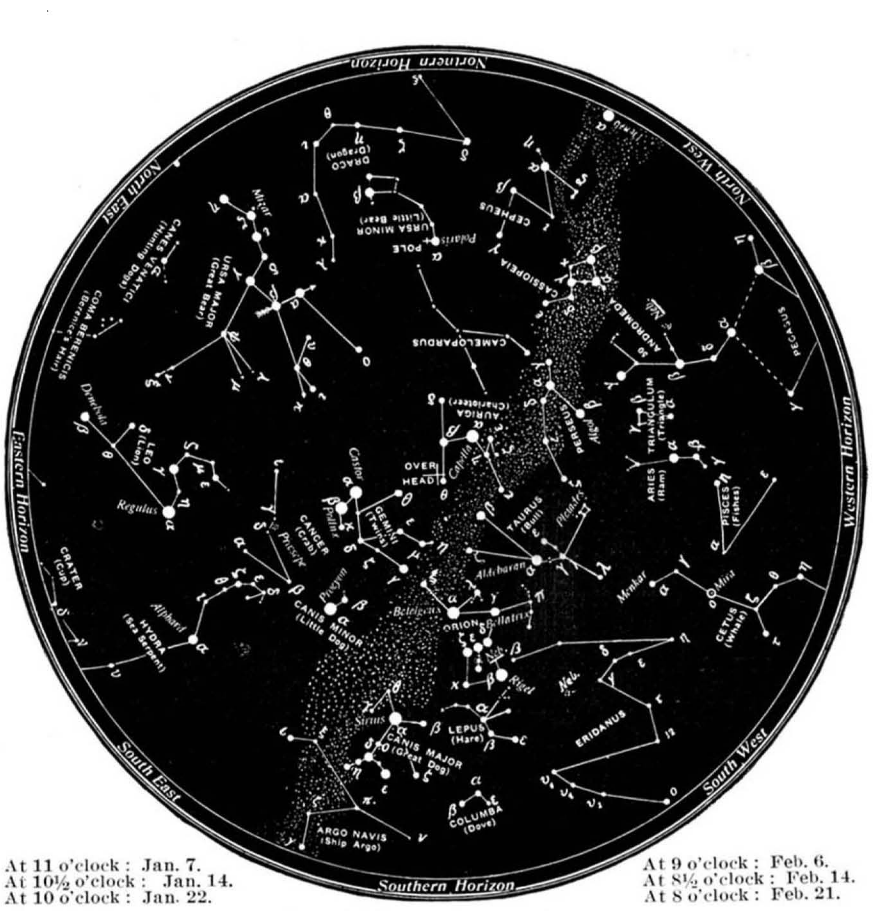
The strange colors which sky, land and sea take on, a few minutes before totality, in the light from the edge of the sun; the rapid advance of the shadow, like a vast thunderstorm on the western horizon, but moving infinitely faster; the sudden darkening of the whole landscape, as on a train entering a tunnel; the appearance of the planets and brighter stars, and of the mysterious corona surrounding the dark moon: then the return of sunlight and of normal conditions—these form a memorable experience, worth a long journey to undergo.

As the sun-spot activity is now rapidly increasing, the corona will, in all probability, be fairly bright, and irregular in form. Mercury, which is near inferior conjunction, will be about 5 deg. northeast of the sun, but by no means brilliant, being a narrow crescent. Venus and Jupiter, 30 deg. and 40 deg. east of the sun, should also be conspicuous. These are probably the only objects that will be visible at a glance. Though Fomalhaut, which will be about 30 southeast of the sun, and Altair, about as far northwest of him, will probably be easily enough seen if one knows where to look for them.

Observers in the United States will see only a partial eclipse.

For stations on the Atlantic seaboard, nearly half the sun's diameter will be obscured at the maximum phase. Farther north and west the eclipse will appear smaller, but an eclipse of some sort will be visible all over this country and Canada, except on the Pacific Coast, where the sun does not rise till the eclipse is over.

At Washington the eclipse begins at 10:11 A.M. by Eastern Standard time, and ends at 12:22 P.M. The times of beginning and ending, though varying from station to station, will be within half an hour of this all through the Eastern United States.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: January 29.

NIGHT SKY: JANUARY AND FEBRUARY

The Heavens

As one map shows, the finest constellations are now in the southern sky. Orion rides high on the meridian. Below him, and a little to the left, is Canis Major, the Dog which forever pursues the Hare, Lepus—a smaller and fainter constellation to the westward. Below Lepus is the small group of Columba, the Dove, which possesses one conspicuous star, while below Canis Major, and far to the eastward extends the huge length of the Ship Argo—the greatest constellation in the heavens—most of which lies too far south for us to see it well, if at all. To facilitate the naming of the very numerous stars in this large region, the constellation has been divided into three parts: *Puppis* (the stern), *Carina* (the keel) and *Vela* (the sails). Most of the stars visible to us belong to the first of these divisions, while the third is entirely below the horizon of New York.

A line drawn from Betelgeux in Orion through Sirius and continued as far again, points out the second-magnitude star Zeta Puppis. Below this, close to the horizon, and only visible on the clearest nights, in our latitude, is Gamma Velorum. These two stars are noteworthy as being the brightest in the heavens, which possess certain peculiarities of spectrum—known technically as "spectra of the fifth type"—which indicate that they are, in all probability, the very hottest of the stars.

To the west of these stars, and still farther south, lies Canopus—Alpha Carinae—the brightest star in the heavens, excepting Sirius alone. It is invisible in the latitude of New York, but may be seen, low on the horizon, from points south of Virginia, and is a conspicuous object in latitudes below 30 deg.

All three of these stars have exceedingly small proper-motions, and are undoubtedly very remote. Canopus, in particular, must be of enormous real brightness—probably at least 10,000 times as bright as the sun.

Above Orion, and nearly overhead, are Gemini, Taurus and Auriga—the last beyond the zenith, on the northerly side. To the east is the inconspicuous group of Cancer, and the prominent one of Leo, while the head and about half the body of Hydra fill the southeast. Mars, which is in Leo, and Saturn, in Gemini, further adorn this part of the sky, exceeding in brightness all the stars but Sirius.

In the northeast, the Great Bear is slowly coming up, with Draco and Ursa Minor following, below the pole. Cassiopeia and Cepheus are sinking in the northwest. Pegasus is setting a little north of west. Perseus and Andromeda are above, and Aries and Pisces to the left.

The great blank in the southwestern sky is occupied by Cetus and Eridanus—neither of them containing any bright stars visible in our latitude, but notable because the stars τ Ceti and ϵ Eridani are the nearest, so far as known, of any visible to the naked eye in this latitude, except Sirius. They are each at about ten light years distance, as is Procyon also.

The Planets

Mercury is an evening star all through January, and is best visible on and about the 20th, when he is at his greatest elongation. Since he is then near perihelion, he is unusually near the sun—in the sky as well as in space—his maximum distance being only 18° 40′; but he is north of the sun, and remains in sight for nearly an hour and three-quarters after the latter has set; so that he should be easily visible.

Venus is also an evening star, far to the east and north of the sun, and very bright. As she comes north, she remains longer and longer in sight each night, till at the end of the month she sets fully three hours later than the sun.

Mars is in Leo, approaching opposition, and rises about 8:40 P.M. on the 1st and 6:10 on the 31st. He is brighter than any star except Sirius, even at the beginning of the month, and doubles in brightness before its close, as his distance from us diminishes from 77,000,000 to 64,000,000 miles.

Jupiter is evening star in Pisces, setting at 10 P.M. in the middle of the month. He is brighter than anything else in the sky except Venus.

Saturn is in Gemini, and is in opposition on the 5th. He is brighter than Capella, and is visible all night long, affording one of the most beautiful of telescopic objects.

Uranus is in Capricornus; too near the sun to be seen easily, if at all, with a field glass. Neptune is in Cancer, and comes to opposition on the 22nd.

His position on the 1st is in 8h. 16m. 11s. R. A. + 19° 27′ 15″ north declination, and on February 2nd in 8h. 12m. 32s. + 19° 39′ 14″—which puts him about 3 deg. northwest of the well-known triple star Zeta Cancri.

The Moon is new at 11:45 P.M. on the 4th, in her first quarter at 10:38 P.M. on the 11th, full at 3:29 A.M. on the 20th, and in her last quarter at 7:35 P.M. on the 27th. She is nearest the earth on the 4th, and farthest away on the 17th. As she moves around the sky she passes near Mercury on the 5th, Venus and Uranus on the 7th, Jupiter on the 10th, Saturn on the 18th, Neptune on the 20th and Mars on the 22nd.

(*Concluded on page 46*)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

FOLDABLE GARMENT HANGER.—L. KALINA, 384 Alabama Ave., Brooklyn, New York, N. Y. This invention provides a hanger, more especially designed for supporting trousers and like garments, and arranged to fold into a comparatively small package for conveniently carrying it along in a pocket, valise, trunk or the like, and adapted to be readily extended and hung up for use on a hook or other suitable support.

ARCH SUPPORT.—EDITH P. CUSHMAN, 70 Broadway, Methuen, Mass. The support is so arranged that it will afford a firm yet yielding support for the distal ends of the third and fourth metatarsal bones, which lack the thickness and heaviness of the first and second bones, and are supported by the muscles and ligaments, to relieve the strain on such muscles and ligaments, and to permit the third and fourth toes to assume their natural straight position.

TOE SEPARATOR.—A. WEIL, care of Frederick Victor and Achellis, 18 W. 22nd St., New York, N. Y. Among the principal objects which this invention has on view are: to provide a convenient and efficient filler for the spaces between the toes, to prevent crowding together of the same, and to provide a spreader of the character mentioned adapted to be worn inside a shoe.

Electrical Devices

ELECTRIC SWITCH.—A. J. TIZLEY, 36 W. 15th St., New York, N. Y. The object here is to provide a switch particularly well adapted for use on candelabra in which a switch member is mounted to rotate on a central tube through which the wires lead, one of the wires being connected with the switch member for making and breaking the circuit.

SNAP SWITCH.—H. K. ELY, Baltimore, Md. This invention has reference to improvements in electric switches, more particularly to those switches of the so-called snap switch type, in which the pressure of a button causes a quick movement of the switch to connect or disconnect an electric circuit.

Of Interest to Farmers.

DISK JOINTER.—S. H. PHELPS, care of Blount Plow Works, Evansville, Ind. Means provide for sustaining the disk with increased rigidity and for adjusting the securing means in various directions and at various angles to compensate for any deformity in the plow beam, and to position the pointer in proper relation to the plow to insure a clean path for the plow by cutting the trash and at all times turning the trash toward the furrow far enough to be completely turned under by the plow.

BOX PRESS.—C. B. RUMSEY, Tampa, Fla. This invention relates to presses used for clamping and pressing down the covers of boxes while being nailed, and in its preferred form the invention is more particularly designed. The clamp elements are mounted for movement to and from the box support of the press, as usual, and have in addition, a secondary sliding movement in the direction of their axes.

Of General Interest

CAMERA.—A. F. KELLOGG, Portage, Wis. Mr. Kellogg's improvement consists of a shutter for excluding the light from the light carrying tube when the device is not in use and means for automatically opening the shutter when the device is in use, through the medium of a pencil or stylus the movements of which are duplicated by the light carrying tube.

OIL CUP.—L. C. DUTRO, Kingman, Ariz. This invention provides an oil cup which will deliver oil to a bearing only at the time and in the degree of need; provides means for adjusting the relationship between the need and the feed of the oil; and provides such oil cups which are simple in construction and positive in action.

HORSESHOE.—T. B. MASON, 209 South Warren St., Trenton, N. J. The invention provides means to facilitate the attachment of the shoe in position and to hold it firmly; and provides an overshoe and attaching means so formed and arranged that the overshoe will be positioned adjacent to the heel or heel calk of the ordinary shoe. The overshoe or auxiliary shoe is to be worn in connection with the regular shoe, particularly to prevent slipping on ice or snow in winter weather.

PRINTING CAMERA.—J. TRIMBACH, Rye, N. Y. The device is primarily adapted for use in a dim light, as is usual with gas-light papers, but the device contains the printing light or lamp, as well as a non-actinic lamp which may be used to position the negative and positive sheets, after which the white light is turned on and the printing begins.

SUPPORT FOR AWNING TOPS.—M. DOWLIN, Henniker, N. H. This improvement has reference to awning supports and has particular reference to appliances for hanging awnings to or removing the same from a building with the minimum amount of trouble and expense of time and without the necessity for using any tools whatever.

POISON BOTTLE.—M. J. DRISCOLL, Cristobal Canal Zone. The prime object of the invention is to provide a bottle that may be utilized for containing poison and so formed as to insure that its contants will be used only with deliberation, thereby preventing the accidental taking of the poisonous contents in mistake for non-poisonous substances.

COUPLING.—L. F. TABBERT, 505 Sparkman Ave., Tampa, Fla. This invention dispenses with the use of rings and the like for retaining the socket member in engagement with the ball member, said rings oftentimes becoming loose and rendering the joint defective. This is accomplished by the provision of a detachable section for the socket member having a pivotal connection with the same and adapted to effectively coöperate with the main portion of said member to retain the ball member in engagement therewith.

CURRENCY WRAPPER.—T. P. MARTIN, JR., care of Oklahoma Stock Yards National Bank, Oklahoma, Okla. This improvement provides a wrapper which, owing to the manner in which it is creased or scored, may be folded to form a wrapper for various sized packages, and which may be quickly and positively secured in position, so as to form a neat and compact package suitable for shipment through the mails.

THERMO HYGROSTAT.—E. M. JONES, 168 West Maumee St., Adrian, Mich. The invention relates to improvements in devices for automatically regulating the temperature and humidity of the air in sleeping-rooms, living-rooms, hospitals, etc. The device operates positively to regulate the hygrostatic conditions without the necessity of frequent adjustment.

EGG CASE.—A. J. COUGHENOUR, Fort Sheridan, Ill. This case is especially adapted for the transportation of eggs, incandescent light bulbs, bottle goods, and like fragile articles by parcels post, express or the like, wherein an outer casing is provided in which is arranged a carrier containing separate compartments for the individual articles. Cushioning mechanism provides against shock or jar of impact is not transmitted to an article.

CIGARETTE BOX.—D. STOLL, 57 Hope St., Brooklyn, N. Y. This invention comprehends the provision of a box designed to contain cigarettes or the like in spaced relation and to project the same, one above the other, in staggered relation or otherwise, such that the convenient withdrawal of the cigarettes independently, can be accomplished.

APPARATUS FOR FILLING RECEPTACLES WITH LIQUID.—O. WICKHAM, 21 Creffield Road, Ealing, London, England. This invention relates to apparatus for filling bottles, jars, and other receptacles with liquids. The essential feature is the use in such an apparatus of a siphon having a single outlet or long leg and a double inlet or short leg each of said short legs or short leg members communicating with a separate vessel or source of supply.

MANUFACTURE OF NATURAL ICE.—E. SEAVEY, 116 W. 102nd St., New York, N. Y. The object of this invention is the provision of certain new and useful improvements in the manufacture of natural ice during the cold season and whereby the water is quickly frozen into blocks or cakes by the use of an inexpensive apparatus.

LOOSE LEAF STATEMENT BOOK.—L. C. VAN VOORHIS, care of Walker Bros., Bankers, Salt Lake City, Utah. The inventor provides complete sheets of varying sizes so that when all are located in the same position with respect to the book they are automatically positioned with respect to one another so that the overlapping and indexing thereof are accomplished. In the present arrangement each division of the book, constituted by a series of leaves, is of the same thickness at one end as it is at the central point, and all of the statement sheets when detached are of uniform size.

SEWER CONSTRUCTION.—W. B. GRAY, 1327 South 22nd St., Louisville, Ky. This invention provides a construction composed of individual units in the form of blocks or sections, wherein the blocks are so constructed and arranged that each block interlocks with all of the adjacent blocks to resist stress in any direction, but to especially resist crushing stress.

WATER SUPPLY SYSTEM.—L. A. NITSCHE, 703 South Houston Ave., Tulsa, Okla. This invention relates more particularly to the construction of wells of a stable, permanent nature in shifting soils such as quicksand, the primary object being to provide for the formation of such wells without the necessity for the use of pile drivers and other expensive and cumbersome apparatus, such as is now necessary for this purpose.

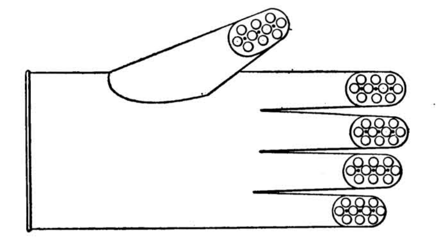
BARREL HEAD.—H. ELLIS, 14613 Westropp Ave., Cleveland, O. An object here is to provide a barrel head which is especially adapted for steel barrels or other receptacles containing liquids such as paint or varnish, having means for locking the head of the barrel and for unlocking it when it is desired to have easy access to the contents of the barrel.

FRUIT WASHER.—F. C. RANDALL, Benton Harbor, Mich. This improvement pertains to the washing of fruits, vegetables, etc., and the main object thereof is to provide a device of this class wherein the articles being washed are caused to revolve in a flow of water to present all portions of their surfaces to the flow or force of the water whereby they will be thoroughly cleansed of all foreign matter.

PENHOLDER.—A. BORSELLA, 519 W. 134th St., New York, N. Y. This inventor provides an arrangement which will guide the hand in properly holding the pen. He provides a penholder with a plurality of guiding lugs against which the thumb and certain fingers press when the holder is in use, the same causing the pen to be properly grasped and held at a proper angle.

DRINKING GLASS HOLDER FOR STERILIZERS.—P. S. GRAVES. Address James I. Ollivetti, Plattsburg, N. Y. The invention provides a device whereby drinking glasses and the like may be easily and quickly placed in or removed from the holder, and by means of the latter easily and quickly placed in or removed from the sterilizing tank for the purpose of sterilizing glasses, the holders preferably being of metal so that they act as conductors which are in contact with the glasses so that the heat is readily conducted away from the latter by the holder and its handle to thereby prevent cracking of the glasses by the intense heat.

MASSAGE GLOVE.—W. R. NORTON, Hightstown, N. J. Mr. Norton's invention relates to massage gloves having a receptacle or receptacles adapted to accommodate a substance or substances employed during the massage with the glove. He provides a simple and inexpensive glove, having one or more receptacles associated therewith, which receptacles are elastic



MASSAGE GLOVE.

and which are easily filled with a desirable substance and from which the substance can be easily fed from the feed easily controlled by the party wearing the glove.

Hardware and Tools

TOOL FOR INSERTING SPRINGS IN EYEGLASSES.—A. R. FEISTEL, Weston, W. Va. This tool is for use for placing the spring wire employed in the springs of eye glasses of the "Shur-on" type, wherein a holder is provided for supporting a reel of the wire, and having means for feeding the wire, and wherein a cutter is mounted on the holder for cutting the wire, arranged to be normally held in inoperative position, and to be moved into position and operated to cut by the same moving means, to permit the insertion of the spring with one hand, leaving the other free to hold the glasses.

DOOR PIVOT.—J. A. CROSS, Westwood, N. J. This improvement refers to pivots for doors or similar closures, which pivot is adapted to raise the door or closure bodily when the same is moved to the closing position, whereby the door or closure is jammed into the frame and thereby locked in the closed position.

Heating and Lighting.

AIR VENT VALVE.—W. SHURTLEFF, address Moline Vacuum Vapor Heating Co., Moline, Ill. This valve is especially adapted for use with two-pipe heating plants, and with steam heating systems, wherein the valve is so arranged that it will permit the discharge of air during heating of the system, while when steam enters the valve the increase in heat will close the valve, to prevent the escape of steam, and to prevent at all times the discharge of steam from the system, and return the condensed steam to the boiler.

OIL GAS BURNER.—R. I. BLUMBERG, 37 Liberty St., New York, N. Y. The invention provides a device for use in all makes or styles of stoves, heaters, ranges, furnaces and boiler heaters, means being provided to convert the present heating appliances, where coal, coke, wood or the like are used, into fuel oil burners with a corresponding economy of fuel cost and increase of convenience and efficiency.

COMPRESSED GAS HEATER.—J. J. YAGER, 517 W. Loucks St., Sheridan, Wyo. This invention relates to an electric heater for use in connection with carbonating apparatus for preventing freezing at the regulator or expansion valve, which is a well known difficulty in apparatus for bottling soft drinks and charging soda water fountains with gas under compression.

GAS HEATER.—J. T. REZNOR, Mercer, Pa. This improvement refers particularly to gas heaters of the reflector type, and an object is the provision of means whereby proper combustion of the gas will be maintained and interference with the flame of air currents and eddies will be prevented.

SHADE HOLDER.—M. F. FINKELSTEIN, 84 Walker St., New York, N. Y. The invention has reference more particularly to a device which comprises a body adapted to be associated with the lighting fixture, and having a shade-receiving ring, a band adapted to encompass a part of the shade and to hold the same relatively to the ring, and means for tightening the band and for securing it, the ring having a part engaging the band and serving to guide and hold the same when it is being operated.

HANGER FOR ELECTRIC LAMPS.—HATTIE L. NEWELL. Address E. S. Higgins, 110 Washington St., Paris, Tenn. The invention is an improvement in that type of hangers for electric lamps which may be raised and lowered to suit convenience. It is distinguished by adaptation for suspension from a tack, nail, or screw, so that it may be conveniently transferred from one portion of a room to another.

STOVE DOOR KNOB.—C. F. HELFLINGER, Hobart, Wash. This improvement refers to a knob adapted to be applied to standard makes of stove doors. The prime object is to provide a knob so formed and arranged as to be effectively insulated from the metal parts of the stove and door to prevent the undue heating of the knob.

ELECTRIC HEATING AND COOKING STOVE.—L. P. HAYS, Idaho Springs, Col. The invention relates to an electric stove for room heating and cooking purposes, and it embodies an electric coil arranged within a casing through which air circulates and is effectively heated by the coil when the latter is traversed by current.

Household Utilities

SAD IRON.—S. GOLDSTEIN, 208 E. 5th St., New York, N. Y. This invention relates to sad irons heated by the combustion of gas within the iron. The object is to provide a simple, strong, efficient, and inexpensive iron, in which the flame is generated by a burner located within the iron, said flame playing against a perforated false bottom of the iron.

SEDIMENT COLLECTING DEVICE AND WATER INLET VALVE FOR KITCHEN BOILERS.—J. F. POLMANN, care of Polmann & Sons, East Rutherford, N. J. This invention relates to a valve device for use in connection with kitchen and other boilers for preventing the circulation of sediment through the boiler system and for enabling the collected sediment to be drawn off from time to time in a simple, convenient and efficacious manner.

FLUSHING VALVE.—C. S. C. ROCK, 204 W. 140th St., New York, N. Y. This invention relates particularly to flushing valves for toilets or the like. An object is to provide a main valve construction embodying two opositively disposed valve seats and an internal movable chamber whose walls are adapted to coöperate with said valve seats in alternation.

Machines and Mechanical Devices

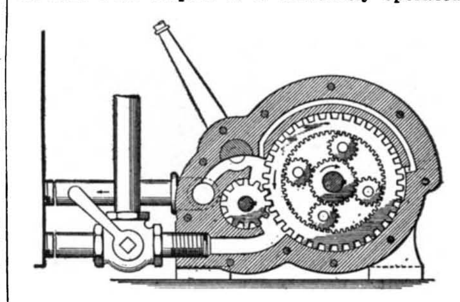
WELL CASING PERFORATOR.—A. C. GRAHAM, 311 Cherokee Ave., Bartlesville, Okla. The prime object of the present invention is the provision of a perforator employing a plurality of wheels, and the provision for actuating the same without the employment of individual elevators for individual wheels, whereby the construction is greatly simplified and a more direct and positive perforating movement is imparted to the wheels.

APPARATUS FOR DRYING SAWDUST.—H. C. JOHNSON, Fort Bragg, Cal. The purpose here is to provide a device having mechanism for taking the waste sawdust of a saw mill, thoroughly drying the dust, removing splinters and other foreign bodies, and delivering it finally in condition for packing fruit and like products.

SHEET METAL TUBE PLANISHING MACHINE.—B. F. WINTERHOFF, Elkhart, Ind. This inventor provides a machine for rolling or leveling seams in sheet metal and more particularly for the rolling or leveling of the seams formed in tubes, from which musical instruments are constructed; provides means for manually controlling the pressure applied in the operation; and provides rollers and beds of varied shape for peening or leveling the joints formed by welding.

PRINTING PRESS.—J. E. RATHBUN, 8 Dutch St., New York, N. Y. This improvement provides means for operating the inking carriage of a "job" printing press to augment the dwell period in the operation of said carriage; provides means for suspending the operation of said carriage and to avoid wear of the carriage-operating connecting member; and increases the output of the press by increasing the speed of operation thereof.

TRANSMISSION MECHANISM.—E. A. MINOR, Box 52, Wilder, Vt. This invention has for its main object the provision of means whereby the speed of transmission may be made variable in desired degrees of the driven element with respect to a constantly operated



TRANSMISSION MECHANISM.

driving element. This is accomplished through what is technically known as a planetary gear and a pump gear, operating as a variable brake therefor. The invention provides external means for varying the effect of said pump gear.

MACHINE FOR MAKING BASKET BLANKS.—O. E. ST. JOHN AND F. NORTON. Address the former, Box 646, Canisteo, N. Y. The invention relates more particularly to a machine for weaving to form blanks from which the usual splint baskets are thereafter made up. The primary object is to provide a machine capable of a continuous automatic operation from the time when the splints are fed into the machine, until the woven blank is discharged therefrom.

TRANSMISSION GEAR INDICATOR.—F. W. WOODHULL, 101 South 5th St., Alhambra, Cal. The invention has particular reference to the shifting of the gearing for the purpose of

(Concluded on page 38)

A Car for Every Prospective Purchaser

American Gasoline Pleasure Car Manufacturers with Prices of Their Leading Models for 1916

Compiled by C. Edward Palmer

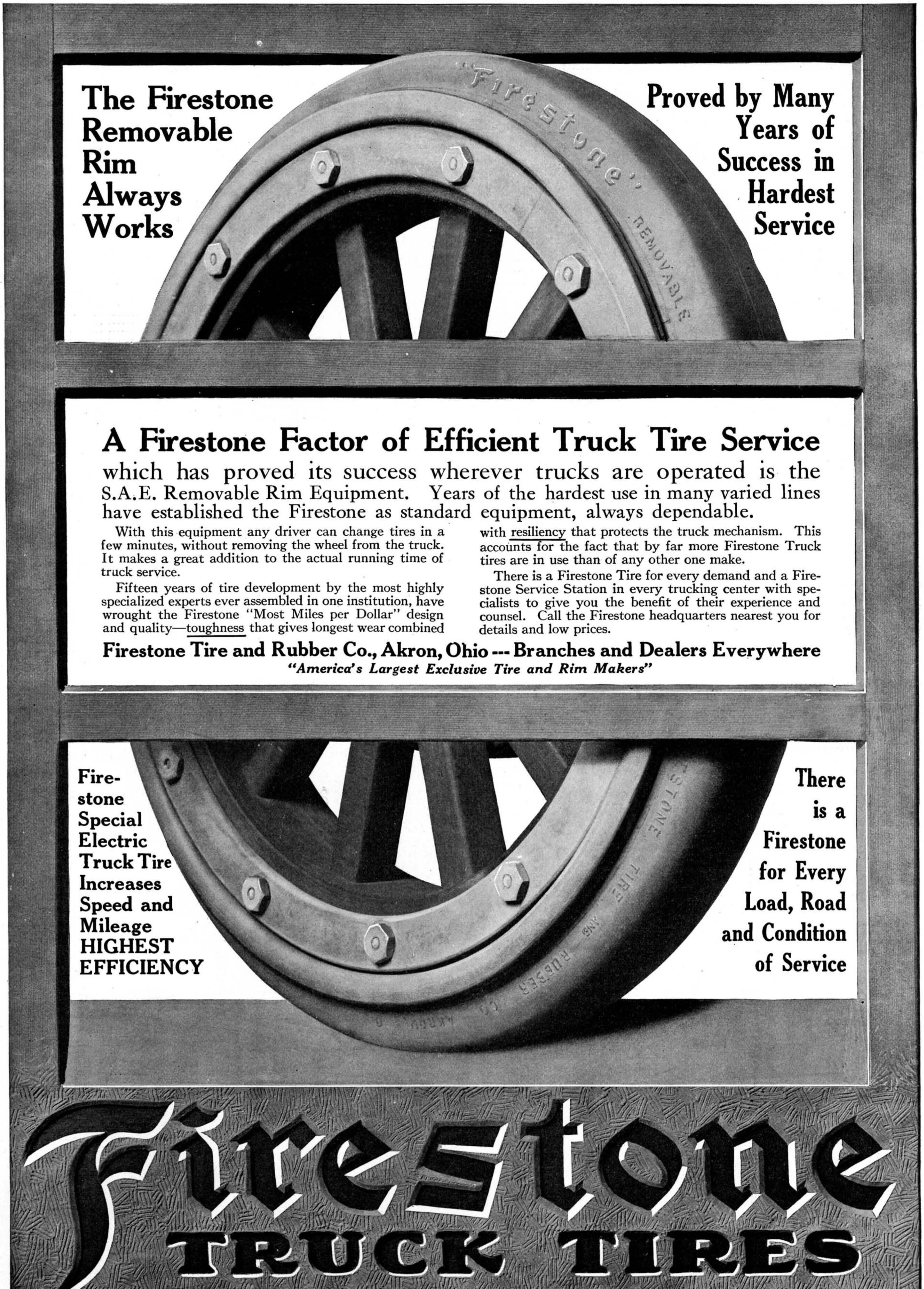
ONLY three or four years ago it was the custom to refer to the automobile business as the infant industry of the country. But it has made such rapid strides, not only in the number of cars made and the number of factories, but in the evolution from the first crude engine to the present-day, highly efficient machine, that this youngster of commerce has become one of the giant industries of the country. The cars manufactured have become so numerous and the prices so diversified that a man who contemplates the purchase of a car has only to name his own price and then proceed to pick from a dozen or so within that figure.

The following table has been compiled with the purpose in view of assisting the visitor at the Automobile Show to see at a glance what cars are listed in the neighborhood of the price he has in mind. The figures were compiled from data supplied by the manufacturers themselves, and any which do not appear have been omitted only because the information was not supplied or not received in time to be included in the list.

The table is self-explanatory, except for the abbreviations used. In each of the six price columns the first figure indicates the number of cylinders, and the second figure the horse-power rating. The letters refer to the type of body of the car at the price given. That is, r means roadster; t, touring car; c, coupe; l, limousine; s, sedan; b, berline.

Name of Car	Name and Address of Manufacturer	Under $600	$600 to $1,000	$1,001 to $2,000	$2,001 to $3,000	$3,001 to $4,000	Over $4,000
Allen	Allen Motor Co., Fostoria, Ohio		4, 37, r, t, $795				
Alter	Alter Motor Car Co., Plymouth, Mich		4, 30, t, $685				
Apperson	Apperson Bros. Auto Co., Kokomo, Ind			6, 48, t, $1,550 8, 58, t, $1,850			
Argo	Argo Motor Co., Inc., Jackson, Mich	4, 22, r, $445 4, 22, t, $495					
Auburn	Auburn Automobile Co., Auburn, Ind		4, 38, r, t, $985	6, 38, r, t, $1,050 6, 40, r, t, $1,375	6, 40, l, $2,700		
Austin	Austin Automobile Co., Grand Rapids, Mich				6, 36-66, r, t, $2,800	6,48-66, r, t, $3,600 6, 36-66, l, $4,000	6, 48-66, l, $4,800
Halladay	Barley Mfg. Co., Streator, Ill			6, 40, r, t, $1,385	6, 50, r, t, l, $2,285,		
Glide	Bartholomew Co., Peoria, Ill			6, 40, t, $1,095			
Bell	Bell Motor Car Co., York, Pa		4, 30, r, t, $775				
Biddle	Biddle Motor Car Co., Philadelphia, Pa			4, 48, r, $1,775 4, 48, t, $1,800			
Briscoe	Briscoe Motor Co., New York City		4, 38, r, t, $750 8, 38, r, t, $950				
Lambert	Buckeye Mfg. Co., Anderson, Ind		4, 30, r, t, $685 6, 35, r, t, $985				
Buick	Buick Motor Co., Flint, Mich		6, 25, r, $950 6, 25, t, $985	6, 25, c, $1,350 6, 34, t, $1,485			
Burrows	Burrows Cycle Car Co., Ripley, N. Y.	2, 13, t, $375					
Cadillac	Cadillac Motor Car Co., Detroit, Mich				8, 60, r, t, s, $2,080 8, 60, c, $2,800	8, 60, l, $3,450 8, 60, b, $3,600	
Brownie	Carter Mfg. Co., Hannibal, Mo		4, 38, t, $735				
Case	J. I. Case T. M. Co., Racine, Wis			4, 40, t, $1,090			
Chadwick	Chadwick Engineering Works, Pottstown, Pa						6, 60, r, t, $5,500 6, 60, l, $6,500
Chalmers	Chalmers Motor Co., Detroit, Mich			6, 25, t, $1,050 6, 23, r, t, l, $1,850			
Chandler	Chandler Motor Car Co., Cleveland, O			6, 35, r, t, $1,295 6, 35, c, $1,950	6, 35, s, $2,250 6, 35, l, $2,450		
Chevrolet	Chevrolet Motor Co. of N. Y., New York City	4, 20, t, $550	4, 22, r, $720 4, 22, r, t, $750				
Cole	Cole Motor Car Co., Indianapolis, Ind			8, 70, r, t, $1,785	8, 70, r, c, $2,185 8, 70, t, s, $2.285	8, 70, l, $3,250	
L. W. C.	Columbia Taxicab Co., St. Louis, Mo					4, 27, l, $3,500	
Partin-Palmer	Commonwealth Motors Co., Chicago, Ill	4, 28, r, $495	4, 34, t, $675 4, 38, t, $975	8, 45, t, $1,195			
Abbott-Detroit	Consolidated Car Co., Detroit, Mich			6,44, r, t, s, $1,195 8, 80, r, t, $1,950			
Crawford	Crawford Automobile Co., Hagerstown, Md			6, 40, r, t, s, $1,650			
Crow-Elkhart	Crow Motor Car Co., Elkhart, Ind		4, 30, r, t, $725 4, 30, s, $895				
Monitor	Cummins-Monitor Co., Columbus, O		4, 30, r, t, $795 6, 40, r, t, $895				
Cunningham	Cunningham, James, Son & Co., Rochester, N. Y.					4, 36, r, $3,500 4, 36, t, $3,750	4, 36, l, $5,000
Daniels	Daniels Motor Car Co., Reading, Pa				8, 34, t, $2,350		
Vixen	Davis Mfg. Co., Milwaukee, Wis	4, 14, r, $395					
Davis	Davis, Geo. W. Motor Car Co., Richmond, Ind			4, 23, t, $1,165 6, 29, t, $1,495			
Dispatch	Dispatch Motor Car Co., Minneapolis, Minn		4, 30, r, $935	4, 30, t, $1,010 4, 30, c, $1,200			
Dodge Brothers	Dodge Brothers, Detroit, Mich		4, 35, r, t, $785 4, 35, r, t, $950				
Dodge	Dodge Motor Car Co., Detroit, Mich	4, 25, r, $490	4, 25, t, $640				
Dorris	Dorris Motor Car Co., St. Louis, Mo				6, 38, r, t, $2,475	6, 38, c, $3,250 6, 38, l, $3,675	
Dort	Dort Motor Car Co., Flint, Mich		4, 30, t, $650				
Sharon	Driggs-Seabury Ordnance Co., Sharon, Pa	4, 10, r, $395					
E. I. M.	Eastern Indiana Motor Car Co., Richmond, Ind	4, 18, r, $450					
Empire	Empire Automobile Co., Indianapolis, Ind		4, 24, r, t, $935	6, 22, t, $1,095			
Enger	Enger Motor Car Co., Cincinnati, O			12, 33, r, t, $1,095			
Fiat	F. I. A. T., Poughkeepsie, N. Y						4, 55, r, t, $4,850 6, 50, r, t, $5,350
Farmack	Farmack Motor Car Corp., Chicago, Ill		4, 35, r, t, $855	4, 35, c, $1,155			
Ford	Ford Motor Co., Detroit, Mich	4, 20, r, $390 4, 20, t, $440	4, 20, c, $640 4, 20, s, $740				
Franklin	Franklin, H. H., Mfg. Co., Syracuse, N. Y			6, 30, r, $1,900 6, 30, t, $1,950	6, 30, s, $2,850	6, 30, b, $3,100	
Grant	Grant Motor Co., Findlay, O		6, 22, t, $795				
Great Western	Great Western Automobile Co., Peru, Ind			6, 35, r, t, $1,185			
Haynes	Haynes Automobile Co., Kokomo, Ind			6, 55, t, $1,385 6, 55, t, $1,495			
H-C	H-C Motor Car Co., Detroit, Mich		4, 28, r, $600 4, 28, t, $650				
Herff-Brooks	Herff-Brooks Corp., Indianapolis, Ind		4, 35, r, t, $885	6, 50, r, t, $1 095			
Holly	Holly Motor Co., Mt. Holly, N. J			6, 60, r, t, $2,000			
Hudson	Hudson Motor Car Co., Detroit, Mich			6, 29, t, $1,350			
Hupmobile	Hupp Motor Car Co., Detroit, Mich			4, 23, r, t, $1,085 4. 23, c, $1,165	4, 23, l, $2,365		
Inter-State	Inter-State Motor Co., Muncie, Ind		4, 35, r, t, $850 4, 35 s, $1,000				
Jackson	Jackson Automobile Co., Jackson, Mich		4, 38, r, t, $985	4, 40, r, t, $1,135 8, 70, t, $1,685			
Jeffery	Thos. B. J. Jeffery Co., Kenosha, Wis		4, 40, r, t, $1,000	4, 40, t, $1,035 6, 50, t, $1,350			
King	King Motor Car Co., Detroit, Mich			8, 45, r, t, l, $1,150 8, 55, r, t, l, $1,350			
Kissel Kar	Kissel Motor Car Co., Hartford, Wis			4, 32, c, $1,450 6, 42, r, t, $1,485	6, 42, s, $2,150 6, 42, l, $2,750		
Kline Kar	Kline Motor Car Co., Richmond, Va			6, 36, r, t, $1,095			
Lewis-6	L. P. C. Motor Co., Racine, Wis			6, 38, r, t, $1,390			
Lenox	Lenox Motor Car Co., Boston, Mass			6, 50, t, $1,985 4, 40, r, t, $2,000	6, 50, r, $2,250 6, 60, t, $2,365		
Hollier	Lewis Spring & Axle Co., Jackson, Mich		8, 40, r, t, $985				
Lexington	Lexington-Howard Co., Connersville, Ind			4, 40, r, t, $1,375 6, 50, r, t, $1,875	6, 60, r, t, $2,675		
Locomobile	Locomobile Co. of America, Bridgeport, Conn						6, 43, t, $4,400 6, 49, t, $5,100
H. A. L.	H. A. Lozier Co., Detroit, Mich			12, 40, r, t, l, c, $1,750			
McFarlan Six	McFarlan Motor Co., Connersville, Ind				6, 90, r, t, $2,990		6, 90, l, $4,200
Madison	Madison Motors Co., Anderson, Ind		6, 40, r, $985	6, 40, t, $1,085			
Majestic	Majestic Motor Car Co., Chicago, Ill			4, 30, r, t, $1,075 6, 45, r, t, $1,530			
Maxwell	Maxwell Motor Co., Inc., Detroit, Mich		4, 25, r, $635 4, 25, t, $6 5 4, 25, c, $865				
Mercer	Mercer Automobile Co., Trenton, N. J				4, 22, r, $2,750 4, 22, t, $3,000		
Metz	Metz Company, Waltham, Mass		4, 25, r, t, $600				
Mitchell	Mitchell-Lewis Motor Co., Racine, Wis			6, 48, r, t, $1,250 8, 50, r, t, $1,450			
Moline	Moline Automobile Co., East Moline, Ill			4, 40, r, t, $1,375	4, 50, r, t, $2,500	4, 50, l, $3,500	
Moon	Moon Motor Car Co., St. Louis, Mo			6, 30, r, t, $1,195 6, 40, r, t, $1,475			
M. P. M.	Mt. Pleasant Motor Co., Mt. Pleasant, Mich			8, 44, t, $1,095			
Marion	Mutual Motors Co., Jackson, Mich			6, 40, t, $1,090			
National	National Motor Vehicle Co., Indianapolis, Ind			6, 51, r, t, $1,690 12, 70, r, t, $1,990	6, 61, r, t, $2,375		
New Era	New Era Engineering Co., Joliet, Ill		4, 24, t, $660				
Marmon	Nordyke & Marmon Co., Indianapolis, Ind				6, 34, r, t, $2,700 6, 34, t, $2,750		
Oakland	Oakland Motor Car Co., Pontiac, Mich		6, 32, r, t, $795	4, 38, r, t, $1,050 8, 71, t, $1,585			
Oldsmobile	Olds Motor Works, Lansing, Mich			4, 30, r, t, $1,095 8, 40, r, t, $1,295			
O-S	Owen-Schoeneck Co., Chicago, Ill				6, 60, r, t, $2,350 6, 60, r, $2,500	6, 60, t, $3,100	
Packard	Packard Motor Car Co., Detroit, Mich				12, 90, r, t, $2,750	12, 90, t, l, $3,150	
Paige	Paige-Detroit Motor Car Co., Detroit, Mich			6, 36, r, t, $1,095 6, 46, r, t, $1,295	6, 46, l, $2,250		
Pathfinder	Pathfinder Co., Indianapolis, Ind			6, 29, r, t, $1,695 12, 43, r, t, $1,975			

(Continued on page 34)


The Firestone Removable Rim Always Works
Proved by Many Years of Success in Hardest Service
"Firestone"
REMOVABLE
A Firestone Factor of Efficient Truck Tire Service
which has proved its success wherever trucks are operated is the S.A.E. Removable Rim Equipment. Years of the hardest use in many varied lines have established the Firestone as standard equipment, always dependable.
With this equipment any driver can change tires in a few minutes, without removing the wheel from the truck. It makes a great addition to the actual running time of truck service.
Fifteen years of tire development by the most highly specialized experts ever assembled in one institution, have wrought the Firestone "Most Miles per Dollar" design and quality—toughness that gives longest wear combined with resiliency that protects the truck mechanism. This accounts for the fact that by far more Firestone Truck tires are in use than of any other one make.
There is a Firestone Tire for every demand and a Firestone Service Station in every trucking center with specialists to give you the benefit of their experience and counsel. Call the Firestone headquarters nearest you for details and low prices.
Firestone Tire and Rubber Co., Akron, Ohio --- Branches and Dealers Everywhere
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Firestone Special Electric Truck Tire Increases Speed and Mileage HIGHEST EFFICIENCY
There is a Firestone for Every Load, Road and Condition of Service
Firestone
TRUCK TIRES

American Gasoline Pleasure Car Manufacturers with Prices of Their Leading Models for 1916—Concluded

Name of Car	Name and Address of Manufacturer	Under $600	$600 to $1,000	$1,001 to $2,000	$2,001 to $3,000	$3,001 to $4,000	Over $4,000
Paterson	W. A. Paterson Co., Flint, Mich.		6, 42, *t*, $985	6, 42, *t*, $1,060			
Peerless	Peerless Motor Car Co., Cleveland, O.			8, 80, *r*, *t*, $1,890		8, 80, *l*, $3,060	
Pierce-Arrow	Pierce-Arrow Motor Car Co., Buffalo, N. Y						6, 38, *r*, *t*, *l*, $4,300 6, 48, *r*, *t*, *l*, $5,000 6, 66, *r*, *t*, *l*, $6,000
Pilgrim	Pilgrim Motor Car Co., Detroit, Mich.		4, 23, *r*, *t*, $685 4, 23, *c*, $835				
Pilot	Pilot Motor Car Co., Richmond, Ind.			6, 45, *r*, *t*, $1,100 6, 55, *t*, $1,735	6, 75, *t*, $2,485		
Harvard	Pioneer Motor Car Co., Troy, N. Y		4, 24, *r*, $750 4, 24, *c*, $850				
F. R. P.	Finley Robertson Porter Co., Port Jefferson, N. Y.						4, 45, *, $5,000
Premier	Premier Motor Mfg. Co., Indianapolis, Ind				6, 38, *r*, *t*, $2,300		
Pullman	Pullman Motor Car Co., York, Pa		4, 22, *r*, *t*, $740 4, 22, *c*, $990				
R-C-H	R-C-H Corporation, Detroit, Mich		4, 25, *t*, $850				
Regal	Regal Motor Car Co., Detroit, Mich		4, 27, *r*, *t*, $650 4, 39, *r*, *t*, $985	8, 44, *r*, *t*, $1,200			
Reo	Reo Motor Car Co., Lansing, Mich		4, 35, *r*, *t*, $875	6, 45, *r*, *t*, $1,250			
Republic	Republic Motor Car Co., Hamilton, O				6, 43, *r*, *t*, $2,950		
Ross Eight	Ross Automobile Co., Detroit, Mich			8, 34, *t* $1,350			
Saxon	Saxon Motor Co., Detroit, Mich	4, 18, *r*, $395	6, 34, *r*, *t*, $785				
Simplex	Simplex Automobile Co., New York City						6, 100, *, $5,000
Singer	Singer Motor Co., Inc., New York City					6, 50, *r*, *t*, $3,200	6, 50, *l*, $4,200
Spaulding	Spaulding Mfg, Co., Grinnell, Iowa		4, 30, *t*, $750	4, 50, *r*, *t*, $1,250 4, 50, *t*, $1,300			
Sphinx	Sphinx Motor Car Co., York, Pa		4, 28, *t*, $640				
Standard	Standard Steel Car Co., Pittsburgh, Pa			8, 70, *r*, *t*, $1,735	6, 70, *t*, $2,100	6, 70, *l*, $3,600	
Stearns-Knight	F. B. Stearns Co., Cleveland, O			4, 23, *r*, *t*, $1,395 4, 23, *c*, $1,900	8, 34, *r*, *t*, $2,050	8, 34, *l*, $3,350	
Steco	Stephens Company, Chicago, Ill	2, 10, *r*, $450					
Stewart	Stewart Motor Corp., Buffalo, N. Y			6, 44, *r*, *t*, $1,950			
Studebaker	Studebaker Corp., Detroit, Mich		4, 40, *t*, $885 6, 50, *r*, $1,000	6, 50, *t*, $1,050	6, 50, *l*, $2,250		
Stutz	Stutz Motor Car Co., Indianapolis, Ind				4, 36, *r*, $2,100 4, 36, *t*, $2,300		
Thomas	E. R. Thomas Motor Car Co., Buffalo, N. Y					6, 43, *r*, *t*, *l*, *c*, *s*, ‡	
Trumbull	Trumbull Motor Car Co., Bridgeport, Conn	4, 14, *r*, $395	4, 14, *c*, $600				
Velie	Velie Motor Vehicle Co., Moline, Ill			6, 40, *t*, $1,065 6, 45, *t*, $1,400			
Richmond	Wayne Motor Works, Richmond, Ind		4, 30, *r*, *t*, $885	6, 50, *r*, *t*, $1,095			
Westcott	Westcott Motor Car Co., Richmond, Ind			6, 41, *t*, *c*, $1,295 6, 51, *r*, *t*, $1,595			
White	White Company, Cleveland, O				4, 30, *r*, $2,650 4, 30 *t*, $2,700	4, 45, *t*, $3,800 4, 30, *s*, $4,000	4, 45, *l*, $5,200 4, 45, *t*, $5,300
Overland	Willys-Overland Co., Toledo, O	4, 25, *r*, $595	4, 35, *t*, $750 4, 35, *l*, $950	6, 45, *t*, $1,145 4, 40, *l*, $1,750			
Winton	Winton Company, Cleveland, O				6, 34, *r*, *t*, $2,285	6, 48, *r*, *t*, $3,500	6, 48, *l*, *s*, $4,750
Zimmerman	Zimmerman Mfg. Co., Auburn, Ind			6, 50, *t*, $1,495			

* Price for chassis only. Bodies extra.
‡ Prices on application.

Prices of Leading Electric Pleasure Cars for 1916

Name of Car	Name and Address of Manufacturer	Passenger Capacity, Body Type and Price		
		Under $2,500	$2,500 to $3,000	Over $3,000
Argo, Borland, and Broc	American Electric Car Co., Saginaw, Mich			
Detroit	Anderson Electric Car Co., Detroit, Mich	3 p. Cabriolet, $2,075 4 p. Brougham, $2,175 5 p. Brougham, $2,250		
Bailey	S. R. Bailey & Co., Inc., Amesbury, Mass		2 p. Phaeton, $2,600 2 p. Roadster, $2,900	4 p. Roadster, $3,200
Baker	Baker R. & L. Co., Cleveland, Ohio	4 p. Coupe, $2,475	5 p. Brougham, $3,000	
Rauch & Lang	Baker R. & L. Co., Cleveland, Ohio		2 p. Roadster, $2,600 4 p. Brougham, $2,800	6 p. Town Car, $4,000
Columbian	Columbia Electric Vehicle Co., Detroit, Mich	2 p. Runabout, $950 3 p. Coupelette, $1,250 4 p. Brougham, $1,450		
100-Mile Fritchle	Fritchle Automobile & Battery Co., Denver, Colo	2 p. Torpedo Roadster, $2,400	2 p. Cabriolet, $2,500 4 p. Torpedo, $2,600	4 p. Coupe, $3,200 5 p. Brougham, $3,600
Hupp-Yeats	Hupp-Yeats Electric Car Co., Detroit, Mich	4 p. Coupe, $1,500 4 p. Coupe, $2,000		
Ohio	Ohio Electric Car Co., Toledo, Ohio	4 p. Coupe, $2,400	4 p. Roadster, $2,650 5 p. Brougham, $2,900	5 p. Brougham, $3,250
Chicago	Walker Vehicle Co., Chicago, Ill	4 p. Cabriolet, $1,985 5 p. Front Drive Limousine, $2,150		
Waverley	Waverley Company, Indianapolis, Ind	4 p. Brougham, $2,000	4 p. Brougham, $2,500 5 p. Limousine, $2,500	
Woods	Woods Motor Vehicle Co., Chicago, Ill		4 p. Brougham, $2,850 5 p. Brougham, $2,900	5 p. Brougham, $3,100

Ready Reference Table of Commercial Vehicles for 1916

Leading Models of American Gasoline Motor Trucks and Delivery Wagons

Compiled by C. Edward Palmer

THE motor truck has come to be such an important and indispensable adjunct to business that many commercial houses, both wholesale and retail, large and small, would be utterly lost if they were compelled suddenly to revert to the old-fashioned and slower method of transportation by means of the horse and wagon. Many large business houses add to their motor truck equipment every year. They buy a truck the same way that they engage a high-priced employee—not because they can get him at a certain figure but because of his capacity for business and his efficiency of operation. Trucks are bought for their capacity and efficiency in the work they are to perform.

To assist the prospective purchaser of a motor truck the following table has been arranged with the trucks grouped according to tons capacity. In each column the first figure indicates the capacity in tons, and the second the horse-power rating of the motor. Not every truck of each manufacturer is listed, but only the leading and representative models. The figures were compiled from data supplied by those manufacturers who responded to the request for this information.

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity, Horse-Power, and Price.					
		Under 1 Ton	1–1½	2–2½	3–4	5	6 and Over
Acme	Acme Motor Truck Co., Detroit, Mich		1½, 25, $1,900	2, 27, $2,150	3, 34, $2,450 4, 34, $3,000	5, 40, $3,500	
Adams	Adams Truck, Fdry. & Mach. Co., Findlay, O		1, 30, $1,850 1½, 35, $2,300	2, 35, $2,500			
Armleder	O. Armleder Co., Cincinnati, O			2, 40, $2,500 2½, 40, $2,800	3½, 47, $3,500		
Atterbury	Atterbury Motor Car Co., Buffalo, N. Y		1, 23, $1,800	2, 27, $2,400	3½, 32, $3,200		
Autocar	Autocar Company, Ardmore, Pa			2, 18, $1,650			
Auto-Truck	Auto-Truck Company, Bangor, Pa		1, 30, $1,400				
Available	Available Truck Co., Chicago, Ill		1, 30, $1,800	2, 40, $2,250	3½, 50, $3,000		
Avery	Avery Company, Peoria, Ill			2, 36, $2,700	3, 36, $3,200	5, 42, $4,500	
Barker	C. L. Barker, Norwalk, Conn		1, 26, $1,600 1½, 26, $1,500	2, 26, $1,700			
Bessemer	Bessemer Motor Truck Co., Grove City, Pa	¾, 25, $975	1, 25, $1,250 1½, 36, $1,800	2, 36, $2,000	3½, 42, $2,800		
Blair	Blair Motor Truck Co., Newark, O			2, 30, $2,850	3, 35, $3,250 4, 45, $3,750	5, 45, $4,500	
Brockway	Brockway Motor Truck Co., Cortland, N. Y	¾, 20, $1,200	1¼, 22, $1,600 1¼, 22, $1,825	2, 27, $1,900 2, 27, $2,125			
Lambert	Buckeye Mfg. Co., Anderson, Ind	½, 25, $900 ¾, 25, $1,125	1, 35, $1,500 1½, 40, $1,800	2, 40, $2,000			
Buick	Buick Motor Co., Flint, Mich		1, 37, $1,150				
Burrows	Burrows Cycle Car Co., Ripley, N. Y	½, 13, $375					
Chadwick	Chadwick Engineering Works, Pottstown, Pa	½, 16, $620					
Chase	Chase Motor Truck Co., Syracuse, N. Y	¾, 25, $1,500	1, 25, $1,650	2, 30, $2,200	3½, 40, $3,300		
Brinton	Chester County Motor Co., Coatesville, Pa		1½, 30, $1,950	2½, 35, $2,250			
Little Giant	Chicago Pneumatic Tool Co., Chicago, Ill	¾, 23, $1,500	1, 25, $1,350 1½, 25, $1,450	2, 27, $2,500			
Coleman	Coleman Motor Truck Co., Ilion, N. Y			2, 30, $2,400	3, 40, $3,000		
Commerce	Commerce Motor Car Co., Detroit, Mich	¾, 22, $875					
Continental	Continental Motor Truck Co., Chicago, Ill		1, 30, $1,550 1½, 40, $1,750	2, 40, $2,100	3½, 45, $3,000	5, 50, $4,000	
Columbia	Columbia Motor Truck & Trailer Co., Pontiac, Mich.			2, 40, $1,650			
Continental	Continental Truck Mfg. Co., Superior, Wis		1, 25, $1,500	2, 30, $2,000	3, 35, $2,300	5, 40, $2,700	
Corbitt	Corbitt Automobile Co., Henderson, N. C		1½, 26, $2,000	2, 26, $2,250 2½, 35, $2,500	3, 35, $2,750		

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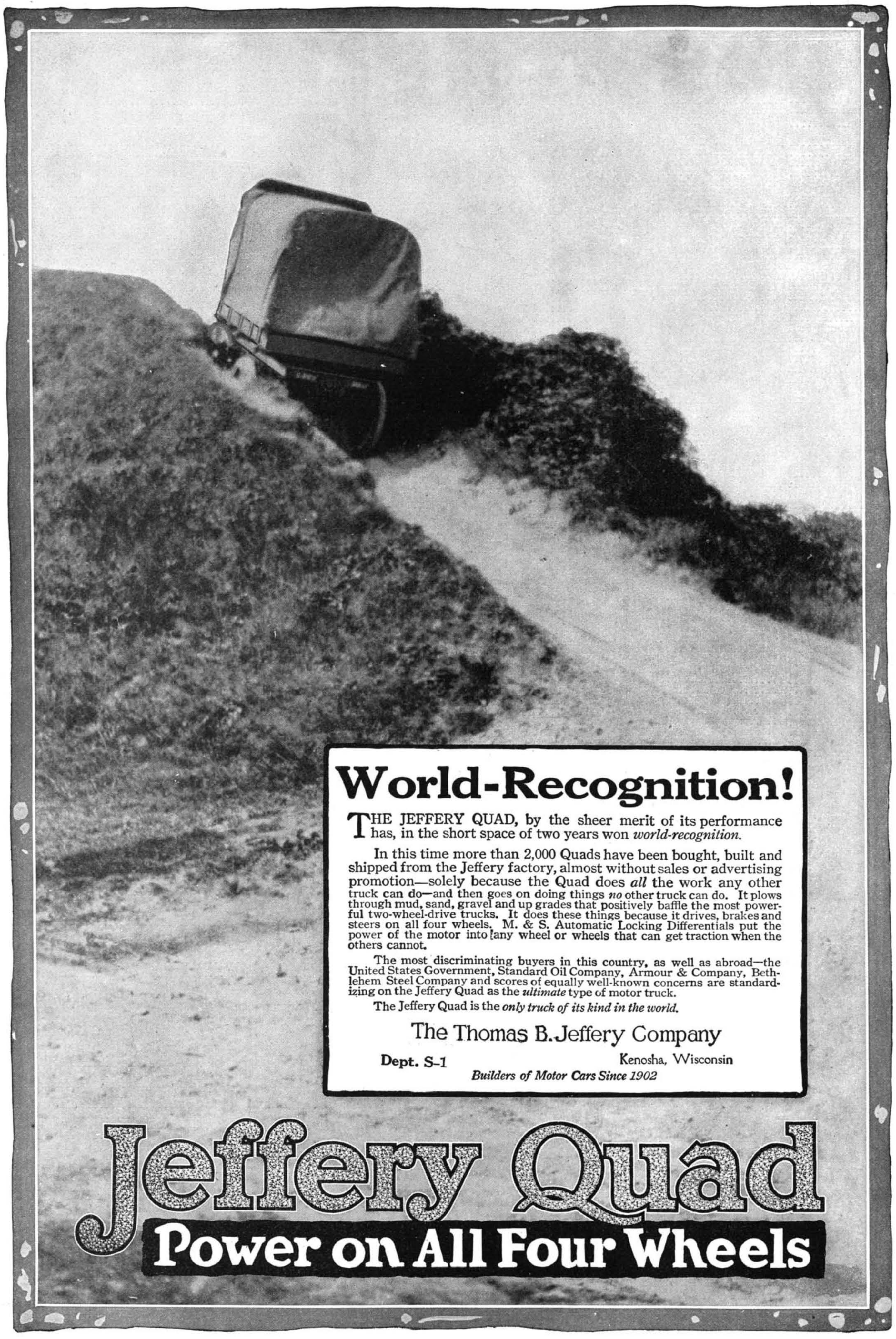

Part of the Evidence upon Which American Business Men Are Buying Jeffery Quads

THE sensational world-wide success of the Jeffery Quad has come with a rapidity never before equaled in the entire history of the motor truck industry. The Quad is known in practically every part of the world. It is recognized everywhere as a *super*-truck.

Originally designed as a military truck to replace the four-mule team on escort wagons in the United States Army, the Quad was immediately recognized for its amazing ability to meet and cope with transportation problems which had not been successfully solved by the rear-wheel-drive type of truck.

The more general the use of the Quad becomes, the more is it being discovered that there is practically no line of business that cannot *profitably* use Quads. In nearly every instance where motor trucks can be used to advantage, the Jeffery Quad *excels.*

Hundreds of concerns in this country and abroad have bought the Quad and know from their own actual experience exactly what the Quad can do. Following is a list of a few of these concerns. We have also quoted from letters written us by users.

These names and these letters are but a drop in the bucket of evidence which has been accumulating at the Jeffery plant—the evidence upon which a constantly increasing number of far sighted, close-buying business concerns are investing in the Jeffery Quad.

A Few of the Concerns Which Have Bought Quads

This list is limited in length because our space is limited. There are scores of other well known concerns which have bought, used and endorsed the Quad.

The United States Government; Standard Oil Co.; Armour & Company, (Packers); DuPont Powder Co.; Morris & Company (Packers); American High Explosives Co.; Bell Bockel Co. (Contractors and road builders); B. W. McCausland (Mining); Parsons Lumber Co.; Bissell Carpet Sweeper Co.; Hill Steamboat Line; Pople Transfer & Storage Co.; Hines Lumber Company; Portland Gold Mining Co.; Val Verde Irrigation Co.; Mogollon Stage & Express Line; Tom Reed Gold Mining Co.; Hawkeye Oil Co.; Mississippi River Power Co.; Milwaukee General Construction Co.; Spencer Brothers Co. (Clay products); Merrell-Soule Co. (Wholesale milk); State Board of Control; City of Whitewater, Wis. (Fire Dept.); Marshall Oil Co.; Hart & Page (Road builders and quarry-men); Borbeck-Lohborg Lumber Co.; E. H. Warren Transfer Co.; Highland Brewing Co.; City of Chippewa Falls (Fire Department); City of Greensboro, N. C. (Road building); Wisconsin Veterans Home; Brook-Hill Farm (Dairying); McMahon & Lonkey (Freighting); Justin Reed (Mountain freighting); Louis Johnson (Teaming and express); City of Collinsville, Ill. (Fire Dept.); Mineral Products Company (Mining); Bishop Manufacturing Company (Cotton Gin, Ice and Feed); F. S. Knox (Oil Dealer); City of Lebanon, N. H. (Street Sprinkling); Ed. Matheson (Stage); Havana Metal Wheel Company (Mfg. metal wheels); B. C. Steele (Teaming and Express); S. H. Brady (Mining); Calif. State Highway Com. (Road work); C. H. Clemons (General store and logger); Sioux City Artificial Ice Co.; Lloyd and Company (Grain business) Blum Brothers (Manufacturers of boxes); Rem Snowden & Co. (Trucking and expressing); Benton City Dray Line (Dray line); A. E. Kruze; W. A. Bradshaw (Mining); J. B. Henderson (Stage); Grant County Comm. (Road work); American Cement Tile Manufacturing Company (Tile maker); Groah Mineral Company (Mining); B. B. Snavely (Miller); James H. Poole (Ranching); Mrs. Elizabeth Ellis (Teaming and expressing); C. L. Percival Co. (Hides and butchers supplies); Seguin Milling & Power Co. (Flour Mills); Intermountain Trans. Co. (Misc. hauling); Lee Moor Construction Co. (Contractors and road builders); G. B. Turner (General transfer); Juntura-Burns Stage Line (Stage) Mr. Randolph (Transfer & Storage); George M. Wadey (Mine operator and contractor); Jay S. Jones (Mining); O'Neil Oil & Paint Co.; J. P. Galloway (Freighting); Paul Waggnor (Ranch); Pirie Tool Sharpening Machine Co.; Neils Ohlson (Teaming); Wm. Bomberger (Miller); Home Oil Co.; St. Bernard Mining Co.; Copper Queen Cons. Mining Co.; General Asphalt Company; City of Winston-Salem, N. C.; Nutty & Gundy; Bethlehem Steel Co.

A Few Among Scores of Letters Written By Buyers

Notice that these letters are far more enthusiastic than any statements ever made about the Quad by the Jeffery Company. The Quad is such a sensationally good proposition that the Jeffery Company is almost over-conservative in its claims. It is far better to have actual owners—disinterested owners—tell of the marvelous things the Quad does than to tell these things ourselves. Read what Quad owners actually think about the Quad:

Through Ten Inch Snow—We are hauling regularly 2 tons on our Jeffery Quad and have no trouble at all, even at the present time when the snow is 8 or 10 inches deep. We have reached the conclusion that there is no truck like the Jeffery Quad, and we think we have the worst proposition in the country for a truck to overcome.—St. Croix Lumber & Mfg. Co., Winton, Minn.

Other Trucks Unable To Do Work—Our 2-ton Jeffery Quad truck has given good satisfaction. We have had it running continually over rough roads, steep hills and in the mud. This truck has stood the test where several other trucks working in the same conditions were unable to do the work.—Lee Moor Contracting Co., Neenach, Cal.

Where Teams Cannot Pull a Load—To say that the Quad is doing work that no other truck could do would not be emphasizing at all. In fact, since the weather has been bad and the dirt roads soft, we are sending this truck where teams cannot pull a load. Several times it has pulled our two-wheel-drive truck and load out of the mud, together with the load on the Quad. I asked the driver, who is a practical automobile man, if there was any kick coming on the Quad, and he said, "If there is, I can't find it."—Marston-Gass Lumber Co., Donora, Pa.

Rear Drive Truck of No Use in Gumbo—We have used our Jeffery Quad going on two years and find it perfectly satisfactory in every respect. A rear-drive truck would have been of no use to us as we are off the pavement 2½ blocks and in the gumbo right on the banks of the Missouri River, and for ten weeks this past season we were constantly in the mud. The Jeffery Company are fine people to do business with.—Sioux City Artificial Ice Co., Sioux City, Iowa.

Over Road Impassable to 18 Horse Teams—The Quad was able to make its regular trips through the mud when the road was impassable to the 14 and 18 horse teams for 7 and 8 days. The Quad has run to date 6,285 miles and the only replacements made have been a fan spider and a fan belt.—Jay S. Jones, Winnemucca, Nev.

Economical in Operation—We have run our Jeffery Quad truck somewhere between 5,000 and 6,000 miles and with the exception of a leak in the radiator and a little trouble with the fan, we have had no expense on this truck in the way of repairs. Its services have been very satisfactory to us and we find it very economical in operating.—Bishop Mfg. Co., Bishop, Texas.

No More Doubts—Regarding the Jeffery Quad, we were a long time buying a truck but when we saw the stunts the Quad would do at the factory demonstrating grounds we had no more doubts. We have a truck that is a real truck.—Borbeck-Lohberg Lumber Co., Lyons, Iowa.

Good Reputation in Alaska—So far the Jeffery Quad and myself have a good reputation and have done twice the work either is intended for.—Fred Clinton, Fairbanks, Alaska.

Business From Larger Territory—Referring to our Jeffery Quad 2-ton truck, we are able to take on business from a much larger territory than when we were entirely depending on horses. Parsons Lumber Co., Rockford, Ill.

Well Satisfied—We are well satisfied with our Jeffery Quad and will not own any other car except a four-wheel-drive car.—The Pople Transfer & Storage Co., Trinidad, Colo.

Used by Fire Departments—The Jeffery Quad is all right in every respect.—Joseph Meuli, Fire Chief, Chippewa Falls, Wis.

Over Stubble Fields to Threshing Outfits—Our first month's output with the Quad was a little over 27,000 gallons. The second month it was nearly 31,000 gallons. We make all our country trips with the Quad, from 20 to 50 miles out and back, over all kinds of roads, over stubble fields to threshing outfits, and have also gone over newly plowed ground to reach a tractor plowing outfit.—F. L. Williams, Standard Oil Agent, Kenosha, Wis.

Pulls Heavy Vans Out of Mud—When our large vans are stuck in the mud, loaded with 5 and 6 tons of household goods and our horses cannot pull them, we send our Jeffery Quad and pull them out.—E. H. Warren Transfer Co., Rockford, Ill.

Does Better Work Than 5-Ton Truck—The sentiment at the mine is strongly in favor of the Jeffery Quad. The truck will carry its rated capacity in places where the —— truck will not go at all; whereas the —— truck with a rated capacity of 5 tons, cannot carry over 2 tons up the hills at our mine. The Jeffery machine makes faster time than the —— car and will operate in deep snow at times when the —— machine cannot be used at all. —Portland Gold Mining Co., Victor, Colo.

Breaking Roads After Snow Storm—After running my Jeffery Quad truck for 9,500 miles the tires are still good. I used the truck successfully breaking roads after the worst snow storm last winter. The truck has proved very satisfactory in every way.—B. C. Steele, West Acton, Mass.

Only Truck He Can Use in His Business—We went with our Jeffery Quad through snow two feet deep. This Jeffery Quad is the only truck I could use in my business.—Standard Oil Co., R. A. Boyd, Agent, Austin, Minn.

Over Bad Roads—My Jeffery Quad goes over roads that it would be impossible for a rear wheel drive truck to go over.—James A. Poole, Marfa, Texas.

Climbs Steep Grade—Colburn Hill is almost a 40% grade. There has never been any other truck up this hill, but we went up with full load, 560 gallons, without any trouble whatever, stopping and starting when we pleased.—Nutty & Gundy, Agents, Standard Oil Co., Washington, Ill.

A Few Reasons Why the Quad Excels

Drives on all four wheels—Enabling the Quad to negotiate deep mud, sand, gravel, snow and difficult grades which are impassable to rear-wheel-drive trucks. This is possible because the weight on all four wheels is used to produce traction up to the capacity of the motor.

Brakes on all four wheels (and also on drive shaft behind transmission)—Brakes at four ground-contact points instead of two—twice the braking power and less than half the skidding effect.

Steers on all four wheels—Front and rear wheels track together—driver does not have to watch rear end of truck (it follows the front end)—driver can turn shorter and maneuver into places where no other truck can go.

M. & S. Differentials—A positive non-slipping drive to every wheel—no wheel can spin—all four road wheels must keep up with the speed of the motor (two outermost wheels can over-run inner wheels in turning corners); thus there is no chance to stall the Quad (within the power of the motor) as long as any one or more wheels can obtain traction, which is an impossibility with non-locking differentials.

Duplex Governor—Driver presses down accelerator pedal all the way, and governor automatically feeds just enough gasoline at all times to keep the truck running at the predetermined governed speed—economizes gasoline, saves the motor and operating mechanism, makes much better average speed and time, permits motor to act as brake on truck going down hill and gives full motor power on low gears.

More Economical—Tremendous saving in tires, repairs and upkeep on account of smooth climbing effect instead of the skidding and bouncing produced by the rear wheel drive.

Summary—The Jeffery Quad does all that any other motor truck can do, and does it at much less cost; and, *in addition,* it goes through mud, sand, snow and over hills and rough country where no other motor truck can go. Moreover, the standardization, interchangeability and duplication of parts worked into the design of the Quad greatly reduce the number of spare parts necessary and decrease the cost and problems of upkeep and maintenance.

Write to the Jeffery Company For Further Details

Whether you are using horses or trucks or not—whether you contemplate the purchase of a motor truck or not—write to the Jeffery Company, Dept. S-1, Kenosha, Wis. We will be glad to send you complete information on the Jeffery Quad and how it has proved a wonderful money saver and money maker in various lines of business. The Jeffery Quad we believe is the biggest thing in the truck business today. Its future is tremendous—every well posted man should be informed on the Jeffery Quad.

Leading Models of American Gasoline Motor Trucks and Delivery Wagons—Concluded

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity, Horse-Power, and Price: Under 1 Ton	1–1½	2–2½	3–4	5	6 and Over
Crawford	Crawford Automobile Co., Hagerstown, Md				3, 40, $3,000		
Crown	Crown Commercial Car Co., N. Milwaukee, Wis		1, 30, $2,000	2, 35, $2,500	3, 40, $3,000		
Dart	Dart Motor Truck Co., Waterloo, Iowa	⅓, 20, $675 ¾, 30, $1,300	1½, 42, $1,800	2½, 42, $2,100			
Vixen	Davis Mfg. Co., Milwaukee, Wis	⅛, 14, $395					
De Kalb	De Kalb Wagon Co., De Kalb Ill		1½, 30, $1,950	2½, 40, $2,450			
Detroit	Detroit Commercial Car Co., Detroit, Mich	⅜, 17, $690					
Denby	Denby Motor Truck Co., Detroit, Mich	¾, ... , $890	1, ... , $1,475	2, ... , $1,985			
Horner	Detroit-Wyandotte Motor Co., Wyandotte, Mich		1, 28, $2,000	2, 32, $2,650	3, 38, $3,200	5, 45, $4,200	
Dispatch	Dispatch Motor Car Co., Minneapolis, Minn	⅞, 30, $935					
Dorris	Dorris Motor Car Co., St. Louis, Mo	¾, 30, $1,900		2, 30, $2,500			
Doyle	James C. Doyle, San Francisco, Cal		1½, 30, $1,750				
Vulcan	Driggs-Seabury Ord. Corp., Sharon, Pa			2, 30, $2,750	3, 30, $3,250	5, 30, $4,500	
Duplex	Duplex Power Car Co., Charlotte, Mich			2, 30, $2,800	3, 40, $3,200		
Durable Dayton	Durable Dayton Truck Co., Dayton, O			2, 36, $2,650	3½, 45, $3,400		7½, 60, $4,950
Fargo	Fargo Motor Car Co., Chicago, Ill	¾, 20, $950	1½, 23, $1,375	2, 25, $1,575			
Federal	Federal Motor Truck Co., Detroit, Mich		1½, 30, $1,800		3½, 40, $2,800		
Flexible Truck	Flexible Traction Motor Truck Co., N. Y. City			2, 30, $2,500	3, 38, $2,800	5, 38, $3,700	
Clintonville, F. W. D.	Four Wheel Drive Auto Co., Clintonville, Wis			2, 29, $3,600	3, 36, $4,000		6, 44, $4,800
G. V. Mercedes	General Vehicle Co., Long Island City, N. Y						6, 35, $4,500
B. A. Gramm	Gramm-Bernstein Co., Lima, O		1, 28, $1,500	2½, 40, $2,600	3½, 48, $3,400		6, 60, $4,300
Garford	Gramm Motor Truck Co., Lima, O		1, 20, $1,450	2, 29, $2,300	3, 29, $3,400	5, 36, $4,300	6, 42, $4,500
Hahn	Hahn Motor Truck & Wagon Co., Hamburg, Pa	¾, 24, $1,100	1, 30, $1,600	2, 40, $2,000	3, 40, $2,500		
Harvey	Harvey Motor Truck Works, Harvey, Ill			2, 40, $1,975	3½, 40, $2,700	5, 50, $3,400	
H-C	H-C Motor Car Co., Detroit, Mich	. . , 28, $550					
Henderson Bros	Henderson Bros., Cambridge, Mass	⅞, 23, $1,100	1, 27, $1,500				
Hendrickson	Hendrickson Motor Truck Co., Chicago, Ill		1, ... , $1,700	2, ... , $2,200			
Howard	Robert G. Howard, Boston, Mass	¾, 25, $990					
Independent	Independent Motors Co., Port Huron, Mich	¾, 23, $1,285		2, 27, $1,800			
International	International Harvester Corp., Chicago, Ill	½, 27, $710					
Mack and Saurer	International Motor Co., New York City		1, 26, $2,000	2, 26, $2,700	3, 48, $3,400 4, 48, $3,750	5, 30, $4,800	6½, 30, $5,800
Jeffery	Thos. B. Jeffery Co., Kenosha, Wis			2, 23, $2,750			
Kearns	Kearns Motor Truck Co., Beavertown, Pa	½, 28, $785					
Kelly	Kelly-Springfield Motor Truck Co., Springfield, O		1½, 30, $2,000	2½, 30, $2,750	3½, 40, $3,400	5, 40, $4,250	6, 40, $4,500
King	A. R. King Mfg. Co., Kingston, N. Y				3½, 32, $2,600		
Kissel-Kar	Kissel Motor Car Co., Hartford, Wis	½, 32, $950	1½, 36, $1,750	2, 36, $2,100	4, 50, $3,350		6, 50, $4,350
Kleiber	Kleiber & Co., Inc., San Francisco, Cal		1½, 34, $2,250	2½, 34, $2,750	3½, 41, $3,300	5, 52, $4,250	
Knickerbocker	Knickerbocker Motor Truck Mfg. Co., N. Y. City			2, 30, $2,200	3½, 40, $2,850		
Knox	Knox Motors Co., Springfield, Mass						Tractor, 50, $4,500
Koehler	H. J. Koehler S. G. Co., Newark, N. J		1, 35, $895				
Kopp	Kopp Motor Truck Co., Buffalo, N. Y	¾, 23			3½, 38		
Kosmath	Kosmath Co., Detroit, Mich	½, 22, $750					
Lange	Lange Motor Truck Co., Pittsburgh, Pa		1½, 30, $1,750	2½, 35, $2,350			
Hall	Lewis-Hall Iron Works, Detroit, Mich				3½, 45, $2,800	5, 45, $3,400	
Lincoln	Lincoln Motor Truck Co., Detroit, Mich	¾, 23, $900					
Locomobile	Locomobile Co. of America, Bridgeport, Conn				3, 29, $3,500 4, 29, $3,650		
Longest	Longest Bros. Co., Louisville, Ky				4, 40, $4,000		
Maccar	Maccar Truck Co., Scranton, Pa		1, 30, $2,100	2, 40, $2,600	3½, 40, $3,250		
Mais	Mais Motor Truck Co., Indianapolis, Ind		1½, 35, $2,600	2, 35, $2,800	3, 45, $3,750		
Martin	Martin Carriage Works, York, Pa		1½, 35, $2,050	2, 35, $2,150	3½, 45, $3,300		
Mercury	Mercury Mfg. Co., Chicago, Ill	½, 15, $750			3, ... , $1,580		10, 35, $3,400 (Tractor)
Mogul	Mogul Motor Truck Co., St. Louis, Mo		1½, 23, $1,600	2, 28, $2,000	3½, 34, $2,550		6, 54, $3,800
Monarch	Monarch Light Truck Co., Milwaukee, Wis	¼, 12, $350 ½, 25, $550					
Moon	Jos. W. Moon Buggy Co., St. Louis, Mo		1½, 30, $1,600				
Moreland	Moreland Motor Truck Co., Los Angeles, Cal		1, 23, $1,550	2½, 33, $2,400	4, 36, $3,200		
Natco	National Motor Truck Co., Bay City, Mich		1½, 20, $1,800				
Nevada	Nevada Truck & Tractor Co., Nevada, Iowa				3, 40, $3,500		
Old Reliable	Old Reliable Motor Truck Co., Chicago, Ill		1½, 23, $1,950	2, 26, $2,450	3, 29, $3,250	5, 42, $4,250	7, 42, $4,500
Packard	Packard Motor Car Co., Detroit, Mich		1, 26, $2,200	2, 26, $2,800	3, 32, $3,400	5, ... , ...	6, ... , ...
Palmer-Moore	Palmer-Moore Co., Syracuse, N. Y	¾, 25, $1,150	1, 30, $1,350				
Menominee	D. F. Poyer Co., Menominee, Mich	¾, 23, $1,125	1¼, 23, $1,575	2, 27, $2,240			
Peerless	Peerless Motor Car Co., Cleveland, O				3, 40, $3,700	5, 40, $4,500	6, 40, $5,000
Pierce-Arrow	Pierce-Arrow Motor Car Co., Buffalo, N. Y			2, 26, $3,000		5, 38, $4,500	
Pull-More	Pull-More Motor Truck Co., Detroit, Mich		1½, 23, $1,600	2, 23, $2,000	3, 33, $2,600	5, 33, $2,800	
Quakertown	Quakertown Auto Mfg. Co., Quakertown, Pa	½, 35, $500					
Reo	Reo Motor Truck Co., Lansing, Mich	¾, 35, $1.075		2, 35, $1,650			
Republic	Republic Motor Truck Co., Alma, Mich	. . , 20, $995	. . . . , 23, $1,275	. . . . , 27, $1,575	. . . . , 29, $2,350		
Robinson	Robinson Motor Truck Co., Minneapolis, Minn			2, 27, $2,000	3½, 32, $2,800	5, 32, $3,400	
Rome	Rome Motor Mfg. Co., Dowingtown, Pa		1, 28, $2,450	2, 32, $2,800	3, 40, $3,400	5, 48, $4,500	
Royal	Royal Motor Truck Co., New York City				3½, 29, $3,500	5, 36, $4,500	6, 40, $4,800 7, 50, $5,000
Rush	Rush Delivery Car Co., Philadelphia, Pa	½, 25, $625					
Sandow	Sandow Truck Co., Chicago, Ill		1½, 30, $1,700	2, 35, $1.900	3, 40, $2,450	5, 45, $3,400	
Sanford	Sanford Motor Truck Co., Syracuse, N. Y	¾, 25, $1,290	1, 25, $1,370 1½, 30, $1,660	2, 40, $1,910			
Schacht	G. A. Schacht Motor Truck Co., Cincinnati, O			2, 40, $2,800	3, 40, $3,200		
Selden	Selden Motor Vehicle Co., Rochester, N. Y		1, 27, $1,700	2, 25, $2,000 2, 33, $2,250	3½, 43, $2,950		
Service	Service Motor Truck Co., Wabash, Ind		1, 35, $1,375 1½, 40, $2,200	2, 40, $2,500	3½, 45, $3,000	5, 50, $4,000	
Siebert	Shop of Siebert, Toledo, Ohio		1, 22, $1,350				
Signal	Signal Motor Truck Co., Detroit, Mich		1, 23, $1,550 1½, 23, $1,750	2, 27, $2,100	3½, 32, $3,000		
Sphinx	Sphinx Motor Car Co., York, Pa	½, 28, $675					
Standard	Standard Motor Truck Co., Detroit, Mich		1½, 30, $1,800	2, 40, $2,000	3, 45, $2,750 4, 50, $3,025	5, 50, $3,400	
Steele	W. M. Steele, Worcester, Mass			2, 30, $2,250	3, 40, $3,000	5, 40, $4,000	
Stegeman	Stegeman Motor Car Co., Milwaukee, Wis		1½, 35, $1,900	2½, 40, $2,500	3½, 50, $3,000	5, 50, $4,000	
Sterling	Sterling Motor Truck Co., Milwaukee, Wis	¾, 22, $895		2, 35, $2,800	3½, 45, $3,400	5, 50, $4,500	7, 60, $4,750
Stewart	Stewart Motor Corporation, Buffalo, N. Y	¾, 30, $1,290	1¼, 30, $1,390				
Studebaker	Studebaker Corporation, Detroit, Mich	¾, 40, $850					
Sullivan	Sullivan Motor Car Co., Rochester, N. Y		1½, 30, $1,600	2, 40, $2,250			
New York	Tegetmeier & Riepe Co., New York City		1½, 30, $1,650				
Tiffin	Tiffin Wagon Co., Tiffin, Ohio	¾, 25, $1,350	1, 25, $1,600	2, 35, $2,400		5, 45, $4,000	6, 45, $4,300
Trabold	Trabold Truck Mfg. Co., Johnstown, Pa		1, 25, $1,250	2, 40, $2,250			
Trumbull	Trumbull Motor Car Co., Bridgeport, Conn	¼, 19, $395					
United	United Motor Truck Co., Grand Rapids, Mich			2½, 27, $2,250	4, 32, $2,900		6, 49, $3,500
U. S.	United States Motor Truck Co., Cincinnati, O			2, 27, $1,900	3, 32, $2,400	5, 32, $3,600	
Universal	Universal Service Co., Detroit, Mich		1½, 30, $1,950	2, 40, $2,800	3, 40, $3,400		
Veerac	Veerac Motor Co., Anoka, Minn		1, 20, $1,000				
Viall	Viall Motor Car Co., Chicago, Ill		1½, 40, $2,250	2, 30, $1,850	3, 40, $2,250	5, 50, $2,750	
Vim	Vim Motor Truck Co., Philadelphia, Pa	½, 20, $620					
Wade	Wade Commercial Car Co., Holly, Mich	½, 10, $300					
Walter	Walter Motor Truck Co., New York City					5, 45, $4,750	6, 45, $5,000 7½, 45, $5,250 12, 45, $5,000
Netco	Welsh & Suthergreen Co., Fitchburg, Mass		1½, 30, $2,000	2, 30, $2,250			
White	White Company, Cleveland, Ohio	¾, 30, $2,250	1½, 30, $3,150		3, 30, $3,850	5, 40, $4,700	
Wilcox Trux	H. E. Wilcox Motor Co., Minneapolis, Minn	¾, 28, $1,200	1, 32, $1,600 1½, 45, $1,800	2, 45, $2,000	3½, 45, $2,900		
Overland	Willys-Overland Co., Toledo, Ohio	⅞, 35, $750					
Wisconsin	Wisconsin Motor Truck Works, Baraboo, Wis		1, 25, $1,650	2, 33, $2,275			
Witt-Will	Witt-Will Co., Inc., Washington, D. C		1, 23, $1,650	2, 28, $2,250	4, 33, $2,750	5, 36, $3,250	
Wichita	Wichita Falls Motor Co., Wichita Falls, Tex		1, 17, $1,650	2, 20, $2,100	3½, 29, $3,250		
Wilson	J. C. Wilson Co., Detroit, Mich			2, 27, $2,000			

Price List of Leading Electric Commercial Vehicles for 1916

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity and Price: Under 1 Ton	1–1½	2–2½	3–4	5	6 and Over
Detroit	Anderson Electric Car Co., Detroit, Mich			2, $3,100			
Baker	Baker R. & L. Co., Cleveland, O		1, $2,300	2, $2,800	3½, $3,500	5, $3,850	
C. T.	Commercial Truck Co. of America, Philadelphia, Pa	½, $1,640	1, $2,095	2, $2,725	3½, $3,530	5, $3,935	
Connersville	Connersville Buggy Co., Connersville, Ind	⅜, $750					
Couple Gear	Couple Gear Freight Wheel Co., Grand Rapids, Mich				3, $3,600* 3½, $4,400‡	5, $5,000‡	6, $4,000*
Ewbank	Ewbank Elec. Transmission Co., Portland, Ore	Prices on Application	Prices on Application				
100-Mile Fritchle	Fritchle Automobile & Battery Co., Denver, Colo		1, $1,750	2, $3,000	3, $4,500	5, $5,000	
G. M. C.	General Motors Truck Co., Pontiac, Mich	½, $1,200	1, $1,300	2, $1,650	3½, $2,000	5, $2,350	6, $2,500
G. V.	General Vehicle Co., Long Island City, N. Y	½, $1,700 ½ $1,950¶	1, $2,100	2, $2,600	3½, $3,250	5, $3,700	
Piercy	Hub Motor Truck Co., Columbus, Ohio			2½, $2,500			
Lansden	Lansden Co., Inc., Brooklyn, N. Y	⅜, $1,175	1, $1,700	2, $2,100	3½, $2,475	5, $2,850	6, $3,200
Elec-truck	LosAngelesCreameryAuto&Mach.Co.,LosAng.,Cal	¾, $2,800					
Walker Balance Drive	Walker Vehicle Co., Chicago, Ill	½,	1,	2,	3 and 4	Prices on Application	Prices on Application
Ward	Ward Motor Vehicle Co., Mt. Vernon, N. Y	⅜, $875	1,	2,	3½,	5, Prices on Application	Prices on Application
Waverly	Waverly Company, Indianapolis, Ind	½, $2,200	1, $2,635	2, $3,410	3½, $3,850	5, $4,625	

* Front Wheel Drive.
‡ Four Whee Drive.
¶ Worm Drive.

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INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

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Inquiry No. 9412. Wanted the name and address of manufacturers of machines to make 2-color typewriter ribbons.

Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451. Wanted the name and address of a manufacturer of machinery for making egg albumen.

Inquiry No. 9452. Wanted the name and address of a manufacturer making machinery for the production of Tannic Acid from the Mangrove plant.

Inquiry No. 9453. Wanted the name and address of a maker of a machine for washing and drying bristles; also machine for cutting, combing and assorting bristles.

Inquiry No. 9454. Wanted the name and address of a manufacturer of a machine for sewing the mouths of bags which will make a lug at each end in addition to sewing the mouth.

Inquiry No. 9455. Wanted the name and address of a manufacturer of equipment for making enamel cloth, rubber, and drill cloth

Inquiry No. 9456. Wanted the name and address of manufacturers of machinery for concentrating Thoria Nitrate from Monazite sand.

(Concluded from page 30)

changing from one speed to another with absolute precision and therefore avoiding numerous objections commonly found in change speed gearings, such, for instance, as harsh chattering of the clutch mechanism and danger of breakage of the clutch elements due to contact when the several parts are operating at different speeds.

APPARATUS FOR CONTROLLING FRICTION CLUTCHES.—A. R. HULTIM, care of John Nielson, Bandon, Ore. Mr. Hultim's invention relates generally to an apparatus for controlling friction clutches, and more particularly to an apparatus in which a non-expansive fluid medium, such as oil, is utilized directly against a piston connected to the movable clutch member, and is operated by an expansive fluid such as steam.

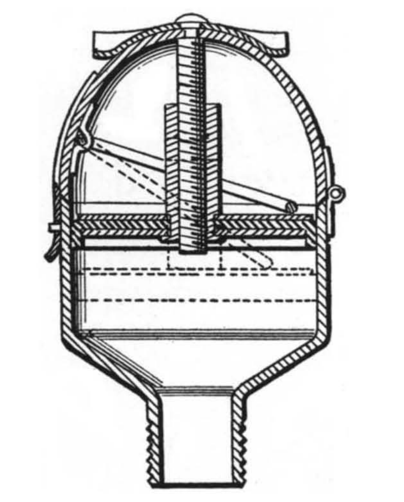
MECHANISM FOR CONVERTING RECIPROCATING MOTION TO ROTARY MOTION.—S. SYLVESTER, Lisbon Falls, Maine. This invention has reference to machines for transmitting reciprocating motion into rotary and has for an object the provision of an improved simplified structure which may be readily reversed at any time so as to cause a rotary movement in either direction.

GAGE FOR PRINTING PRESSES.—J. STIVERS, Room 706, Claus Spreckels Bldg., San Francisco, Cal. Among the principal objects which the present invention has in view are: to facilitate increasing speed of operation of job printing presses; to facilitate hand feeding incident to the employment of such presses; and to reduce the manual labor commonly incident to feeding a press of the character mentioned.

SHAPING MACHINE.—R. F. SMITH, 16 Cherry St., East Lynn, Mass. The inventor provides improvements in the art of shaping bodies whereby regularly or irregularly shaped holes or depressions are broached or produced, or the exterior surfaces of the bodies are changed to a predetermined shape in a very simple and effective manner and without requiring automatic brakes or stops on the machine.

CIRCULAR SAW GUARD.—C. E. EVANS, Weed, Cal. Among the objects of this invention are to provide an anti-friction member on the guard which may be engaged by the lumber to be cut for pushing the guard below the table, means for holding the guard yieldingly over the saw, and means for shunting the cut off portions of the lumber from the saw.

GREASE CUP.—A. E. TOOMEY, Edmore, N. D. The invention provides a cup having a cap hingedly connected to the cup and carrying the plunger and associated mechanism, whereby the cup may be readily opened for filling, by simply swinging the cap back upon its hinges and with the necessity of the removal of any of the parts. The cup has a cap on top to which a screw-driven plunger is connected for reciprocation within the body of the cup, means being hingedly connected to the cut for preventing the rotation of the plunger or with the screw.



GREASE CUP.

MACHINE OR PRESS FOR MOLDING PLASTIC MATERIALS.—L. PENKALA, 116 Rue Pierre Joigneaux, Bois Colombes, Seine, France. This invention has reference to a press for molding plastic materials based on the known principle of the combination of a conoidal worm or screw with two gear wheels engaged in its convolutions for conveying the material, while successively compressing its particles and bringing it to the mouth of the press to be molded in an almost dry condition.

MACHINE FOR MOLDING PLASTIC MATERIALS.—L. PENKALA, 16 Rue Pierre Joigneaux, Bois-Colombes, Seine, France. This invention relates to a drum press for molding plastic materials, based on the known principle of the combination of a screw with two cam wheels engaged in its convolutions for conveying the material, successively compressing its particles, and carrying it to the mouth of the press to be molded almost in a dry state.

SPOOLING MACHINE.—F. L. ATHERTON, 17 Market St., Paterson, N. J. This invention provides a machine arranged to permit of running the quill or spool-carrying spindle at a high rate of speed to wind the thread on the quill or spool with a view to prevent the thread from sloughing when the quill or spool is used in a loom shuttle, to insure winding of the thread on the quill or spool with uniform tension and to automatically stop the spindle as soon as the quill or spool is filled with the desired amount of thread.

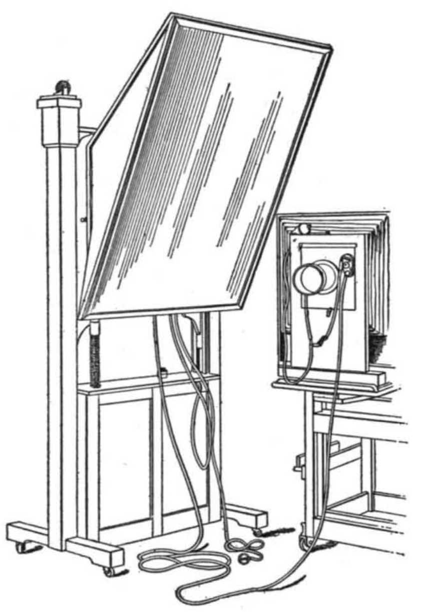
FLUSHING VALVE.—W. NEMETHY, 444 Walnut St., Yonkers, N. Y. The object here is to provide a valve having a sleeve slidably mounted on a guide secured to a tank at an outlet therein, the guide affording communication between the tank and the outlet when the sleeve and the valve are raised against the resiliency of a spring connecting the sleeve with the guide.

TARGET CARRIER.—W. N. PICKETT, Box 534, Cashmere, Wash. This inventor provides means for exposing a target in position for practice, delivering the same to the marksman, and returning a fresh target to practice position, without requiring the operator to expose himself to being shot, or of the loss of time now necessary to carry a target from the practice position to the marksman, and to substitute a fresh target for the one removed.

ANIMAL TRAP.—G. M. FOX, Lexington, Neb. This invention relates more particularly to a trap for catching gophers, rats and other rodents. It provides a trap having means whereby the trap may be disposed at or near the mouth of the burrow of an animal and having an improved arrangement for setting and releasing the trap.

AUTOMATIC MEASURING DEVICE.—J. TEMPLE, 674 South 2nd St., Plainfield, N. J. This improvement relates particularly to devices for measuring granular matter, and has for its object to provide an improved construction whereby a predetermined amount of granular matter, as for instance coal, may be measured and discharged in certain measured quantities.

FLASH LIGHT APPARATUS.—J. L. COURSON, Barberton, Ohio. This invention provides means for simultaneously actuating the shutter of a camera and the flash light apparatus by means of the ordinary shutter-actuating means, such as the air bulb. It provides means for electrically igniting each of a plurality of charges successively, one charge for each shutter actuation, and provides means electrically energized to carry an unexploded charge into ignition position after the previous charge has been ignited.



FLASH LIGHT APPARATUS.

ADJUSTABLE PARALLEL GAGE.—B. S. THOMPSON, 844 Franklin St., S. E., Grand Rapids, Mich. The invention relates to gages used by machinists, pattern-makers and other mechanics, and provides an adjustable parallel gage for convenient use on planers, shapers, vises and other machines and tools for gaging the work in hand, and arranged to allow the mechanic to quickly and accurately adjust the gage to a desired height.

LUG STRAP FOR PICKER STICKS.—W. H. KELLY, 1850 Perkiomen Ave., Reading, Pa. This invention pertains to looms and provides a lug strap for picker sticks arranged to permit of convenient adjustment up or down on the stick for exerting more or less power, to securely hold the lug strap in the adjusted position and to allow of fitting the lug strap on sticks of different width and without weakening the stick by holes, notches, and the like.

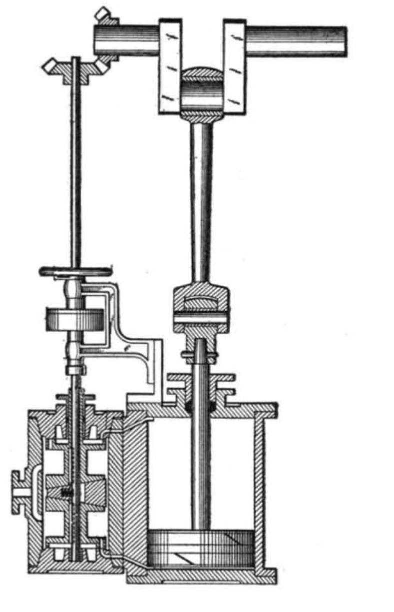
Prime Movers and Their Accessories

STEAM ENGINE.—G. E. QUIGLEY, 121 W. Chalmers Ave., Youngstown, Ohio. An object here is to provide a steam engine having a cylinder body which does not have to be cored, owing to the fact that passage-ways or ports are provided in separate port carriers. A further object is to provide an engine in which the coring of the cylinder saddle is obviated.

INTERNAL COMBUSTION ENGINE.—H. C. WELL, Room 1201, 110 W. 40th St., New York, N. Y. The improvement provides an engine with means to reduce the friction between a rotary valve sleeve and a reciprocating piston. It provides a ring to which the piston rod is articulated, the ring being rotatably disposed in an annular guideway at the inner side of the hollow piston.

ROTARY VALVE.—J. FERRER and E. ALONSO, P. O. Box 118, San Juan, Porto Rico. This invention provides a rotary substitute for the present reciprocating valve now used in such engines; provides a separate valve for each end of the cylinder but revoluble with a shaft common to both; provides for compensating for the wear on either or both of the valves, and provides in each valve distinct inlet and exhaust passages adapted for alternate communication with the corresponding cylinder ports.

REVERSING GEAR.—J. FERRER AND E. ALONZO, P. O. Box 118, San Juan, Porto Rico. This improvement relates to steam engines, particularly to engines provided with rotary valves for the steam inlet and exhaust, and the main object thereof is to provide means for reversing the engines. It provides means for reversing the engines while in operation. It accomplishes this by changing the relationship of the rotary valve with respect to the crank-shaft of the engine. The invention also provides manual means for such reversing which are normally locked against movement.



REVERSING GEAR.

INTERNAL COMBUSTION TURBINE.—G. T. DAVIS, 30 R. D. No. 1, Clinton, Mich. The invention relates to improvements in devices for producing pressure by combustion, and provides a structure which will continuously produce pressure by internal combustion for use in operating a continuously moving turbine or other steam operated devices.

ENGINE ATTACHMENT.—C. W. SHEPARD AND H. W. PAYNE, Box 424, Globe, Ariz. This invention is an improvement in engine attachments, and the invention has for its object to provide an attachment of the character specified adapted to utilize the pressure of the exhaust gases from an explosion engine, for generating electricity for lighting and starting.

Railways and Their Accessories

AUTOMATIC RETAINING VALVE FOR AIR BRAKE SYSTEMS.—E. U. MACK, 327 E. Palmetto St., Florence, S. C. This invention provides a safety device which will automatically close the exhaust outlet from the triple valve when a full application of the brakes has been made and the air pressures equalize in the auxiliary reservoir and brake cylinder under each car of a train, and thus retain the pressure in the brake cylinder while the auxiliary reservoir is being re-charged with air from the main reservoir on the locomotive.

LUBRICATING DEVICE.—O. SWANSON, Box 17, Atchee, Colo. This invention relates to lubricating devices designed especially for lubricating the flanges of the wheels of railway rolling stock. The device is characterized by a rolling member which supplies the flange of a wheel with lubricant while in frictional rolling contact therewith.

RAILROAD SPIKE.—O. WEISS, P. O. Box 740, Helena, Mont. This invention relates more particularly to an improvement in self-locking spikes. An object is to provide a spike embodying improved means whereby the spike may be retained against accidental disengagement from a sleeper or after having been driven into the same.

Pertaining to Recreation

POOL TABLE POCKET LIGHT.—H. JORSTAD, Stanhope, Iowa. This invention has reference more particularly to luminous means to be associated with each pocket of the pool table. It provides pocket lighting whereby any of the pockets occupied by a ball will be readily seen, as the light of the pocket engaged by a ball will burn until the ball is removed.

GAME APPARATUS.—GERTRUDE E. MAGER, 1225 Garden St., Hoboken, N. J. The purpose here is to provide a game whereby to instruct children in the alphabet, in the compiling of small words, in numerals, etc., and also to enable children to quickly distinguish one letter from another and to name it, or numerals, or to recognize and locate short combinations of letters.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Development in Commercial Vehicle Design

(*Concluded from page 17*)

taken at both ends of the gear set. One shaft extends to the differential and drive gear assembly on the front axle, while the other transmits power to the drive gearing on the rear axle. It will be seen that although the construction is more complicated, owing to the greater number of parts used, than the conventional truck, this is largely compensated for by the similarity between many of the power transmission units. It is not necessary to carry as many repair parts in stock as would be needed to maintain a fleet of the simpler two-wheel drive trucks in which the front and rear axle assemblies are entirely different.

The Tractor and Trailer Principle in the Ascendancy

There are certain transportation engineers who, having carefully worked out hauling costs, insist that the tractor and trailer principle is the cheapest method of moving heavy loads. They advance the contention that the ordinary motor truck carries its load like a pack mule, *i.e.*, the motive power is applied through the rear wheels over which fully 80 per cent of the paying load is placed. They claim that the ordinary motor truck is at a disadvantage in heavy hauling: first, because a large part of the motive power is lost since it is applied at the wrong point. As is well known a front wheel drive can pull a heavy load over obstructions that cannot be surmounted by a rear wheel drive. Second, a motor truck empty is practically a vehicle without springs. If the springs are made heavy enough to carry the heavy load they must be so stiff that they lack resiliency when the truck is operated without a load. The power plant is subjected to more vibration because of this fact. Third, the ordinary motor truck not only supports its own weight, but also that of the paying load on rubber tires. When heavy loads are carried the tires depreciate rapidly. Fourth, the average motor truck, representing a large initial investment, must remain idle while being loaded and unloaded. The truck cannot be easily converted from one purpose to another, which means that in a business where many trucks are needed, as in contracting, a number of trucks are necessary to carry the widely diversified materials and tools used by these firms. A motor truck fitted with a body suitable for carrying lumber cannot carry road metal economically, nor can it be used to transport heavy building material such as structural iron or large stone slabs.

The tractor illustrated is really a mechanical horse, as it will move any load that can be pulled over the highway. It supplies a front axle drive to the vehicle carrying the load. By a special spring construction the tractor is carried by flexible springs which are resilient enough to fully protect the motor mechanism while at the same time the heavy load to be moved is supported by an independent pair of very heavy springs which are mounted under the turntable carrying the trailer and directly over the solid rear axle of the tractor. By using a separate vehicle as a semi-trailer 60 to 75 per cent of the paying load can be carried on steel tires, reducing tire expense to a minimum. Such a tractor need never be idle. When there is loading or unloading to be done it is only the carrying vehicle which remains unoccupied. The tractor is ready for attachment to any other vehicle as soon as one trailer is detached. In fact, the tractor can be used to haul two trailers if desired.

Increased Braking Power for Motor Tractors

Another interesting feature of the tractor shown in the accompanying illustration is the use of hydraulic brake actuation means. When hauling a heavily loaded trailer it is apparent that great braking power is needed to stop both the tractor and load on a down grade of any consequence. If attempt were made to brake the tractor by direct mechanical linkage, the operator would be forced to exert all his strength and even then he might not obtain the positive control necessary to bring the vehicle to a quick stop. With the aid of the hydraulic brake arrangement it is possible for the operator to control the load without the expenditure of much effort. The usual hand operated brake lever is connected to the plunger of a pump which draws oil from a reservoir and forces it into a larger cylinder in which works the plunger operating the brake actuating mechanism. Two of these brake actuators are used, one on each radius rod, each controlling one of the large hub brakes. Owing to the difference in size between the pump piston and the brake actuating plunger, a hydraulic ram effect is secured. When it is desired to release the brake a movement of the hand lever forward after the retaining latch is lifted opens the by-pass valve and permits the liquid to flow out of the brake cylinder into the reservoir. The brake actuator is returned to the bottom of the cylinder by the brake releasing springs.

The tractor principle is receiving wider application than formerly and a variety of these tractors are offered. The one illustrated is a pioneer form and also incorporates a number of novel features that make it especially interesting and representative of this coming form of industrial transport.

The Knight-Type Sleeve-Valve Motor

(*Concluded from page 19*)

ing considerable side pressure, the cylinder wall (i. e., the inner sleeve) travels up with the piston, thus reducing the friction. On the explosion stroke, the piston carries a severe load, again exerting pressure on the cylinder wall, and on this stroke the inner sleeve travels down with the piston.

The exhaust valve is opened (40 deg. before lower center) by the port in the inner sleeve coming down from behind the junk ring, the outer sleeve port registering to give full valve opening. The closing of the exhaust valve is accomplished by the outer sleeve, the upper edge of the port traveling down past the lower edge of the cylinder wall. This closing is accomplished at 5 deg. after top center, completing the cycle of operations, the intake valve opening 1½ deg. after the closing of the exhaust.

With the foregoing in mind, it will readily be seen that the inventor has accomplished more than his design originally contemplated, for he has not only secured positively opened and closed valves, but has produced a motor in which the compression does not depend upon the seating of the valves, in which the valves are protected from the strains and stresses incident to explosion, and in which the friction of the piston against its retaining wall has been materially reduced.

It is the aim of the internal combustion engine designer to secure, among other things, first, a spherically shaped combustion chamber, and, second, an explosion point so located that the piston receives the full charge of the explosion immediately, eliminating the lag in the burning of the gas, which is always present if the spark plug points are not over the piston. Reference to the illustration shows the egg-shaped combustion chamber, and the location of the plug, the latter being exactly in line with the center of the piston. The cylinder head design also permits of easy machining, and hence there are no rough or high spots to gather carbon, and cause pre-ignition.

By use of this head, cooling is also rendered much easier, the water flowing freely around the submerged head, carrying off the excess heat, and cooling the spark plug, as well as the junk ring, which, in turn, draws the heat from the inner sleeve. The outer sleeve is cooled by the water flowing around the cylinder wall proper, the outer sleeve also transmitting the heat from the inner sleeve in the lower part of the cylinder.

The oiling system of the sleeve-valve motor generally calls for force-feed through a drilled crank shaft to the connecting rod bearings. Earlier Knight motors were built with splash system, depending upon movable and adjustable troughs placed under each connecting rod.

DU PONT FABRIKOID

How Many Cars Have Hides?

(A sequel to "How Many Hides Has a Cow?")

IT is a fact that more cars are now upholstered in Du Pont Fabrikoid than in any other material.

The number of automobiles upholstered in hide leather counting all grades, *real grain leather* and *splits* or so-called "genuine leather" is steadily diminishing.

About 20% of the new pleasure cars sold in 1915 were upholstered in hides or hide splits. About 10% were upholstered in cloth. Of the remaining 70% upholstered in leather substitutes the majority were in Du Pont Fabrikoid, Motor Quality.

Four years ago nearly all automobiles were upholstered in good leather, *but* 1915 production was just about twice that of 1912; in the meantime the hide supply has been steadily decreasing, and finally the war demand for shoe and harness leather has made prices soar.

The attempt to meet the famine in real grain leather, by splitting the hides and selling the coated and embossed splits as "genuine leather" has been a failure.

The public has learned by experience that there is a vast difference between real grain leather and so-called "genuine leather." Today automobile manufacturers face the choice of real grain leather or its nearest popular competitor, Du Pont Fabrikoid.

Real grain leather, because of its scarcity and high price, is out of the question for popular priced mode s that are produced in any considerable quantity. Therefore, since coated splits, masquerading as "genuine leather", have proved impractical, the decision of the greatest makers of popular cars has been in favor of Du Pont Fabrikoid, Motor Quality, proved the most desirable after several years' use on hundreds of thousands of automobiles.

Du Pont Fabrikoid is not leather, but a scientific substitute therefor, which has made good. It has the artistic appearance and luxury of real grain leather, and in addition is waterproof, washable and will outwear the grade of "genuine leather" used on 90% of the cars that "have hides".

Fabrikoid Rayntite Tops are guaranteed one year against leaking. They do not get shabby because they are washable and fadeless, and will not hold grease or dust.

Booklet and small sample of Motor Quality sent free.
A usable piece, 18x25 inches, sent postpaid for 50c.

Du Pont Fabrikoid Company, Wilmington, Del.

World's Largest Producer of Leather Substitutes
(Works at Newburgh, N. Y.)

Canadian Factory and Sales Office, Toronto, Ont.

Latterly, however, this design has been dropped in favor of the one above referred to, an oscillating plunger pump eccentrically driven from the eccentric shaft by a continuation of the inner sleeve connecting rod of one of the cylinders delivering oil to the crank shaft bearings, drilled holes in the crank shaft registering with the oil holes in the crank shaft bearings, and leading to the connecting rod bearings.

The surplus oil thrown off from the connecting rod bearings is broken up into a mist or spray, which lodges on the bottoms of the sleeves, and is carried up between them by their reciprocating action, aided by grooves cut on the outside of each sleeve, which act as conveyors to lift the oil, and the suction present at the intake port. Holes drilled in the sleeves assist in distributing the oil evenly over all surfaces. The thorough distribution of the lubricant between the sleeves, and between the outer sleeve and the cylinder wall proper, greatly assists in so distributing the heat of the explosion that cooling is more uniform and thorough than is possible in any gas engine utilizing a stationary combustion chamber wall.

To pass the oil up to the sections of the sleeves above the ports, diagonal grooves are cut on the outside of each sleeve between the ports, these grooves conveying the oil to the upper part of the sleeves, and the travel of the sleeves distributing it. The junk ring is lubricated by the action of the piston in depositing oil on the inner sleeve when the sleeve is practically at the bottom of its travel, and the former is at top position at the conclusion of the exhaust stroke. Immediately after receiving this deposit of oil, the sleeve travels upward, and deposits the lubricant on the junk ring.

Seeing America and the Lincoln Highway

(*Concluded from page* 13)

mendous amount of improvement which has been achieved with the expenditure of the two and one half million dollars which have, according to careful estimates, been used for Lincoln Highway improvement during the two years since the announcement and dedication of the route. The last time I drove this route I headed west by the compass, and the Lincoln Highway was only an idea in the minds of a few of us. This year I followed a line of red, white and blue markers straight through to the coast.

I planned on reaching Cheyenne, Wyoming, the seventh day out of Detroit, but because of the fact that it rained every day for the first two weeks we did not get into Cheyenne until the evening of the twelfth day. Every time it rains in the Middle West thousands of dollars' worth of road work is wiped out, to be done over again by the people when the first fair days arrive. But the people are beginning to realize that the dirt roads, which require almost complete reconstruction after every rain, are really the most expensive roads they could have, requiring the expenditure of thousands of dollars a mile every year in maintenance and in hauling costs, three fourths of which could be saved by hard-surfaced roads.

I encountered gangs laying concrete roads on the Lincoln Highway in Indiana at midnight under the light of arc lamps; and across this state, as in Iowa and Nebraska, the driver is almost given the impression that he is traversing what will be a railroad grade. For steam shovel work is noticed mile after mile across all of these states. The hills are being cut off and dumped into the valleys. Oftentimes the cuts are 30 feet deep, as near Marshalltown, Iowa, and the fills nearly as deep. All this work is preliminary to permanent hard-surfacing. But for all the improvement, the Lincoln Highway is as yet nearly all natural road from the Mississippi River to the California line. Yet the effort which is expended upon keeping the Highway in perfect shape is so great that it can be said now that the Lincoln Highway trip in dry weather would present almost no difficulties.

One cannot consider a transcontinental drive without touching upon one of its most interesting features, one which makes up for all the discomforts of wet weather—the diversity and beauty of the scenery. The fair farming country of Indiana, Illinois, Iowa and Nebraska, presents a constantly varying picture of rustic peace and plenty. The green valleys and rolling hills of the Middle West lead one gradually from the Mississippi basin to the national divide at the summit of the Rockies by a hardly perceptible grade which rises some 8,000 feet in 1,000 miles.

A Ruskin or a Whistler is required to fitly portray the wondrous beauty of the drive around Lake Tahoe, that little jewel of lakes that lies on the border between Nevada and California. Fed by a hundred tinkling crystal streams of icy water, which flow from the eternal snows of its encircling peaks; surrounded by mighty forests of virgin fir and pine, it lies in the bottomless crater of some prehistoric volcano, its pellucid depths of Mediterranean blue reflecting the fleecy California clouds. I have driven a great deal in many parts of the globe, and have seen most of the famous beauty spots of both the old and the new world, but I have yet to experience a sight more wonderful or a drive more inspiring than this trip over the Lincoln Highway around Lake Tahoe. California roads are in the main perfect. The Lincoln Highway from Reno west is in really wonderful condition.

The troubles of the transcontinental tourist are over when he reaches Reno, in the Truckee Valley, itself one of the world's beauty spots. The crying shame is that there should be any troubles at all in the path of the motorists attempting to reach this wonderland of nature. The crying need is for a hard-surfaced, perfect road leading from the Statue of Liberty to the Pacific shores, allowing those thousands and hundreds of thousands of eastern car owners to start for California with an assurance of perfect comfort every foot of the way. The West needs these people, it needs their money. They need the West, and it is a realization of these facts that is lending such force to our efforts in improving the Lincoln Highway.

But the great West is helpless to help itself. I stopped in Reno and had a talk with Frank Byington, the mayor. He expressed conditions when he said: "We want the tourist, we want good roads; but Nevada has 425 miles of Lincoln Highway between its borders, an area of 110,000 square miles and a population of less than eighty thousand. What can we do?" The same thing is true of Utah, Wyoming, and to a lesser extent in Nebraska. Every effort is being strained to put the Lincoln Highway in the best possible condition. To-day there is but one really bad spot on the road across Nevada, and that is a matter of twenty miles near Fallon, which $50,000 would remedy. But when you speak of hard-surfaced roads across the West you are speaking in sums of money which by no possibility could be raised in the West. The question is a *national* problem, the *country* must coöperate to put through our main routes. The Lincoln Highway Association offers a medium for this coöperation.

If you drive across the Lincoln Highway this year, or next year you will get some impression of the magnitude of the problem which the Lincoln Highway Association has before it. It is one of the greatest problems which face the country to-day. It is a problem of greater interest by far to the majority of our people than any question of tariff or international relations. The building of the Lincoln Highway is a problem of vital interest to sixty million Americans. If all of them could be made to realize it and give it their aid and support, as the people directly on the route are doing, it could be completed next year.

The conception of a transcontinental boulevard is two years old. To-day it is well marked from ocean to ocean and is a pleasant drive in fair weather every foot of the way. That is a great deal. But we must eliminate that fair weather proviso. With the help of all patriotic

Americans we will, and "Seeing America" in a motor car ten, or even five, years from now will not be an exploit for the adventurous, but an everyday trip of interest and enjoyment to millions.

Development of the American Motor Car That Has Led Up to the V-Type Multi-Cylinder Motor

(*Concluded from page 26*)

is a well defined point beyond which it is not possible to carry the intensity of each explosion without making the motor very rough. It was clearly demonstrated that it would be necessary to use more cylinders of small diameter rather than to increase the size of the four cylinders and the six cylinder motor was the outcome.

Fig. 4 shows the six cylinder engine, in which, practically speaking, secondary vibration and the rocking couple are eliminated. The increase in the number of cylinders also causes the impulses to overlap and thus practically eliminates dead centers. In consequence this motor can be made to pull steadily at a much slower speed than the four. The slight added complication which many conscientious motor car builders had sought to avoid was readily accepted by the public because the new construction gave an important result previously unobtainable.

An important improvement which was consummated during the era of the six cylinder motor was the addition of an electric generator and an electric starting motor.

For a long time the results obtained from the six cylinder motor seemed to satisfy the public completely; but the public was becoming more critical each year and began to come back with the same old demands, asking for more range of ability, greater smoothness, and less noise. As in the case of the four cylinder, an attempt was made to give more range of ability by either making the motor larger, or by running it faster, and while the six cylinder motor, due to its inherently perfect balance, can be run at higher speeds than the four with a reasonable degree of smoothness, still it was found that there is a definite point beyond which it is not possible to increase the size of the cylinders or the speed of the motor, without running into roughness. It was, therefore, determined that it would be necessary to add more cylinders and make them smaller, and the eight cylinder or twin four V-type motor was developed.

The First of the Twin Type

Fig. 5 shows the twin four V-type motor. This motor has a better overlap of impulses than the six cylinder motor and consequently more nearly constant torque.

For a given total size of motor, the twin four motor will, of course, have smaller cylinders than the single six, and each individual impulse is, therefore, smaller, with the result that the character of the torque is improved not only because the explosions come closer together—that is four per crankshaft revolution instead of three—but also because each individual impulse is less intense and, therefore, has less tendency to produce harshness.

The principal objection to the twin four type of motor is the fact that it contains the four cylinder principle and is, therefore, subject to secondary vibration, but this is considerably less than it would be in a single four; but as it is desirable to run multi-cylinder motors at higher speed in order to obtain the greatest range of ability, the secondary vibration becomes objectionable on account of the fact that it builds up in proportion to the square of the speed. The search for further refinement was, therefore, insistently pressed, and resulted in the designing of the twin six or twelve cylinder V-type motor.

The Latest Development

Fig. 6 shows the twin six motor, which combines the perfect balance of the six cylinder motor with the greatest continuity of torque thus far obtained. In this motor small aluminum alloy pistons, carefully designed bearings, combined with a perfect lubrication system and careful workmanship make possible a

obtained except with special racing motors. On the other hand, the continuity of torque enables cars equipped with this type of motor to be driven at a mere crawl.

The extreme reliability of modern valve mechanism and spark plugs minimizes the objection to the additional number of these parts which are required in this type of motor.

It is my opinion that in the twin six motor we have reached the practical limit in the number of cylinders, as in this motor we obtain practically uniform torque and plenty of power without making each individual impulse of sufficient magnitude to be objectionable. One reason for this statement is the fact that in order to get a perfectly balanced unit, the next step would either have to be 18 or 24 cylinders.

The Automobile of 1916

(*Concluded from page* 11)

change speed gearing. The brake rod arrangement has been simplified in many cases, to reduce a number of supports or connecting links. The foot brake and clutch pedals, and even the steering gear, are being attached to the power plant instead of to separate points on the frame, and there is also a general decrease in weight and increase in strength by the use of steel stampings and drop forgings for parts that were formerly cast of malleable iron. The use of center control, which is a logical change, has met with considerable favor. Instead of the old gear shift lever arrangement at the side of the frame, the use of the unit power plant has made it possible to attach the change speed gearing shift lever and emergency brake actuator directly to the gear box cover, thus eliminating the outboard supporting bracket and telescopic control pipe and rod arrangement that was formerly used.

Another point making for simpler chassis construction is the use of the Hotchkiss drive. With this system the braking and driving torque is taken through the rear springs, which means that all radius rods, torque members or distance rods have been completely eliminated. This reduces the number of points of a depreciating nature and results in a quieter operating chassis. Several cars are adopting a recently developed form of differential gear, in which the compensating action is obtained through worm gearing instead of the usual spur or bevel gear arrangement. This form is said to provide traction to the wheel having the greatest resistance instead of to that having the least resistance, as is done by the more conventional spur or bevel pinion forms.

The body construction is not only of more graceful appearance, but bodies are larger, more comfortable, and in many cases even lighter than the designs they displace. Another development is the use of adjustable parlor car types of seats in the higher grade cars. One improvement that is sure to be appreciated by the motorist is the detachable coupe or limousine top, which can be used to convert the usual form of open roadster or touring car to a more comfortable vehicle well adapted for winter service. Other changes in body design are the use of close coupled three- and four-passenger bodies of the three- and four-leaf clover seat arrangements. The seats of most runabouts are now being made wide enough to carry three people.

Easier Riding Qualities as the Result of Improved Spring Suspension

In the matter of spring suspension the chassis has been improved greatly for the coming season. The cantilever type of spring is becoming very popular, but it has not captured the entire field, because many of the most easy riding cars are equipped with semi-eliptic and three-quarter eliptic springs, having an especially long lower member supported under the axle instead of attached to the top of that member. The underslung frame, which was featured by a number of makes of cars in years past, has been entirely eliminated from the market.

Predictions were freely made last year that wire wheels would be universally wheel was drawing to a close. Practically all automobile manufacturers will furnish wooden wheels of the conventional artillery type on the 1916 models, though wire wheels may be secured as an option in many cases by paying an extra sum for the car.

There has been practically no change in the rim equipment, as the quick detachable demountable form is used on practically all types of cars. There is renewed interest, however, in the cord type of tire, owing to qualities of resiliency, fuel economy, and endurance claimed by the protagonists of this form of construction. The cord tire is not new by any means as it was one of the first forms of pneumatic tires devised for use in connection with the bicycle. In this tire the carcass is composed of an arrangement of cords looped around anchorage members at the base of the shoe and then vulcanized side by side instead of the usual fabric layers.

Many motorists expected to find the electrical gear shift a feature of many of the 1916 automobiles on account of the wide use made of electric current in the modern motor car. The hand operated gear shifting lever still reigns supreme, however, though the electric gear shift is offered as optional equipment in a number of cases.

Electric Starting and Lighting Systems

(*Concluded from page* 23)

that is one quarter discharged and which shows a specific gravity of 1.200 will not freeze at temperatures exceeding 60 degrees below zero.

When 5-32 candle power lamps are used in the lamp bank it means that 5 amperes will flow through the battery. If the battery is completely discharged and it is a 100 ampere hour type, it will take approximately 24 hours to charge it completely.

When alternating current only is used for the lighting mains it is necessary to interpose a rectifier between the line wire and the storage battery. Simple rectifiers that may be connected to any lamp socket may be obtained at relatively small cost from dealers in electrical appliances. During the winter season it is well to remember that a storage battery is only about 50 per cent as efficient as during warm weather and the lamps should only be used when necessary and no current wasted in useless engine starting. A depleted storage battery always shows when it is discharged by causing the lamps to burn dimly or supplying so little current that the starting motor will barely turn the engine crankshaft over.

Inspection and Care of the Dynamo and Motor

The manufacturers of starting and lighting systems have made every effort to have the various units function as nearly automatically as possible. At the same time some attention will be needed by the other parts of the system though these do not need the periodic inspection that must be given the storage battery. The dynamo should be looked over and any carbon dust that has been worn away from the brushes due to the abrading action of the commutator and which has fallen to the lower portion of the commutator compartment should be blown out with compressed air because a considerable accumulation of this material, which is a conductor of electricity, may allow a leakage of current to the ground or produce a short circuit between the brush carrier and the generator casing. A blackened or rough commutator must be smoothed down with fine sand paper while the armature is rotating. The makers give positive instructions that emery cloth should not be used for this purpose. After the commutator has been smoothed, all particles of metal should be removed from the insulation between the copper segments and care should be taken that this insulating material does not project higher than the surfaces of the segments. Any projections should be filed down to a lower lever than that of the copper members upon which the brushes bear.

The brushes must not only make perfect mechanical contact with the commutator

connection with it. Oil or grease on the brush assembly or segments should be removed and it is well to make sure that there is sufficient spring tension to keep the brushes in positive contact with the commutator. At the same time, the spring tension should not be excessive because too much spring pressure will cause untimely deterioration of the brushes and will also tend to heat the commutator. The starting motor is subject to the same electrical troubles as the generator. Defects in either the motor or dynamo driving mechanism are of a purely mechanical nature and can be easily corrected by any mechanic. The centrifugal governors used on a number of the generators applied to cars several years old are not apt to give trouble unless parts become broken or the action becomes clogged with gummed oil or grease. Any oil between the clutch faces will prevent proper frictional adhesion, while broken links or springs in the governor mechanism will disturb the continuity of the drive.

Lamp Troubles and Their Causes

All wiring should be protected from the possibility of becoming covered with grease, oil or water and in all cases the regular insulation should be supplemented by a conduit or insulating material or a substantial armor. All connections should be gone over to make sure that these are tight. If a fuse is blown or if the protective circuit breaker operates this indicates a "short-circuit" between one of the current conveying wires and the metal frame of the car. A short circuit is often indicated by the action of the amperemeter. If the pointer vibrates on the discharge side it shows that there is a path for the passage of current between one of the wires leading to the lamps or other current consuming units and the frame. If the lamps do not functuate properly, trouble may be looked for in the wiring or in defective lamps.

In many lighting systems the dash and tail lights are wired in series and if one of these goes out it will produce a break in the circuit and automatically make the other go out also.

Lamp troubles may be usually laid to defective wiring, "grounds," loose contacts, defective fuses and switches. Dim lights indicate a rundown storage battery.

The user of an electric starting and lighting system will avoid trouble by observation of the few simple rules which follow and which have been formulated by a prominent manufacturer of these systems:

FIRST: Always be sure that the battery is properly charged and that all connections throughout the system are clean and firm. SECOND: If the generator is suspected, the only point liable to be at fault is the brush contact at the commutator or accumulations of oil and grease on the commutator. Short circuited armature or field windings are extremely rare. Do not replace worn out dynamo or starting motor brushes with any other than those supplied by the manufacturer and be sure that the brushes are properly fitted to the commutator. Never put oil or grease on the commutator of the generator or starting motor, as this is a point that requires no lubrication. Never turn the hose on the generator, starting motor or any of the regulating devices when washing the car. THIRD: Inspect the generator driving means from time to time. If a silent chain is used don't tighten up the chain unless the slack becomes excessive from wearing of the link rivets. It is necessary to operate a silent chain reasonably loose to prevent noise and wear. The silent chain drive, if exposed, must be cleaned at frequent intervals and lubricated. FOURTH: Never run the car if for any reason the battery is disconnected, unless the chain driving the generator or the generator itself has been removed. Never attempt to propel a car with a starter. Such "stunts' are possible but expensive! Do not attempt to make any adjustments of any kind in the circuit breaker, regulating relays or dynamo-output governors. Always have this work done by a competent mechanic familiar with the system. Never fuss with the system when it is operating properly.

Father Time the Only Official Tester

(*Concluded from page* 24)

automobiles, and it was his decision that put two-cycles on the scrap heap to keep company with steamers. Thus two marvelous types of cars—and they were marvelous types—passed out of use. Their merits could not save them from the discard.

The lesson is simply this: No type of motor can stay on the market unless it

has two cardinal points of value, namely:

1. Positive merit.
2. Absence of demerits, defects, drawbacks, disadvantages.

The two points are not similar.

The rejected two-cycle had twice as many power strokes as were found in the accepted and triumphant four-cycle. That was the two-cycle's positive merit.

But, also, as owners came to learn, the two-cycle was freakish in performance and could not be depended upon. It was not free from defects. Therefore, it was forced to pass out of the market.

So with the steamer. All the claims made for the steamer in the paragraph at the head of this article were true, unquestionably true. The steamer was wonderful in positive merits. But, when owners of steam cars eventually weighed the steamer's merits against its demerits, the verdict was "guilty," and the steamer—once overwhelmingly the most popular car in America—fell into general disuse.

These two striking cases, distinctly separate yet remarkably alike, are not the only ones that could be cited. I have seen many "wonders" come and go. And as each new idea is put forward in the automobile industry, I seek to determine, first of all, what are its weaknesses, and, next, whether its weaknesses can be cured. For incurable weaknesses mean inevitable defeat: no merit is ever great enough to offset glaring faults.

The Heavens in January

(*Concluded from page* 28)

Taylor's Comet

A comet, visible in a small telescope, was discovered by Taylor at the Cape of Good Hope at the beginning of December, close to Delta Orionis. It was moving slowly northward and westward. Provisional elements of its orbit, computed at the University of California, show that it had just passed perihelion (on November 4th) at the unusually large distance of 223,000,000 miles from the sun. Its orbit is inclined 17° to the plane of the ecliptic, and its motion is in the same direction as the earth's, but a little slower. It will, therefore, remain visible for several months, but slowly recede from the earth and sun and grow fainter. Its predicted position on December 24th (the last date given in the published ephemeris) is 5h. 12m. 47s. R. A. 3° 56′ north declination. Its motion is northeasterly, and almost uniform, at the rate of 18s. of R. A. and 14′ of declination per day, which would put it on January 1st in about 5h. 8m. + 6° about 3° east and a little south of γ Orionis.

Princeton University Observatory, December 20th, 1915.

Death of James M. Dodge

On December 4th, 1915, James Mapes Dodge, an inventor of mechanical devices, more particularly conveyors and power transmission systems, died at his home in Philadelphia.

Mr. Dodge was born on June 30th, 1852, at Waverly, N. J. His grandfather was Prof. James J. Mapes, a noted chemist and scientist, and his mother, Mary Mapes Dodge, a noted author for many years editor of the "St. Nicholas Magazine."

It is probably to the widely diversified experience gained in earlier years that Mr. Dodge owed his great business success of later years. After leaving college he worked a short while in an iron works, leaving later to enter the employment of John Roach, the shipbuilder, at Chester, Pa. Here he rapidly advanced to the positions of journeyman, foreman and superintendent of erection. Shortly after the Centennial at Philadelphia in 1876, he left the shipyard and after several years of experience in the East went to Chicago. There he formed the acquaintance of William D. Ewart, the inventor of the Ewart link-belting and later became associated with Mr. Ewart in the development of the chain business.

The remarkable development of chain drive and conveying and elevating appliances is too well known to be described in detail, suffice it to state that Mr. Dodge's later career was prominently identified with it.... developed a system of storing anthracite coal in large conical piles and reloading it by machinery, which is still without a rival to-day. His inventions relating to the construction and manufacture of silent chain are as important as they are numerous.

Mr. Dodge possessed that rare combination of talents, inventive genius and executive ability of the highest order. He was a staunch advocate of welfare work among employees and though for many years a large employer of men, it is said that he never met with strikes or other labor troubles. He was a conspicuous leader in the general introduction of scientific management with the double purpose of greater efficiency in the work and more pay, shorter hours and better working conditions for his men. At the time of his death he was identified with a number of prominent clubs, technical societies and institutions.

Motor Truck Notes

T. N. A. writes: "We have found by experience that the pneumatic tires on our 1,500-pound delivery cars give far better service if they are kept inflated to their proper pressure. We cannot get our men to test the pressure every day, however, and we would like to know if there is any method by which we could connect the valve with the ignition system so that a soft tire would stop the motor until the driver dismounted and either changed the tire or pumped it to its proper point."

A. Your plan would hardly be practicable, although it would certainly serve to remind the men to keep the tires well inflated. The same results could be obtained, however, by the use of one of the ingenious devices known as a "tire signal." This is to be attached to each valve in the place of the dust cap, and is previously set to any pressure below the normal that is desired. For example, if a 4-inch tire should be inflated to 80 pounds per square inch, the signal could be set to give its warning at 70 pounds per square inch of air pressure. This setting cannot be made by the driver, and therefore he is compelled either to drive his car with the tires properly inflated, or to be annoyed and made conspicuous by the continuous shrill warning note of the signal, which cannot be turned off until it is removed from the tire.

W. C. O. writes: "Our County Supervisors have decided to treat our main highways with hot tar. Are any trucks provided with mechanical sprinkling devices for this purpose?"

A. Some truck companies have designed special tank bodies that are provided with an air compressor operated from the transmission of the car. This air compressor forces the hot tar out through openings, in the form of a spray, so that the material is sprinkled evenly over the entire surface, and none is wasted. A built-in steam generator is also included in the outfit, for the purpose of keeping the tar in a fluid state. This is accomplished by means of coils of pipes in the tank, through which the steam passes. It might be well to suggest that, if the sprinkler truck is to be used in restricted territories, it would be advisable to provide it with steel wires that would also serve partially to roll the road. Tar, grease, or gasoline is very destructive to rubber, and naturally a truck used for tar sprinkling would have occasion to travel almost continuously over freshly-oiled roads. If, however, the territory over which the sprinkler would do its work is a large one, it must be remembered that steel tires will not allow the vehicle to travel as fast as would those of the conventional type.

D. W. C. writes: The engine used on one of our light trucks heats up unduly. We have had the carbon cleaned out, the carburetor adjusted, and know the lubrication system is working all right. Our steam engineer advises that we clean out the cylinder water jacket and radiator spaces with boiler compound, as the water we use deposits solid matter and the boiler compound is absolutely necessary in connection with our stationary steam

pound dissolve the scale and sediment in the water spaces?

A. We advise caution when using boiler compounds in cleaning out automobile cooling systems. Some of these are very harsh in action and contain acids that cannot fail to injure the delicate construction of the radiator, which uses very thin tubes. Find out what the boiler compound consists of before using it. A compound that would be entirely practical in a large steam boiler with tubes and shell varying from 1/4-inch to 3/8-inch thick might easily eat through the thin radiator tubes, which are no thicker than heavy paper. A large number of scale dissolvers are offered for cleaning out automobile cooling systems, all of these being guaranteed to do no harm to radiators. Consult a local chemist to find out what foreign matter the water you use contains, and he will undoubtedly recommend some chemical to neutralize the foreign matter. A good way to clean out sediment is to run a stream of city water under pressure through the cooling system for a few minutes. This will remove almost all loose sediment. The heat is not great enough in a radiator to produce a hard scale such as forms in a steam boiler, so a compound strong enough to cut this would probably injure the automobile cooling system. You will prevent all future trouble from your cooling system if you set out a rain barrel and use this water, distilled by nature, in the radiator. The only sediment then resulting would be the rust from the water jacket interior, which is unavoidable. Be sure the fan belt is tight and circulating pump functioning properly. The impeller in the water pump sometimes sticks and shears off its driving key or it may wear enough to reduce the flow of water. Your overheating trouble may be due to either of these causes.

Legal Notes

Holding as to Patentable Novelty.—In Miehle Printing Press & Mfg. Co. v. Whitlock Printing Press & Mfg. Co., Judge Lacombe in the course of his decision said, "Patentable novelty is sometimes found in discovering what is the difficulty with an existing structure and what change in its elements will correct the difficulty even though the means for introducing that element into the combination are old and their adaptation to the new purpose involves no patentable novelty."

Patent Decision.—A recent issue of the Patent Office Gazette contains a report of three commissioners' decisions in ex parte cases, all involving the question of patentability and particularly interesting because one case was decided by Commissioner Ewing himself, the second by First Assistant Commissioner Newton, and the third by Assistant Commissioner Whitehead. In all three cases some claims held unpatentable by the Board of Examiners-in-Chief were decided to be patentable by the commissioner of his assistants on appeal. One case was that of Ex parte Whitelaw, the invention being an engine, and in deciding the case Mr. Ewing held that a construction in certain of the claims involved a reorganization not suggested by the patents cited and allowed the claims.

In the case decided by Mr. Newton, that of Nelson & Nelson, metallic packing, the assistant commissioner held that the references could not be held to disclose the split ring of spring metal provided with a seat of less diameter than the normal diameter of the ring, and, furthermore the mode of providing the result is different in applicant's device from that in either of the references.

The case decided by Mr. Whitehead was Ex parte Klenk and in holding two claims patentable the assistant commissioner said the claims specified "that the springs by which the latch is held in place are so arranged that they provide a stop for limiting the movement of the latch in an unlocking direction. This construction is not suggested by any of the references and the claims are deemed allowable."

NEW BOOKS, ETC.

THE AEROPLANE. By Claude Grahame-White and Harry Harper. New York: Frederick A. Stokes Company. 8vo.; 280 pp.; illustrated.

THE MAN-OF-WAR. What She Has Done, and What She Is Doing. By Commander E. Hamilton Currey, R.N. (Retired). New York: Frederick A. Stokes Company. 8vo.; 297 pp.; illustrated. Price, $1.50 net.

"The Romance of Reality" series aims at combining sound science with fascinating reading. In "The Aeroplane" is sketched the history of human flight, from such crude efforts as those of Simon the magician to the present use of aircraft in sport and in war. As an English work, it perhaps over-emphasizes Cayley, Henson, and Stringfellow, but it will do our general reader no harm to know a little more of the truly prophetic work of this trio. Speaking of prophecy, the authors assure their countrymen that in less than twenty years the Londoner will be spending his week-ends in New York, crossing in twenty hours by means of luxurious, vibrationless aero-liners of enormous size. In Commander Currey's "The Man-of-War," we again find popular history and present achievement pleasingly combined. From the galley of the 16th century to the torpedo craft of to-day, text and pictures make clear to us the construction, armament and handling of the fighting ship.

WIRELESS TIME SIGNALS: Translated from the French official handbook, *Réception des Signaux Radio télégraphiques par la Tour Eiffel*. London: E. & F. N. Spon, Ltd. 8vo.; 133 pages; 30 illustrations and one folding plate. Price, $1.25 net.

The high order of importance attained by radio time signals and weather bulletins renders most opportune the appearance of the work entitled "Wireless Time Signals." It is not an original work but a translation from the French official handbook, *Réception des Signaux Radio télégraphiques par la Tour Eiffel*, to which the translators have added several original appendices.

A minor portion of the work is devoted to descriptions of apparatus suitable for the reception of time signals from long distance stations, especially the Eiffel Tower plant at Paris. Modern amateur practice is much in evidence in the apparatus and circuits described.

The bulk of the book deals with the subject of time signals and contains much information of great interest, particularly to those desirous of comparing chronometers with the time signals, with the minimum of error.

STEAM POWER. By W. E. Dalby, F.R.S. New York: Longmans, Green and Co., 1915. 8vo.; 760 pp.; with 250 diagrams. Price, $6 net.

"Steam Power" is broadly conceived and executed. The scientific principles of the subject are first approached by way of the objective realities of a steam plant; this parallels the method of mastering a foreign tongue by starting with actual conversation, leaving the grammar and construction for later consideration. Once the student has mastered the plan and the practical workings of engine, boiler and condenser with their necessary connection and accessories, he is initiated into the more abstruse considerations of heat streams, and the heating, motive power and cooling circuits. At this point thermodynamics is taken up, and the calculation of the properties of steam as recorded by the Calendar tables. The second division of the work deals with the dynamics of the steam engine, in which the reciprocating engine largely figures. The third division treats of steam turbines. The work includes the author's researches in the science of the locomotive, and his theories are in some aspects original and suggestive. The diagrams, charts and tables form no small part of this large and thorough volume, and they are so incorporated and explained as to be in the highest degree helpful to the student.

DIRECTORY OF MERCHANTS AND MANUFACTURERS IN INDIA, 1915. Rajkot, Kathiawar, India: Laxmichand Dossabhai & Bros. 8vo.; 500 pp. Price, 3 rupees.

Importers and exporters may find in this directory information of value. It lists a wide range of occupations and manufacturers, from accountants and architects to agricultural supplies, household furniture, clothing, brassware, food products and perfumery. It also gives banks and bankers, consular officers and governors' staffs. It aims at presenting the most vital industrial information in a low-priced and compact form.

ESSAYS FOR COLLEGE ENGLISH. Selected and Edited by James Cloyd Bowman, A.M., Louis I. Bredvold, A.M., L. B. Greenfield, Ph.M., and Bruce Weirick, A.M. New York: D. C. Heath & Co., 1915. 8vo.; 447 pp.

We are pleased to meet with so meritorious a collection of modern essays, addressed to the freshman taking a technical course. Many of the essays deal with rural and agricultural conditions and problems; some are on science and scientists; one discusses education, another social psychology, yet another the conservation of natural resources. Most of them made their first appearance in standard publications, and among the authors are Woodrow

Wilson, Theodore Roosevelt and Paul Elmer Moore. One or two older favorites are included. An introduction treats of the analysis of the essay, and puts the student in the way to determine the point that the author is endeavoring to make, whether he really succeeds in making it, and, if so, whether he makes it in the most effective manner. As an illustration, the introduction presents a complete thought analysis of Matthew Arnold's "Literature and Sscience."

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY. New York: The Marconi Publishing Corporation. Over 800 pages; profusely illustrated. Price, $1 net.

"The Year Book of Wireless Telegraphy and Telephony" for 1915 appears to have been compiled along the same general lines as its predecessors of 1913 and 1914; perhaps the most valuable feature of the work being its international character. Obviously, the world-wide travels of the radio operator have been constantly in the mind of the compiler, for not only are the international radio laws and regulations covered at length, but such information as the land stations throughout the world, and monetary systems of the different nations, their units of measure and other information of similar nature is presented in profusion. The list of English terms encountered in wireless work together with their French, Italian, Spanish and German equivalents is also of great value, as may be likewise claimed for the list of works published throughout the world on radio telegraphy, which is perhaps the most complete of its kind.

Even a most careful examination of the contents of this book fails to disclose the lack of any important information that might be of interest to radio operators and others engaged in the wireless field.

SYMBIOGENESIS. The Universal Law of Progressive Evolution. By Hermann Reinheimer. London: Knapp, Drewett and Sons, Ltd., 1915. 8vo.; 425 pp.

Those who have read "Evolution by Co-operation," by the same author, will already be familiar with his general views. In that work he endeavored to show that over and above Darwin's tenet of natural selection by competition stands the law of positive co-operation among organisms. The present work is an amplification of this theory, buttressed by quotations from Samuel Butler to Sir E. Ray Lankester, and illuminated by rays from all related fields of human knowledge. In the so-called "love-foods," produced by sexual symbiosis in the plant, we have, so the author claims, the lever which makes the whole world of animal life to move; their elements react not only upon mechanical energies, but also toward physiological and psychological elevation. Nutrition and work, in their co-operative aspects, are the two factors offered by the author as most truly illuminating the origin and transmutation of species and, even more particularly, of values. Even though one may not wholly surrender to Mr. Reinheimer's argument, or accord to his theory that supreme importance with which he invests it, there are in his volume so many important related facts, and so much pause-compelling suggestion, that his work must be reckoned with in any future study of Nature's methods in evolution.

THE BOOK OF WIRELESS. Being a Clear Description of Wireless Telegraph Sets and How to Make and Operate Them. By A. Frederick Collins. New York: D. Appleton and Company, 1915. 8vo.; 222 pp.; illustrated. Price, $1 net.

The boy who reads this manual will find descriptions of installations to suit all pocket-books and all degrees of youthful intelligence and experience. If his spending money is limited he will doubtless be most interested in the small outfit first given. As his knowledge and h resources grow, the long distance set will probably appeal strongly to him. But in any case he will find all he wishes to know here set forth in simple words of explanation and instruction, with all parts clearly illustrated, and the cost of all materials plainly given. When he has put up and used one of these sets for a time, he will doubtles turn with interest to the final division of the work, which leads him through the processes of making induction coils and transformers. There is also a chapter devoted to government regulations and examinations, and a dictionary of the terms commonly in use among wireless operators.

AEROPLANES AND DIRIGIBLES OF WAR. By Frederick A. Talbot. Philadelphia: J. B. Lippincott Company, 1915. 8vo.; 283 pp.; illustrated. $1.25 net.

In some ways the aeroplane and the dirigible have proved disappointing when put to the test in war; in other ways they have established themselves as a surprisingly efficient Fourth Arm, and have modified tactics in a way entirely unforeseen. Mr. Talbot's popular survey of this subject includes Germany's rise to airship supremacy, her aerial dreadnought fleet and its military value; he describes the various aircraft of the fighting nations and follows their flights, their accomplishments, and their defeats; methods of bomb-throwing are explained, and many of the ruses used to mislead the airman are exposed. The feasibility of mining the air against aircraft is discussed; the aerial torpedo, which the war

seems to have pushed into oblivion, is mentioned; and clear explanations are made of such comparatively little-known artifices as that of the "smoke screen," used by the aeroplane much as a cuttlefish uses its inky fluid, to cloak its escape from danger. The author has succeeded in placing vividly before his reader the part that the Fourth Arm is playing on the battlefields of Europe.

WHOSE SIN IS THE WORLD-WAR? By Count Julius Andrássy. Translated from the Hungarian by Ernest J. Euphrat. New York: New Era Publishing House, 1915. 8vo.; 154 pp.

Count Julius Andrássy, the son of a minister of foreign affairs, is himself a statesman and a close student of history and politics. His answer to the pertinent question of the title is, while of course open to some national prejudice, at least dispassionately given, together with facts both for and against each nation involved. Though his interpretation may at times be questioned, and some of his principles and deductions repudiated by broader viewpoints, yet his argument stands as a strong presentation of the Germanic cause, and is worthy of a careful reading. It places at the door of Russian aspiration the first responsibility for war; it attacks, while it to a certain extent excuses, British policy; and it condones Germany's action on the score that she had at stake "interests vital enough to go to war about, after adjustment in an amicable manner had become impossible."

MECHANICAL DRAWING FOR COLLEGES AND UNIVERSITIES. By James D. Phillips, B.S., and Herbert D. Orth, B.S. New York: Scott, Foresman and Company, 1915. 8vo.; 283 pp.; illustrated. Price, $1.75.

Mechanical drawing is a primary step in almost all the constructive arts; the study offers also an excellent training in observation and perception, thus combining commercial and educational value. The course here offered is one of balanced appeal, designed to develop the imagination and to perfect the coördination between hand and eye, while at the same time presenting the latest and best commercial drafting-room practice. No previous course of study is necessary to mastery of the lessons, which stand complete in themselves, although they are to be followed by a text for high schools, the two books constituting a complete course in mechanical drawing.

NATURE NOTES FOR OCEAN VOYAGERS. By Captain Alfred Carpenter, R.N., D.S.O., and Captain D. Wilson-Barker, R.N.R. Philadelphia: J. B. Lippincott Co., 1915. 8vo.; 181 pp.; 139 illustrations, including map of the world. Price $1.75

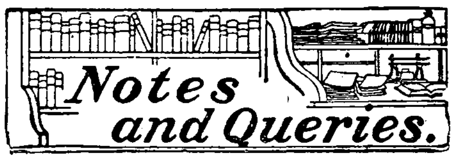
These notes form an attractive volume for either easy chair or ocean voyagers They touch upon the many remarkable forms of animal life in the sea; they picture plant life and sea weeds; they deal interestingly with those things which have done so much to clothe the ocean in mysterious glamor—light and phosphorescence. Reverting to the age of the early explorer, they sketch for us the uncouth monsters with which his imagination peopled the waters. Weather and waves are each given an adequate chapter, and the notes conclude with an account of old sea customs and chanteys.

HORSE, TRUCK AND TRACTOR. The Coming of Cheaper Power for City and Farm. By Herbert N. Casson, Rollin W. Hutchinson, Jr., and L. W. Ellis. Chicago: F. G. Browne & Co., 1913. 8vo.; 200 pp.; illustrated. Price, $1.

Edison once disposed of the horse in a single sentence; he said it was the poorest motor ever built. Mr. Casson adds that it has an eating capacity of five acres per year, a thermal efficiency of but two per cent, and an average working day of three and a half hours. He tells us that our national bill for horse maintenance is $2,000,000,000 per year, equal to the total operating cost of all our railroad mileage! Mr. Hutchinson follows with a series of incisive papers on motor transportation in its relation to scientific efficiency, while Mr. Ellis marshals some convincing arguments as to the value of the tractor on the farm. Cost is consistently held in view as a subject of first importance and vital figures of equipment and upkeep are unsparingly presented. The authors are authorities in their respective fields, and horse owners will find in their book an interesting and profitable study.

DIE WELT DER VERNACHLÄSSIGTEN DIMENSIONEN. Von Dr. Wolfgang Ostwald, Privatdozent an der Universität Leipzig. Dresden und Leipzig: Theodor Steinkopff, 1915. 8vo.; 219 pp.; illustrated. Price, M.5.75.

"The World of Neglected Dimensions" is the first attempt ever made to present to the German-reading public a broad and popular view of modern applied colloidal chemistry. The growing importance of this branch of chemistry, with its close relationship to industry, deserves the careful attention of chemists and manufacturers. Two winters ago Dr. Ostwald delivered, under the auspices of sixteen universities of the United States and Canada, a series of fifty-six lectures; it is upon these that the present work is based. The chapter devoted to the technical and practical use of colloidal chemistry makes particularly timely and interesting reading.



Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13095) E. S. Writes: In the SCIENTIFIC AMERICAN for September 25, I notice the paragraph, Astronomy in the Public Libraries. My library is one in which the school and public libraries are combined; the town is very small and so far as I have observed no one is in the least interested in astronomy. I should like very much to receive your suggestions on the most successful methods of getting them interested. It does not seem advisable to put in many books until the interest is awakened and the demand for them comes. Are there large pictures, charts, star-maps, or bulletins of any kind that could be used as posters to attract the eye? If you will suggest some things of this kind which can be obtained inexpensively, I shall be glad to try them. About the only material in the library on astronomy is Serviss' Astronomy in a nutshell, Evans' Friendly stars, and Mitton's Children's book of the stars, besides the SCIENTIFIC AMERICAN. I would like especially to arouse the school children so as to get them to watch for and use the star maps in the SCIENTIFIC AMERICAN. A. Your suggestions for interesting your people in astronomy are very good. We agree with you that pictures should be hung on the walls to excite curiosity. A large picture of the moon at first quarter and another at the full would be striking. This with a picture of Saturn would perhaps be enough to begin with. A good plain Atlas of the Heavens, such as Burritt's with the constellation figures shown would be desirable on the tables. You would better ask the aid of the University of Minnesota at Minneapolis, and of Carlton College, at Northfield, Minnesota. These colleges can give you much assistance in getting pictures and books. The University is a state institution and will be much interested to assist you.

(13096) I. H. asks: There has been considerable argument over a certain question which I refer to you for settlement. Is it any easier to walk toward the rear than toward the front of a rapidly moving train? Consider the speed as constant. Please state the principles on which your answer is based. A. A person in a closed car in which the air is moving with the car, can walk backward and forward with equal ease so far as we can see. There is no question about it excepting as to the inertia of the person as he goes with the car. And he still moves forward with the car as he walks backward in it. So that his inertia of forward motion is not changed. He is simply trying to move upon a moving car and still go along with it. This he ought to do with no greater difficulty than upon a car at rest.

(13097) X. asks: 1. What is magnesium, and how is it prepared for a flash light? 2. Can anything else be used in place of magnesium, which is cheaper than magnesium? 3. Please give me a formula for such a flash powder. 4. What is the relative lighting value of such a powder? 5. How does an aluminum flash compare with a magnesium flash? 6. Is there anything cheaper which can be mixed with it to make a stronger flash? I do not want chlorate of potash nor anything which would be explosive. 7. Where can magnesium in the mineral form be procured? A. 1. Magnesium is an element, just as iron and copper are. It exists abundantly in nature, being the sixth in the order of abundance in the earth. It constitutes approximately 2.68 per cent of the entire earth. Among the minerals in which it is found are magnesite, dolomite, soapstone, meerschaum, and hornblende. Its sulphate is found in many mineral springs as Epsom salts. Formerly the metal was separated from its compounds by chemical processes, but it is prepared at present by the use of the electric current. It is reduced to a powder by mechanical means, grinding and rubbing, and the finest particles are separated from the coarser by flotation in water or by an air current. Its inflammability renders the use of air for this purpose rather dangerous. 2. Aluminum powder can be used for a flash light, either alone or mixed with magnesium. It is cheaper than magnesium, but not quite so actinic. Aluminum is ordinarily completely burned when blown through a Bunsen flame. 3. A flash light mixture has been made containing magnesium, 2 parts; aluminum, 2 parts, and chrome alum, 10 parts. This is said to burn with little smoke. Powdered aluminum does not require magnesium to ignite it in a hot flame. 4. The actinic quality of the mixture given above would be slightly less than that of magnesium used alone. 5. We have stated under (3) that the actinic quality of an aluminum flash is less than that of magnesium. 6. We do not know any chemical to mix with aluminum other than magnesium for a flash light, which would make a non-explosive mixture and improve the

quality of the light. 7. The magnesium minerals can be procured in America from dealers in minerals.

(13098) D. B. R. asks: What Government stations send out time signals and at what wave length do they operate? A. At the present time the following stations are sending out time signals at the wave lengths indicated: Arlington, 2,500 meters; Key West, 1,000 meters; New Orleans, 1,000 meters; North Head, 2,000 meters; Eureka, 1,400 meters; San Diego, 2,000 meters; Mare Island, 2,500 meters.

(13099) G. H. E. asks: What apparatus is necessary to receive signals from the Arlington station? I am located 700 miles distant. A. The most suitable apparatus would consist of an inductive tuner, an Audion detector, a pair of high grade telephone receivers, and two variable condensers—one for the primary circuit of the inductive tuner and the other for the secondary. While a crystal detector could be employed, it would not be sufficiently sensitive to insure the reception of the Arlington signals under adverse conditions.

(14000) C. J. asks: 1. Has the ocean ever actually been measured in depth? If you will please answer this question and tell me how it was done I shall be very thankful. 2. There is one more very queer question. Why did not the *equinox* of this fall come Sept. 23 as it should, but instead it came Sept. 27? I have sent this question to several of the Boston papers, but they can give no satisfactory reply. A. 1. The bottom of the ocean has been reached by sounding in every place where sounding has been attempted. You will find full descriptions of the sounding apparatus and the depths reached in a very complete work called, "The Depths of the Ocean," by Sir John Murray, who was an authority upon this subject. We can send you the book for $7.50. The sounding of the deep sea is done just as any sounding is done by sending a weight down, only in this work an iron weight and a steel wire are used and not a lead weight and a line. 2. The Autumal Equinox this year was on September 23, at 10 hours 24 minutes in the evening by Eastern Standard Time. The equinox cannot occur as late as September 27 in any year. The interval is the same each year between two autumnal equinoxes, but the day of its occurrence varies somewhat because of the allowances for leap year. Our Calendar Years change their length by a day every fourth year, and this causes a change in the dates of the equinoxes.

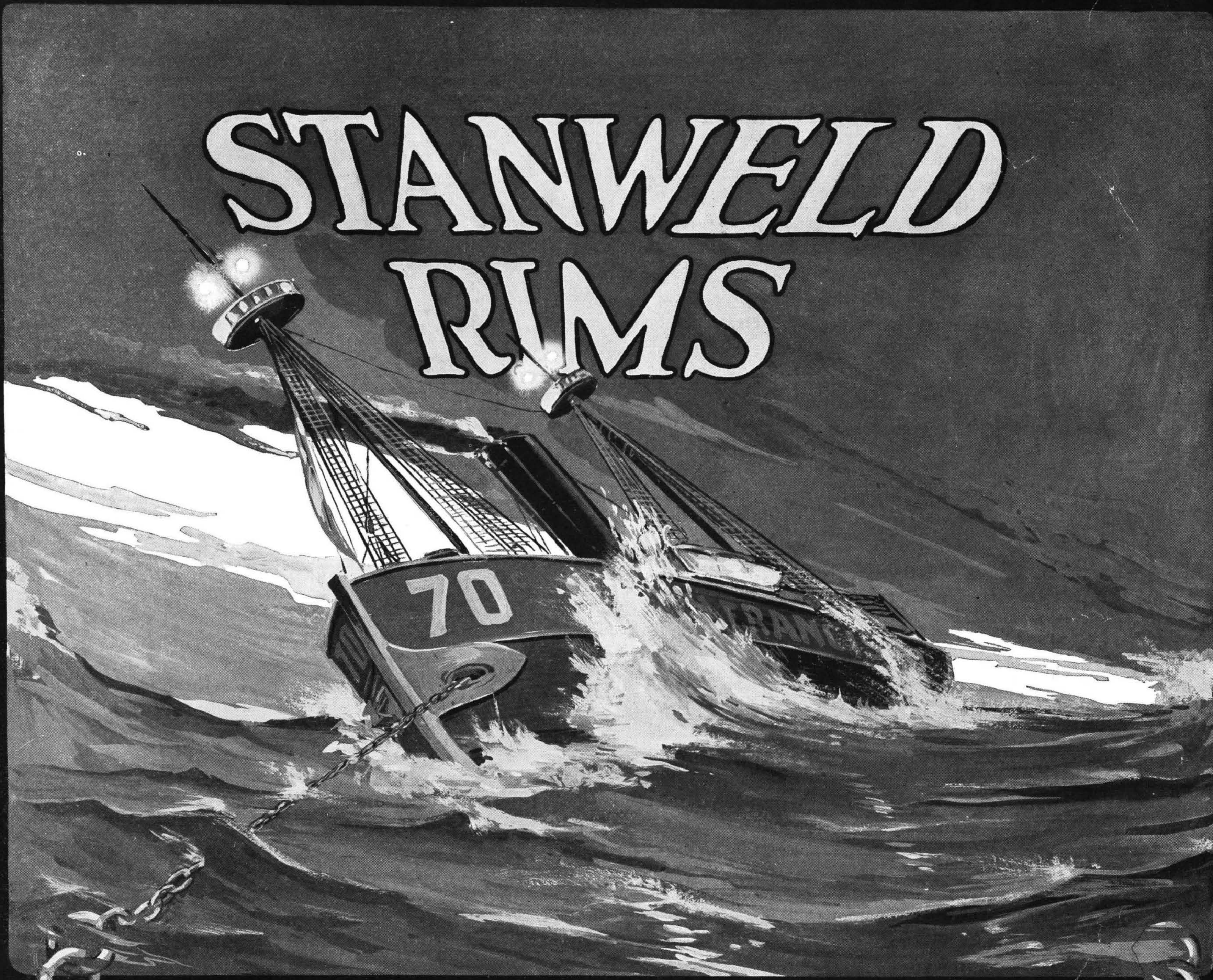
(14001) J. L. P. asks: 1. Please give the derivation of the formulas $H = \frac{2\pi IT}{r}$ for magnetic coils, and $H = \frac{2I}{r_1}$ for a long straight conductor, where I = current, T = turns, r = radius of coil and r_1 = the distance in centimeters from a long straight conductor. 2. What would be the cost per watt-hour of electrical energy generated by a zinc-carbon sodium chloride battery? What is the voltage of such a cell? Is there any kind of battery which generates electrical energy cheaper than the zinc-carbon sodium chloride battery? A. 1. The derivation of the formulas which you give is quite too lengthy for Notes and Queries. It may be found in part in Stewart and Gee's Elementary Practical Physics, Vol. 2, on Pages 214 to 229, or in Pender's American Handbook for Electrical Engineers, in the Chapter of Electricity and Magnetism, pages 383 to 411. A full demonstration is given in J. J. Thompson's and Maxwell's works. All these freely employ the calculus, without which a full demonstration is not easily made. 2. We can find no figures for the zinc-carbon sodium chloride cell, nor have we seen or known of one for many years. It may have been cheap but it could not keep a place for itself. We have set one up and measured it for you. It gave three amperes on short circuit and had less than half a volt. The cell is very little cheaper than a LeClanche cell but electricity from it would be very expensive. More than that the current dropped to half its value in the first minute through polarization, for which the cell makes no provision.

(14002) G. C. F. writes: In your issue of August 7th, in the Notes and Queries department, No. 13067, W. M. asks if the sun ever sets on the United States or its possessions. Your answer is, in substance, that from the most eastern point in Maine, to the western extremity of the Philippine Islands is 176 degrees 35 minutes of longitude, or 3 degrees 25 minutes short of half way around the globe. This, you state, represents 13 minutes 40 seconds in time, or allowing for refraction, there is actually 9 minutes 8 seconds when the sun is not shining anywhere on United States territory. Have you not made a slight error? While the most eastern point of Maine is 66 degrees 45 minutes west longitude, Porto Rico, according to the Encyclopedia Britannica, extends 1 degree 15 minutes farther east, or longitude 65 degrees 30 minutes. Taking these figures, the United States possessions extend through 177 degrees 50 minutes of longitude, or only 2 degrees 10 minutes short of half way around the earth. This represents, we believe, 8 minutes 4 seconds of time, or, allowing for refraction, an actual expiration of about 3½ minutes between the setting of the sun on the Philippines and its rising upon Porto Rico. If refraction can bend the sun's rays so that they come so very near shining or United States territory during the entire twenty-four hours of the day, it is, as you intimate, a poor campaign orator who cannot bend them the rest of the way. A. We have not received any other letter about the query whether the sun shone all the twenty-four hours upon the domain of the United States. We confess that we overlooked little Porto Rico, but she well deserves to be taken into the account. We will do so. According to the best figures we can find the eastern point of Porto Rico is in longitude 65 degrees 13 minutes 40 seconds west. The farthest point of the Philippines is according to the Encyclopedià Britannica in 116 degrees 40 minutes east. The latest edition of Bowditch's Navigator, issued by the U. S. Hydrographic Office in 1914, gives the horizontal refraction as 36 minutes 29.4 seconds. Calculating the distance in degrees from these data, we find that the American domain extends over 178 degrees 6 minutes 20 seconds, while refraction extends the sunshine 1 degree 12 minutes 58.8 seconds. The sunrise band covers 179 degrees 19 minutes 18.8 seconds, leaving 40 minutes 41.2 seconds of the semi-circumference, or in time 3 minutes 7.47 seconds from sunset on the western point of the Philippines to its rise on the eastern point of Porto Rico. This is the best we can do for the United States.

(14003) J. D. Asks: 1. If a train was running at a speed of sixty miles an hour and a man is sitting on the back end of this train with a gun that would shoot at the rate of sixty miles an hour, and he shoots from the back end of this train in opposite direction, what effect would this condition have on the bullet? 2. If the man with the gun was on the front end of this train and was to shoot back at a man on the back end of train and train to be going sixty miles per hour and the gun would shoot at the rate of sixty miles an hour what would be the result? A. 1. In the case you propose the bullet after it left the gun would still move forwards with the speed of the train and backwards with the speed given it by the powder. Since these two speeds are equal and opposite in direction the bullet would drop to the ground directly under the point where it left the gun. 2. In this case the man at which the bullet was shot would be killed, if the aim was good. This may be made clear perhaps by asking if you could not throw a ball on a train to a man to the rear of the place where you were standing? Could you not toss a biscuit to a person in the next seat in a car either toward the front or rear? If you could toss a biscuit you could fire a bullet in either direction and with the usual result when a bullet is fired. This matter seems very simple to us. We do not know why it causes so much discussion.

(14004) E. R. S. Asks: 1. Can you give me the different products of the Solvay process, and also their practical use and value? 2. If you place a given weight of water in a barrel or tank and add a given weight of live fish, what would be the result in weight of the amount of water the fish would naturally displace? A. 1. The Solvay process is for the manufacture of sodium carbonate from sodium chloride. The uses of sodium carbonate are many. Its most familiar use is for washing. It is the common washing soda. It is also used in making glass, and soap, and in making other sodium compounds. The value of glass and soap you doubtless know. 2. If a live fish is put into a tank containing water, and the air bladder of the fish is not distended so that the fish sinks, the water displaced weighs less than the fish. If the air bladder is distended to such an extent that the fish just remains under the water without rising or sinking, the fish displaces its weight of water. If it floats with its back fin out of water it displaces its weight of water. These three are the possible cases. It might also happen that the fish assisted itself to remain without sinking by the use of its balancing fins. It then displaces less than its weight of water.

(14005) J. H. W. asks: 1—Is it a fact that ivory possesses a greater degree of elasticity than rubber? 2—Does a golf ball flatten out to the extent of 25% of its diameter upon being struck for a drive with a wooden club? I realize that in the latter question the extent to which the golf ball would give would be somewhat dependent upon the make of the ball and the force of the blow. In answering the question, please consider it as relating to an ordinary golf ball when struck for a drive of say 200 yards under average conditions. A. 1—Elasticity is the property of the recovery of size or shape after distortion. All bodies are more or less elastic. Probably no solid is perfectly elastic, so that it comes immediately back to its original size and shape. Ivory will doubtless recover quicker than india rubber. The limit of elasticity is the amount which a body can be distorted and still recover. Rubber has a greater limit than ivory. When a body takes a different size or shape after distortion it is said to have a set. Rubber usually does not recover wholly after any considerable stretching or pressure. Rubber also loses its elasticity completely after some time. Ivory retains its elasticity indefinitely. In this latter sense ivory is more perfectly elastic than rubber. Each is valuable in its place, and neither can take the place of the other. Billiard balls cannot be made of rubber, nor can elastics be made of ivory. 2—We have no figures for the flattening of a golf ball when struck, but we hardly think it is as much as 25%. We should think it would crack before it yielded so much. Make an estimate of the force of the blow in pounds and place a ball under the weight equal to that number of pounds. You can then see how much the ball is flattened by the weight.



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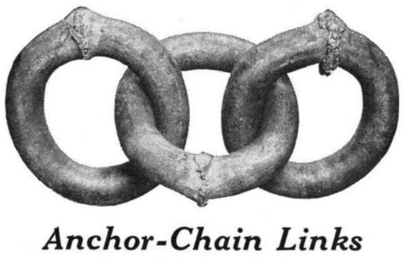

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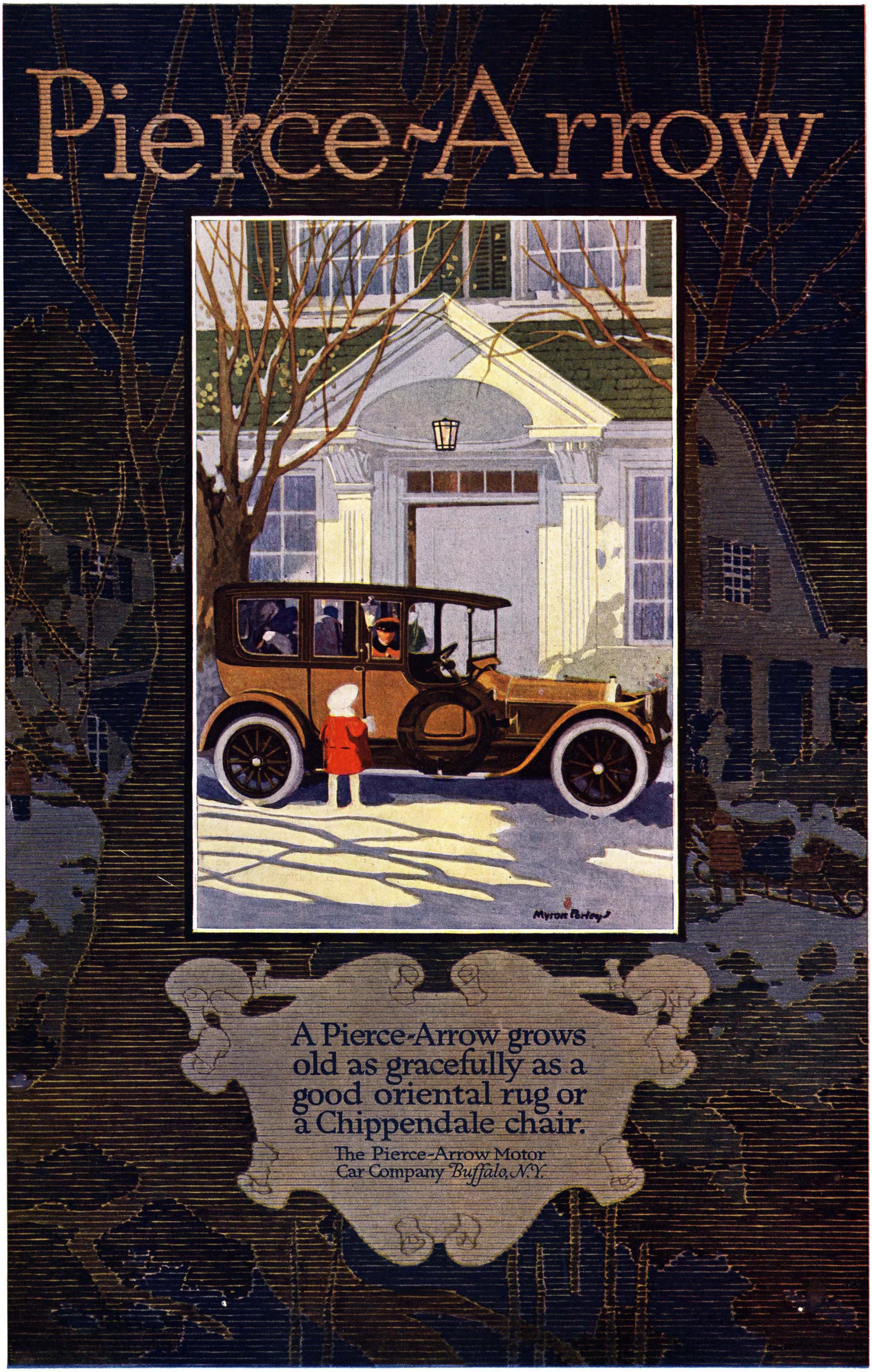

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