Critical analysis of motor cars of 1914

Howard Earle Coffin, Hudson Motor Car ...

Critical Analysis of Motor Cars of 1914

By Howard E. Coffin

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Publisher's Preface

THIS book is published to promote interest in Hudson six-cylinder automobiles.

Mr. Coffin is the Vice-President of the Hudson Motor Car Company, but in this critical analysis of the motor cars of 1914 he barely mentions the Hudson Six 54.

He has treated the subject in hand as thoroughly and as clearly as though he had no interest in any one motor car manufacturer.

We feel, however, that the information he has given and which is based upon his experience is of such vital interest to the motor-buying public that we undertake the distribution of his book.

Naturally we want the public to be interested in six-cylinder automobiles and naturally we desire them to buy Hudson automobiles.

This book is not printed with any other aim than to fairly present the conditions and to frankly admit the purpose that inspires its distribution.

HUDSON MOTOR CAR COMPANY

Author's Preface

A FLATTERING amount of public interest has always been centered in the automobile business.

Facts about the design, manufacture and performance of motor vehicles generally, have seemed to exert a peculiar appeal.

The pleasure car, the motor truck and the spectacular though less useful racing machine—each has had its great share of attention.

The automobile has supplanted the "weather" as the great national topic of general conversation.

The car owner talks "shop" upon every possible occasion.

New fuels, new inventions and new models give him ample ammunition. The would-be owner dreams of the new car and his family see to it that his dreams are made to come true.

The street urchin knows every motor vehicle at sight and longs for a more intimate acquaintance.

Women are not supposed to know much of things technical, but do appreciate beauty of line, luxury and comfort.

For all I am confident these pages will hold something of interest.

HOWARD E. COFFIN

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Howard E. Coffin

Critical Analysis of Motor Cars of 1914

The Conquest of the Six

THE first and biggest problem which will confront many buyers of 1914 cars is the question of the four versus the six-cylinder motor.

One good demonstration will be enough to convince the intending purchaser of the superior road performance of the six, but the salesmen of the four-cylinder cars will have given him many arguments against it.

He will have been told that in both first cost and maintenance expense the six will be higher than the four, that a great deal more gasoline will be used in six cylinders than in four, and that the added mystery, complication and trouble in two extra cylinders will prove a terrible cross.

He will have been told also that the six is merely a passing fad—the toy of those who do not care for expense and a type sure to be discarded within another year.

Now this line of argument is exactly the same as that used a few years ago against the four. Single and double-cylindered motors were then largely in vogue in America. Nevertheless, the four was found to be a great step in advance over the two and the one, and in just the same way progress in design has placed the six a great step beyond the four.

The adoption of the six by the leading makers of this country has not shown a multiplication of troubles any more than did the four over the two and the one. As a matter of fact, more troubles are even today experienced with two-cylinder and one-cylinder cars than with either 4's or 6's.

Many of the leading makers of the country have come to the six gradually; many, who are this year building 6's only, have for several years built both 4's and 6's.

There are one or two notable examples among the six cylinder builders who three years ago stated that they would never build anything but 4's. It is hardly conceivable that these concerns would revise the entire manufacturing policies of their great plants, discard old equipment and add new at the expense of many thousands of dollars, unless there were some very definite and tangible reasons in the claims for the superiority of the six.

In short, *the six has conquered the four,* just as in years past the four conquered the three, the two and the one.

Anyone doubting this statement has only to study the following tabulation by years of the products of the leading factories of this country:

MODELS BUILT

Showing Progress of Six-Cylinder Development

Name	Early Models	1908	1910	1911	1912	1913	1914*
Pierce	1	4–6	6	6	6	6	6
Winton	1–2	6	6	6	6	6	6
Peerless	..	4–6	4–6	4–6	4–6	4–6	6
Stevens-Duryea	3	4–6	4–6	4–6	4–6	6	6
Lozier	..	4–6	4–6	4–6	4–6	6	4–6
Stearns	2	4	4	4	4	4–6	4–6
Franklin	..	4–6	4–6	4–6	4–6	4–6	6
Oldsmobile	1–2	4–6	4–6	4–6	4–6	6	6
Premier	..	4–6	4–6	4–6	4–6	4–6	4–6
Mitchell	..	4	4–6	4–6	4–6	4–6	4–6
Locomobile	Steam 2 cyl.	4	4	4–6	4–6	4–6	6
Pope	1	1–4	4	4–6	4–6	4–6	6
Packard	1	4	4	4	4–6	6	6
Chalmers	..	4	4	4	4–6	4–6	6
White	Steam 2 cyl.	..	4	4	4–6	4–6	4–6
Garford	..	..	4	4	4–6	4–6	6
Hudson	..	..	4	4	4	4–6	6
Studebaker	1	4	4	4	4	4–6	4–6
Speedwell	..	..	4	4	4	4–6	6
Herreshoff	..	4	4	4	4	4–6	4–6
Cole	..	..	4	4	4	4–6	4–6
Marmon	..	4	4	4	4	4–6	4–6
Maxwell	1–2	1–2–4	2–4	2–4	4	4–6	4–6
Oakland	..	2	4	4	4	4–6	4–6
Kisselkar	..	..	4	4	4	4–6	4–6
Stutz	..	..	..	..	4	4	4–6
American	..	4	4	..	4	4	4–6
Moon	..	4	4	..	4	4	4–6
Buick	1–2	2–4	4	..	4	4	4–6
Abbott	..	..	..	..	4	4	4–6
Haynes	2	4	4	4	4	4	4–6
National	..	4	4	4	4	4	4–6
Henderson	..	..	..	..	4	4	4–6
Marion	..	4	4	4	4	4	4–6
Velie	..	..	4	4	4	4	4–6
Chandler	..	..	..	..	..	..	6
Rambler	1	4	4	4	4	4	4–6
Cadillac	1	1–4	4	4	4	4	4
Reo	1–2	1–2	4	..	4	4	4
Overland	..	4	4	..	4	4	4
Moline	..	4	4	..	4	4	4
Hupmobile	..	..	4	4	4	4	4

*This information is as accurate as can be obtained at this date.

The arguments of a higher first cost and a greater expense in upkeep can no longer be advanced as favoring the four over the six.

Medium and even low-priced 6's are being announced for this season.

In gasoline consumption they compare favorably with 4's of equal power. In road performance they will be found far superior. In tire economy and in the decrease in expense due to wear and tear the balance sheet must favor the six.

The smaller cylinder diameters, the lighter reciprocating parts, the lesser shocks upon pistons, bearings and transmission mechanism, the overlapping of the power impulses, the greater number of these impulses and the absence of vibration at all speeds leave little for argument between the total operating costs of these two motor types.

The differences in performances of the one, the two, the three, the four and the six, are based upon nothing that is mysterious, indefinite or intangible.

The advantages which have been attained through each increase in the number of cylinders may be shown graphically in a most simple and convincing manner. No argument, either of theory or practice, can weaken the conclusions drawn. Twelve years of engineering and commercial progress in one of the greatest of the world's industries bear ample witness to their truth.

In the diagrams on subsequent pages may be seen the five stages in the evolution of the automobile engine. The third stage, the three-cylinder, has never been an important commercial factor for vehicle use. The five cylinder has never been considered seriously because of structural difficulties and because of the peculiar problems of running balance encountered by the five throw crank shaft.

The progress in gas engine construction outlined in these diagrams may, speaking generally, be said to cover that period of time since 1900—in short, the commercial life of the horseless vehicle to date. Within this time we have seen the hesitating and uncertain single cylinder of infancy grow into the smooth, powerful six-cylindered sweep of a great industry.

In considering the diagrams which follow it is necessary that we appreciate and remember two things:

Firstly, that, without regard to the number of cylinders combined in one power generating unit as a "motor" each individual cylinder is a gas engine within itself and that its functions are therefore those of the single-cylinder motor. The joining of cylinders upon a common crank case, the utilization of a common crank-shaft and a common cam-shaft may give us the "two," the "four" or the "six," but cannot in any way affect the cycle of operations within the individual cylinder.

The cycles of the cylinders of a multiple engine will be timed, the one with the other, to deliver power impulses to the common crankshaft during equally-spaced intervals of time, but that is all. The gas mixture of the two, the four or the six may be taken through a common carburetor and the exhaust may be carried away in a common "header," but operations within each cylinder are still the operations of the single-cylinder engine.

Secondly, and even more carefully, we must bear in mind the true ideal of the automobile industry. Much money has been made, but much more has been lost in this business and if the mere coining of dollars had been the great and only aim of the engineer and of the manufacturer, progress might long ago have ceased.

But from the beginning there has been progress—a pace so rapid that the business has become known as "a young man's business."

Old methods and old processes have been found wanting and new and better ones have been invented and substituted.

Twelve years of marvelous growth in automobile building have revolutionized our very methods of life and have done more for the advancement of the mechanical arts than has a century of the history of any other industry.

And all through these years, within the brain of the engineer and within the mind of the manufacturer, who backed that brain with his money, one ideal has been foremost. To build the most perfect automobile in the world and at a price within the means of the greatest number of people has been and is that ideal.

Always, therefore, we have progressed toward the better, the more comfortable and more nearly perfect car.

Now, let us consider the diagrams, Figures 1 to 9, and their vital bearing upon the realization of this ideal.

In the complete cycle of the operations within each cylinder of any four-cycle engine there are four piston strokes—two inward toward the crank-shaft and two outward toward the head of the cylinder. Let us assume for the purposes of our calculations that we desire our engine to develop 40 horsepower. If we assume that for each 7 1-2 cubic inches of piston displacement in our cylinder we obtain one horsepower (approximately correct assumption), then to develop 40 h. p. our cylinder or cylinders must have a total volume of 300 cubic inches of piston displacement. By piston displacement is meant the total volume swept through by the piston or pistons of a motor during the one working stroke.

Consider the four strokes of a single-cylinder engine's piston.

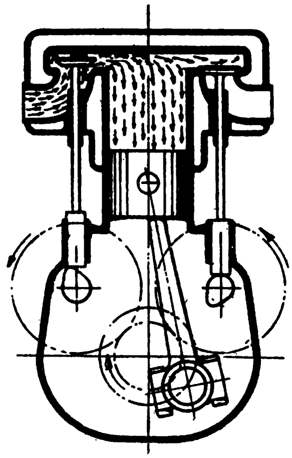


Figure 1

1st stroke—suction stroke—inlet valve open—gas drawn through carburetor and inlet valve into cylinder. Crank-shaft moves one-half of a complete revolution, piston moves from upper end of cylinder to lower end of cylinder.

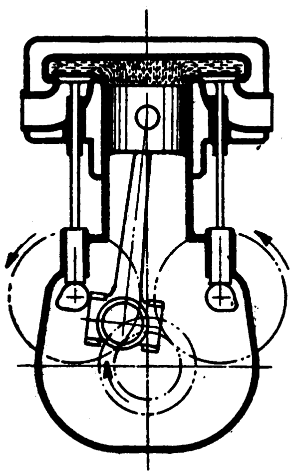


Figure 2

2nd stroke—compression stroke—gas compressed into small space left between piston and cylinder head. Pressure about 60 lbs. per square inch on piston head—crank-shaft completes first revolution—piston moves up to top of cylinder, thus compressing gas.

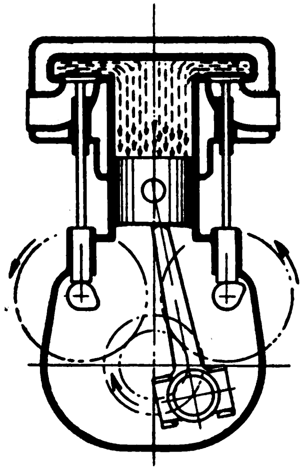


Figure 3

3rd stroke—working stroke—gas is ignited by electric spark—piston is forced by explosion to travel downward in cylinder just as bullet in gun. Force of explosion transformed into rotative effort by connecting rod, crank and crank-shaft. This effort transmitted to flywheel through crank-shaft—crank-shaft makes third half revolution and piston returns to lower end of cylinder. Exhaust valve opens before piston reaches bottom of stroke.

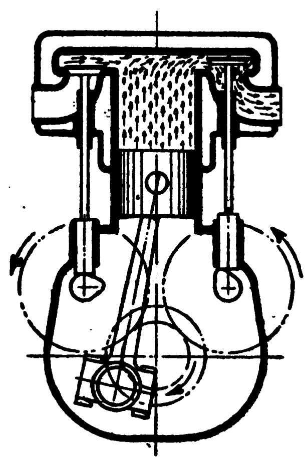


Figure 4

4th stroke—exhaust stroke—exhaust valve open—momentum of flywheel rotation caused by explosion of gas during third stroke causes crank-shaft to make fourth half revolution, carrying piston again to the upper end of the cylinder and pushing out through the exhaust valve the burned gases remaining from the explosion.

Now, if we consider starting the motor from a standstill, it is clear that the first two strokes—those of suction and compression—must be performed by the hand of the operator or by some other power outside the motor itself. Moreover to compress the gas in the cylinder to 60 lbs. pressure requires considerable work.

It is equally clear that, with the motor once started and running under its own power, the one working stroke of the piston must supply sufficient energy to carry on the operations of those three strokes which not only produce no power, but actually use up power in friction and in work of compressing the charge.

Each cylinder develops power only during the time the force of explosion is acting upon the piston head.

Now this explosion force acts merely while the piston travels from the upper dead center on the working stroke downward to the point where the exhaust valve opens. This exhaust is usually opened about 45 to 55 degrees "early" measured upon the flywheel, or a little less than one-sixth of the piston travel from the bottom of the working stroke.

Because of structural reasons, necessary valve timings, etc., we cannot depend upon even our working stroke to generate power for much more than five-sixths of the piston travel during that period of the cycle.

Therefore, if we assume for convenience a stroke of six inches, it follows that only about five inches of the piston travel during the one working stroke is really available for power generation. Now the piston during the entire cycle makes, as we have shown, four strokes of six inches length each or twenty-four inches in all—*but during only five inches of this twenty-four is the piston self-propelling.* During the other nineteen inches of its travel it must be driven through its operations of suction, compression and exhaust by the momentum of the flywheel.

Clearly, then, not all the energy imparted through the crank-shaft to the flywheel is available for doing outside work—some of this energy must be put back into driving the piston and crank-shaft during three non-working strokes, into stopping and starting the reciprocating parts twice in each revolution, and into the work of valve operation.

In addition to the work mentioned, the new charge must be compressed to perhaps 60 pounds pressure per square inch during the "compression stroke."

Let us now observe from the charts shown in Figures 5 to 9, page 15, the effects of an increase in the number of cylinders —in reality the effect of grouping two or more single cylinder gas engines upon a common crank case and a common crank-shaft with common flywheel. Let us still assume that we desire 40 h. p. and hence must have 300 cu. in. of piston displacement.

If the shaded portions in the chart be made to represent in each instance the piston displacement during five-sixths of the working stroke, then the parallelograms shown under the headings of "single cylinder," "two cylinder," etc., may be said to represent proportionally the conditions of the cycle of operations in each motor.

Moreover, by superimposing the parallelograms of the individual cylinders of the motor, we are able to judge as to the character of our power delivery and as to the internal stresses set up within the working parts of forty-horsepower motors of different numbers of cylinders.

Under single cylinder, Figure 5, page 15, we have a parallelogram 24 in. long—the distance of piston travel during one complete cycle. Five inches of this twenty-four (the shaded portion) represent the effective part of the working stroke and the area of the shaded portion is proportional to the total piston displacement as five is to six.

This shaded portion, then, in each cylinder's cycle is proportional to the piston displacement of that cylinder and is necessarily proportional to the amount of power developed by that cylinder, the amount of total pressure exerted upon bearings and the strains throughout the entire driving mechanism incident to the application of the motive power to the wheels of a car.

The diagrams on the next page show in graphic form the effects of dividing a given power among different numbers of cylinders.

Piston displacement of 300 cubic inches and a piston stroke of 6 inches assumed for each motor. Effective length of power stroke taken as ⅚ of full stroke or 5 inches. Shaded areas show lengths of effective portions of working strokes. Unshaded areas show lengths of piston travel during which power is being consumed instead of produced.

Shaded areas also are proportional to piston displacements in individual cylinders—proportional to maximum pressures or blows upon piston heads and motor bearings—proportional to flywheel weights—also to strains set up throughout transmission and rear axle mechanism.

There is also shown graphically the overlapping of the effective power strokes of the six—also the gaps between the power strokes with any lesser number of cylinders.

The usual explosive pressure of 300 pounds per square inch of piston area is assumed.

SINGLE CYLINDER

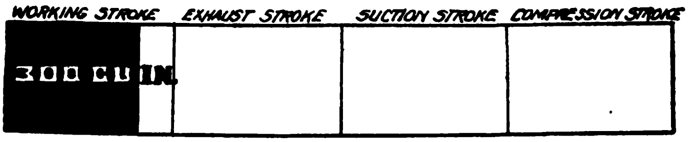


Figure 5

Maximum load on piston and bearings 15,000 lbs. Gap of 19 inches of piston travel between power impulses. Running balance imperfect. Very heavy flywheel necessary. Crank on dead center twice in each revolution—four times in each cycle.

TWO CYLINDER

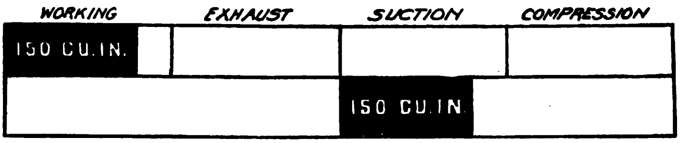


Figure 6

Maximum load on each piston and on bearings 7500 lbs. Two gaps of 7 inches each between power impulses. Running balance imperfect. Flywheel one-half of weight needed for single cylinder. Both cranks on dead center at same time twice in each revolution—four times in each cycle.

THREE CYLINDER

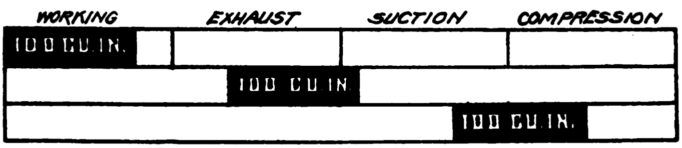


Figure 7

Maximum load on each piston and on bearings 5000 lbs. Three gaps of 3 inches each between power impulses. Running balance imperfect. Flywheel one-third weight needed for single cylinder. Only one crank on dead center at one time.

FOUR CYLINDER

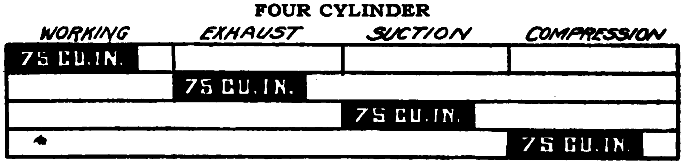


Figure 8

Maximum load on each piston and on bearings 3750 lbs. Four gaps of 1 inch each between power impulses. Running balance imperfect. Flywheel one-quarter the weight needed for single cylinder. ***All cranks on dead center at same time twice in each revolution—four times during each cycle.***

SIX CYLINDER

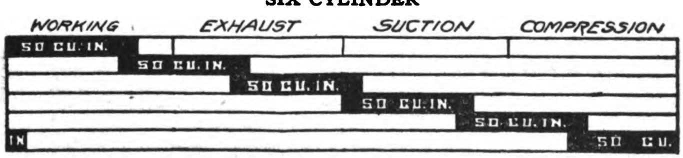


Figure 9

Maximum load on each piston and on bearings 2500 lbs. Six overlaps of 1 inch each in power generating strokes of pistons. ***Continuous power.*** Running balance perfect. Flywheel weight only one-sixth that needed on single cylinder. ***Only two of six cranks ever on dead center at the same time.***

Note that in the six, Fig. 9, there are six working strokes of 5 inches each or 30 inches in all during two revolutions while one piston travels only four 6-inch strokes or 24 inches in all. 30—24=6 inches of over-travel of power strokes or one inch overlap in each.

It will be seen that, with two cylinders, Figure 6, the tremendous explosive force necessary to produce 40 h. p. in the single-cylinder engine, is divided just in half. In the four-cylinder, Figure 8, the force acting on each piston head is only one-quarter that of the single cylinder and the bearing pressures, strains, etc., are also quartered. By the same token these pressures, loads and strains in the four are 50 per cent greater than in the six.

This fact within itself goes far to explain the lower cost of upkeep of the six-cylinder car over that of the car of any other lesser number of cylinders having equal total displacement.

But this is not all of the story by any means.

In motors of varying cylinder numbers, it will be seen that in the six-cylinder only, Figure 9, can overlapping working strokes be had. Clearly, then, from six cylinders and from *no fewer number of cylinders* can continuous power be obtained.

Even in the four-cylinder motor all cranks are on dead center at the same time twice for every crank-shaft revolution or four times for every complete cylinder cycle.

In the six with its one hundred and twenty degree spacing of crank pins, two cranks only of the six can ever be upon dead center at the same moment of time.

As is shown in the diagram of the six-cylinder motor, Figure 9, there can never be a time when one or more of the six cylinders are not delivering power to the crank-shaft.

A six-cylinder motor thus is producing continuous power during all of the time that it is running. The one, the two, the three and the four-cylinder motors are producing power only during the effective portions of the working strokes and must eat up power which has previously been delivered to the flywheel, to carry through the gaps or portions of the piston travel when the motor is not within itself generating power.

Hence, the great superiority in performance of the six-cylinder engine over that of any lesser number of cylinders. Hence the great superiority of the six in flexibility, in hill climbing, in economy of operation and lower upkeep cost, in quietness and freedom from vibration.

This latter item—the absence of vibration—is a wonderful quality. The effect of vibration in tiring the occupants of a car during a long ride is not generally appreciated. A day's road work in a six-cylinder car leaves the driver and passengers feeling decidedly fresher than with a car of any lesser number of cylinders.

Vibration in a motor car is, after all, merely misdirected energy. To shake the lamps, the fenders, the body and the passengers within the car, requires the expenditure of a very considerable amount of energy. This energy must be supplied by the motor and this energy wasted in producing vibration must be subtracted from the power of the motor effective for driving the car.

Hence, in any motor of a fewer number of cylinders than six, there will be found a certain percentage of power dissipated in objectionable vibration. Moreover, this vibration is very injurious and destructive to the entire mechanism and absence of vibration must mean a lessening of wear and tear upon all parts of the car.

One sometimes hears the question: "Admitting that the six cylinder is a more perfect motor than the four, would not the eight cylinder be better than the six?"

The answer is: "No!"

In the six we come near to perfection in many things. We have the fewest number of cylinders that will give us the overlapping power strokes and the advantage of continuous power. We have a disposition of cranks which assures us of a perfect running balance and an absence of all vibration. We have an easy carburetor action through a simple manifold. In the six we have the shortest and lightest motor in which we can even approximate these results without building the complicated V type employed in the few instances where the eight cylinder has been adapted to motor vehicle uses.

For marine work the "eight" is usually built up by joining together two fours, each retaining its own carburetor, etc. For car purposes the eight has usually been formed by V-ing the cylinders into a common crank case, fitting two connecting rod bearings to a common crank pin, and doing many things of a doubtful commercial possibility.

There is little of general interest in a discussion of the eight.

Summary of Advantages of Six-Cylinder Motor

Continuous Power—overlapping of strokes.

Perfect Balance—absence of vibration at all speeds.

Lessened shocks to pistons, bearings and transmission mechanism—because of smaller cylinder diameters. These shocks are 50% greater in a four cylinder than in a six of equal power.

Lighter reciprocating parts—hence a quicker and more flexible motor. Less power lost in overcoming inertia of heavier reciprocating parts.

Lessened fuel consumption—gear shifts seldom necessary even in city traffic—acceleration without rich mixture—practically all work on high gear—motor idles more slowly—no losses in vibration at any road speed.

Decreased tire wear and cost—through steady application of power.

Decreased upkeep expense—because of absence of vibration and lessened wear and tear of lighter power impulses.

Lighter flywheel—lesser strains through sudden letting in of clutch.

Greatly increased comfort—greater mileage without tiring passengers.

Motors

CONSIDERABLE difference in motor practice is still to be noted among the cars of reputable makers.

The "L" head and the "T" head are the predominant types. Rather one may say the "L" head is the predominant type, with the "T" head as a second.

There are a few instances of the so-called valve-in-the-head construction and a few notable instances of the valveless or non-poppet valve type.

Beyond the few makers who adopted the non-poppet type (the Knight and similar engines) two or three years ago, there has been little or no tendency toward such designs. There seems to be a very generally accepted feeling, both in Europe and America, that improvements in the old-fashioned poppet valve and its operation have made it so simple and so generally noiseless and satisfactory in its action, that there is little if anything to be gained by an adoption of these more expensive and more complicated types.

All valve-operating mechanism must be enclosed for lubrication and protection from dust. The reason valve gears wear out and get noisy is because of lack of proper housing. The great weakness of the "valve-in-the-head" construction is that guides, rocker arms, bearings, etc., are usually left without adequate means of lubrication and with no protection against dust and wear.

While neither the bores nor the strokes of motors in this country have been carried to the extremes noticeable in Europe, it may be said that bores for 1914 are decreased rather than increased and that strokes are increased in a moderate degree.

It would seem that the general acceptance of the six-cylinder motor in this country would tend to keep the bore-stroke relation within reason. There seems to be a feeling that while wonderful results have been obtained particularly in Europe with four-cylinder racing cars through the use of extremely small bores and abnormally long strokes, it does not follow that such practice gives the best commercial "Six."

Pistons and connecting rods are being lightened, both in Europe and in America. Europe first discovered the advantages in added power and in running qualities to be obtained by this practice.

One French designer has made the statement that he would rather take one ounce from each of the pistons in his motor than to reduce the final weight of the finished car by 100 pounds, and the results obtainable by a lightening of the reciprocating parts would seem to bear out this statement.

The lightening of reciprocating parts and the added number of cylinders of the six-cylinder motor have materially reduced the flywheel weights and hence the strains possible in the driving gearing through the sudden letting in of the clutch by the inexperienced driver.

The lightening of all these parts mentioned has made greatly for the increase of power from a given piston displacement and for snappier and quicker motors.

We believe that such changes will be found in many of the 1914 models. They are the direct result of experience and experiment and of a close observation of foreign progress.

Maximum loads and shocks upon pistons, bearings and transmission mechanisms increase rapidly with any increase in cylinder diameters. For instance, assuming the usual figure of 300 lbs. of explosive pressure per square inch of piston area, we have

Cyl. Diam.	Piston Area		Lbs. per Sq. In.	Total Force
3½	9.621	x	300 =	2886.3
4	12.566	x	300 =	3769.8
4½	15.904	x	300 =	4771.2
5	19.635	x	300 =	5890.5

The great advantages of the smaller cylinder diameters are clearly apparent. It is much better to divide the power among six small cylinders than among four large ones.

The practice of casting cylinders in blocks of three and four is decidedly on the increase. A few 1914 6's show all six cylinders cast in one block, but most of these newer motors show two blocks of three cylinders each.

Some of the larger motors still adhere to blocks of two, especially where both 4's and 6's of the same size cylinders are built. The blocks of six, while perhaps cheaper to manufacture, present difficulties of handling and in repair and replacement in the hands of the owner.

Only one or two makers now build even four-cylinder motors with cylinders cast singly, as such a construction necessitates added length and weight in the motor as a whole, added bearings upon the crank-shaft and a heavier crank case to keep these bearings in proper alignment. There are also the added water and other connections—hence added joints and chances for trouble.

A short motor with a heavy crank-shaft with three or four bearings gives a construction much to be preferred to a long motor with five or seven crank-shaft bearings and the lighter crank-shaft usually employed with the mistaken idea that an increase in the number of bearings makes such practice permissible.

As a matter of fact, it is the twist in the long crank-shaft of moderate diameter that is responsible for many motor troubles. If the shaft is made large enough to withstand this twisting action, there will be little fear as to the sufficiency of shaft strength or of the bearing surfaces in any well designed motor.

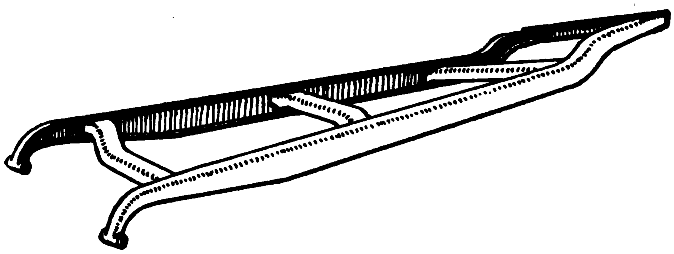
Here there is no longer need of experiment or failure. The bearing pressures permissible in an automobile motor are now of engineering record and with our better understanding of the principles of lubrication there should be no occasion for trouble in any car reasonably well cared for by its owner.

Among the advantages of casting the cylinders in blocks may be mentioned a more uniform cooling, resulting in equal cylinder temperatures, added rigidity to the motor, permitting of a lightening of the crank case construction, and a much more perfect alignment of the cylinder bores, one with the other.

Four-Point and Three-Point Suspension

THE best argument of the advocate of three-point suspension gives us the strongest reason for the use of the four-point system.

We need say very little as to relative merits. We will merely reproduce a little sketch often used to show the need of the three-point system.



Now this sheet metal frame within itself is clearly a very poor and flimsy foundation upon which to erect any structure.

While the frame side rails, if properly designed, are very stiff and strong in vertical plane, it is clearly impossible to brace the frame within itself to withstand twists.

As a matter of fact, if this rectangular pressed steel frame were laid upon a level floor, one corner might easily be lifted half a foot without disturbing the other three corners.

Clearly the car body with its light panels and door openings, the radiator, and the sheet metal work of the superstructure cannot be depended upon to strengthen this frame as a foundation.

Yet this is exactly the assumption of the three-point suspension enthusiast. He strangely overlooks the one strongest element of the entire construction—the crank case of the motor—to which he may safely tie the side rails of the frame in such a way that a real foundation may be provided for the lighter and weaker parts of the superstructure.

He carefully cradles the motor or power plant on three hangers or trunions and feels that he has accomplished a worthy end. He will dilate at length upon the advantages of relieving the big, strong brute of a power plant of all road strains, but will forget to say just where these strains are finally taken.

But why argue in detail?

The car springs are interposed between axles and frame to cushion and take care of road shocks.

Any properly designed aluminum crank case will safely brace the frame at four points against the shocks transmitted through the springs.

Moreover, with this four-point suspension of the crank case the frame will withstand these shocks and will not transmit them to the lighter parts of the superstructure.

Many of the best cars in the world have four-point suspension. The HUDSON has it of course—and has had it from the first.

That the crank case arms break is a myth, but the freedom of "four-point" cars from squeak and "working" of the parts of the superstructure is indeed a pleasant reality.

Wire Wheels

WIRE Wheels for American uses have not come nearly as fast as has sometimes been predicted. There are two or three reasons for this. Some types of these wheels have not, in the opinion of American makers, been fitted for the rutty roads in certain sections of this country. The popularity of the wire wheel in Europe, where the ordinary roads resemble the American boulevards, can easily be understood, but the makers of wire wheels, both in Europe and America, have had a good deal to learn in the design and production of wire wheels to meet the road conditions of this country.

Another element which has tended to hamper the general use of wire wheels by the larger manufacturers has been the question of sources of supply. No one in this country has been prepared to supply wire wheels in large quantities and at a reasonable price. Hence for 1914 most makers will furnish wire wheels to special order only and at an advance in price which will just about represent the additional cost of such wheels to them. Sooner or later the wire wheel will cost little if any more than the wood, but this time cannot be expected until the wire wheel is made in some such quantities as is the wood wheel.

Perhaps one of the most practical objections to some of the earlier styles of wire wheels has been that because of the extreme length of hub and projection of spokes outward beyond the plane of the wheel, these spokes were liable to damage in the deep ruts of dried mud to be found in some sections of the country. This objectionable feature in the construction of these wheels can be and now is being largely avoided by some of the makers of these goods.

Many of the arguments in favor of wire wheels are good ones. Upon such points as the lightening of unsprung weight upon the tires, a better cooling of the tires at high speed, a decrease in tire wear as a consequence of this weight and cooling effect, and a snappier or somewhat livelier feeling in the car because of the lessened weight in the wheel rim (lessened fly-wheel effect), there can be little question as to the advantage.

It is sometimes argued that the wood wheel is more easily cleaned than is the wire wheel, but to those of us who have used both wood and wire, this question does not seem of particular importance.

In 1902 and 1903 many of us were building cars equipped with wire wheels. The artillery wood wheel then became popular because it seemed to present advantages both in appearance and in strength, but the wire wheels of 1902 and 1903 were very different from the wire wheels of today.

Advantages Claimed for Wire Wheels

1. Lighter weight—less wear on tires because of less uncushioned dead weight pounding on them.

2. Livelier car—lessened weight at periphery of wheels—hence less "fly-wheel" effect when starting and stopping.

3. Easier braking—same reason as No. 2.

4. Lessened tire wear—see Nos. 1, 2, 5 and 7.

5. Cooling effect—through metallic contact between rim and spokes the heat of the tire is radiated rapidly and tire life increased.

6. Ease and rapidity of tire change—whole wheel may be changed more quickly and easily than can rim and tire.

7. Elasticity—shocks of starting and braking are cushioned—hubs turn slightly before turning wheel and vice versa—more resilient feeling to car.

8. Entire wheel can be enameled—no paint to check off at the hub flange letting water soak into the woodwork.

Weight Distribution

ONE now and then hears some discussion as to the proper distribution of weight in a motor car.

Some makers argue that as much weight as possible should be concentrated at the rear. This argument has been evolved to explain and to approve the placing of tires and gasoline tanks on the rear of the car. Very few makers placed these parts at the rear until the change in body design through lowering of seats and deepening of upholstering forced the removal of the fuel tank from its front seat location, and the demand for the clean running board and unobstructed entrance from both sides, front and rear, made the problem of extra tires the bane of existence to the engineer.

By the same token few makers considered this rear location of weight of any particular advantage until forced into it by reasons of design entirely apart from any question of a theoretically correct system of touring car weight distribution.

Now the weight of the car and its passenger load is carried upon four points—where the four tires are in contact with the road. Since all drivers object to carrying more than one size of tire we may quite correctly assume that all four points have equal supporting powers.

So, laying aside for a moment the question of power transmission, it would seem clear that if we have a given load to carry upon four pneumatic tires and desire the very best to be obtained in uniform wear and consequent economy of tire cost per mile, we should so proportion our weights that each tire may bear its equal share.

Since tire expense is one of the greatest elements in car maintenance—equal to and sometimes greater than fuel cost itself, it would seem worthy of our most careful consideration.

Applying the principle of the four equally loaded tires to the automobile, the more nearly "amidships" we can place our center of weight, the more uniform will be our tire loading, the more uniform the wear and the greater our tire economy.

Hence the long wheel base and the load carried as much as may be between the axles. Hence, also, the desirability of a weight distribution which will, so far as may be, subject tires, front and rear, to equal load and wear.

But, unfortunately, our theoretical condition is impossible in accepted designing practice. With any usual and reasonable arrangement of the motor car elements, the rear end of a touring car is apt to be heaviest even without passengers.

The passenger load invariably increases this inequality between the fronts and rears.

Below are given two tabulations showing the weight distributions in two typical and similar cars with various passenger loads. These cars are in every way duplicates except as noted. The resultant figures are interesting.

Actual Weight of Front and Rear of Car with Front and Rear Position of Tank and Tires

Tank in dash and tires on side				Tank and tires in back	
Front	Back			Front	Back
1924	1884	No passengers		1704	2170
2056	2110	2	"	1836	2396
2050	2424	4	"	1830	2710
2040	2580	5	"	1820	2866
2078	2814	7	"	1858	3100

NOTE:—Because of the increased weight of necessary tire irons at rear and because of tank brackets and heavy steel tank necessary where exposed to damage at rear of car, total car weight is increased between 50 and 75 pounds through placing tank and tires on rear.

Now from the above tabulation it can be seen that even with tires and tank forward with passengers aboard, the rear tires carry loads greatly in excess of the front. Moreover, these rear tires must transmit the power of the motor to the roadway. The strains imposed upon them when the low gear of the transmission is in use are usually limited only by the traction.

Hence, even with the forward arrangement of tires, fuel tank, batteries, etc., we cannot hope to equalize the tire work done front and rear. At best we can only alleviate the abuse of the rear. We cannot possibly proportion the load equally and thus arrive at or even approximate the condition of greatest tire efficiency for the four wheels of our car.

I have even heard the claim made that the added weight of tanks and tires at the back increased the life of the rear tires.

This argument was based upon the theory that at high speeds this added weight kept the tires in more intimate contact with the ground, thereby preventing damage when the tire bounded and again struck the roadway.

I believe that there is nothing in this argument as applied to any normal car or to any normal road speed. If there were any real weight in this argument, then at any given road speed a light car should be harder on tires than is a heavy one. We all know that this is not true, either within our own experience or that of the tire makers. The actual weight upon the rear wheels is always the tire maker's guide in determining upon tire sizes for any car.

One sometimes hears the statement that added weight in the rear permits of "holding the road" better at very high speeds. If this were true, what of the road performance of the hundreds of thousands of cars which have seen years of satisfactory service—with gasoline tanks under the front seat and tires, batteries and tools on the running boards beside the dash or driver's seat?

And what of the better road performance of the "roadster" with its light body fitted to the same touring car chassis but carrying body weight and passenger load and hence the center of gravity more nearly amidships?

There is another important question involved in weight distribution—the tendency of a car to skidding either in front or rear under certain road conditions.

Suppose we illustrate this briefly by diagrams.

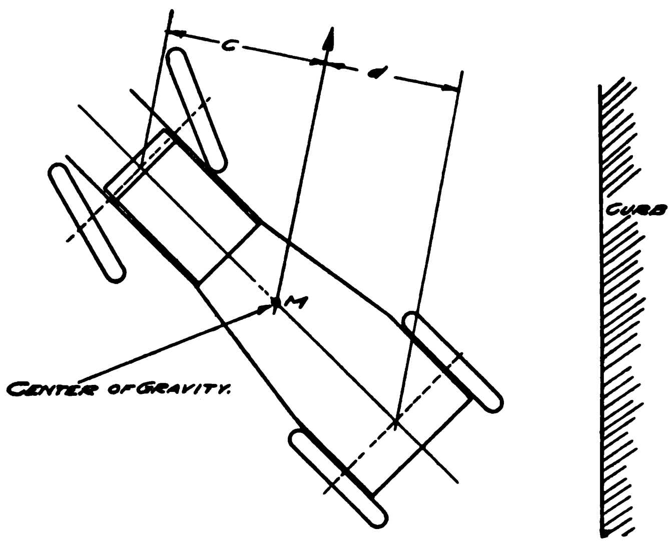


Figure 10

Showing center of gravity amidships as at M. Weight centered at this point exerts lessened skidding tendency.

With the center of load practically amidships as at M in Figure 10, any force which may be exerted by the total weight of the car may be said to act through the point M, and no matter what the direction or character of such force, the front and rear axles, being equally distant from M, the front and rear wheels will be affected equally.

The entire car may tend to slide sideways under the influence of a transverse force, but assuming a uniform road surface front and rear, there will be no tendency for the car to pivot about either the front or rear axles.

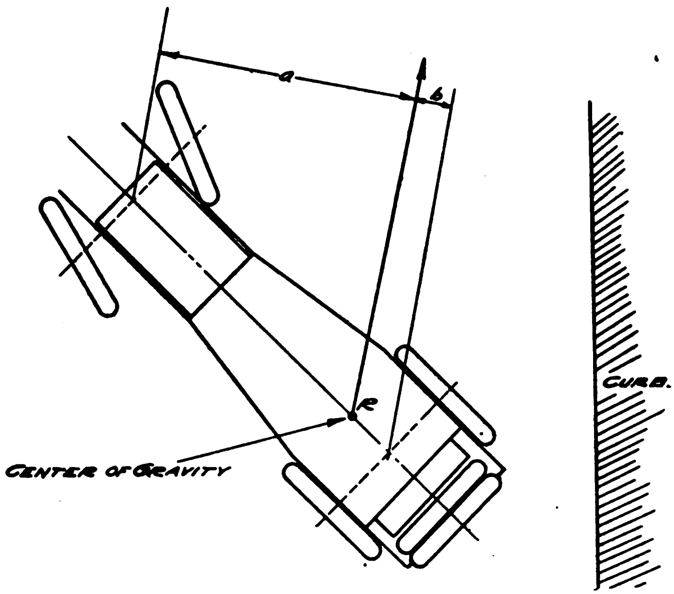


Figure 11

Showing center of gravity nearer rear axle as at R. Gasoline tank and tires placed behind rear axle tend to counterbalance weight upon front axle and move point R well back toward the rear axle. Skidding conditions much more serious than with center of gravity amidships as in Fig. 10.

Now let us remove the weight of gasoline tank and tires (between three and four hundred pounds) from an amidships position to the rear of the chassis, thereby removing the center of weight M toward the rear as at R in Figure 11. Any forces now set up because of the weight centered at R will no longer be resisted equally by front and rear wheels. The front wheels being farther away from the point R will receive less of the force, while the proportion thrown against the rear wheels will be much greater.

Moreover, the very fact that we have added weight behind the rear axle has tended to lighten the load on the front wheels (tended to lift the front) and move this point R much farther to the rear than would this same weight of tank and tires if added at any point ahead of the rear axle.

It is practically impossible to design a car along modern lines in such a way that the center of weight shall fall forward of amidships even when the car is without passengers, therefore we need not consider this phase of the question.

Skidding is the result of the action of forces set up through a change in direction of movement of the car. Such change in direction may be brought about by a turn of the front wheels, by unequal traction of the driving wheels, by unequal braking stresses or by the slope of the road surface as shown in Figure 12.

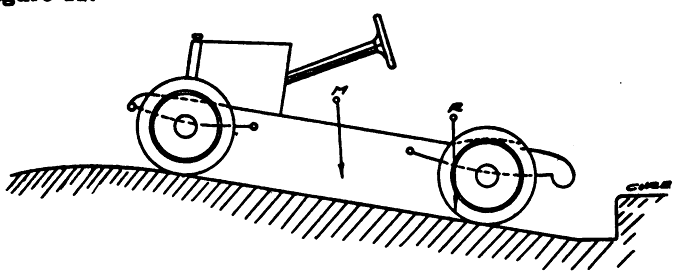


Figure 12

Showing effect of weight distribution upon tendency of car to slide or skid sideways due to slanting condition of slippery road or wet pavement. With center of gravity at M amidships the force of gravity tends to slide the entire car sidewise. With center of gravity at R this force acts more strongly upon the rear of the car. Hence the tendency so often noticed on a slippery crowned road or pavement for the rear of the car to slide toward the curb.

Once diverted from its normal line of travel, the force of inertia of the weight centered at R will exert a very different influence upon the behavior of the car than when centered at M.

Try as best we may we cannot with a varying number of passengers arrive at the ideal condition of having the center of weight amidships, but, from the approximate weight figures given above, it can be seen that by the placing of the gasoline tank forward as in the dash, and the tires and batteries on opposite sides near the dash lines, a much better and safer weight distribution as regards skidding on "greasy" pavements may be obtained.

Can any sensible argument be evolved to justify the placing of three to four hundred pounds on the back of the car behind the rear axle? Added weight at the rear is not a necessity for easy riding—proper spring design insures this quality.

Maintenance Cost

THE prospective purchaser will be told by the salesman of the four cylinder car that even though a good six may now be bought at about the same price as a good four, the maintenance expense of the six will be much heavier.

Statements of this kind are untrue.

Given two equally well built cars of approximately equal horsepower, equipped with four and six cylinder motors, and there is every argument that the year's maintenance charge on the six will be *less* than on the four.

The items of *garage, chauffeur, insurance* and *interest* on investment cannot be said to favor either the four or the six and may therefore be left out of consideration entirely.

The *lubricating oil* item should vary little between the two types of motors. It is a matter so small that any slight difference favoring the one or the other cannot affect the total maintenance expense.

We should naturally expect a lesser *depreciation* upon the six for more than one reason.

First, it is a newer and more desirable type than the four and will command a higher price accordingly at the end of a year.

Second, we have already seen that horsepower for horsepower the reciprocating parts of the six are lighter than the four and that the blow upon each piston of the four is 50% greater than in the six. Hence, bearing pressures and strains are 50% greater than in the six of equal power.

Third, these greater stresses of the four are intermittent, for we have seen that, because of dead centers and gaps between the power strokes of the four, in the six is the fewest number of cylinders from which we can have continuous power.

Fourth, the great foe of every structural mechanism is vibration. It matters not how carefully we may design a part for the performance of certain work, if vibration is present we must revise our figures. Whether we design an automobile, a locomotive or an office building, the principle is the same. A railway car axle is strong enough to sustain many times its greatest load, yet vibration often causes crystalization and breakage.

There can be no doubt but that in this serious cause of depreciation the six has the advantage of the four. Drive a four cylinder car at twenty-five or thirty miles per hour. The shake and rattle of lamps, fenders and footboards clearly show the percentage of the motor's power lost in vibration destructive both to parts of the machine and to the nerves of the occupants.

As to the question of *tire cost* there can be no argument. Other conditions being equal the smooth and continuous power of the six small cylinders will show a tire saving. The heavier flywheel and the heavier blows on the pistons of the equally powered four must bring greater tire wear.

As to differences in car weight there need be none. Motors of equal powers now approximate equal weights.

The *repair* and *adjustment* item cannot be said to vary greatly or favor one car against another. Under this heading are included those minor items not properly related to depreciation. Carburetor or ignition adjustments, the charging of batteries, etc., are here grouped. But even here the absence of vibration in the six would seem to argue an advantage against the four. Broken wires, loose nuts, rattles and leaking pipe line connections are certainly to be charged to vibration.

And now we come to the item about which we hear most—the cost of *gasoline*.

It readily can be shown from the experience of every motor car owner that only a comparatively small percentage of the total maintenance charge can be written in against fuel. A mile or two more or less per gallon does not much influence the total. But as a matter of fact four and six-cylinder motors of equal powers vary little in the amounts of fuel used. This entire problem of fuel economy is rather one of proper carburetion than of the number of cylinders in the motor. There are other items of design affecting fuel consumption more than mere number of cylinders.

Recent discussions of the Standard Oil Co., the probable shortage of fuels and the increased price of gasoline have exaggerated the importance of fuel cost as a factor of the total annual maintenance expense of any kind of motor car.

Suppose the average car to be driven six thousand miles in one year. Assume a mileage of twelve per gal. and a fuel cost of twenty cents per gal. This will give us a total fuel cost per year of one hundred dollars. A ten per cent saving in favor of either four or six would be only ten dollars—an insignificant sum when compared with the several other items entering into total annual maintenance.

The arguments of the slightly lessened thermal efficiency of the six because of added wall area exposed to the cooling water, and the lessened mechanical efficiency, because of the increased friction in added bearings and cylinders, are not of real practical value. No automobile engine is ever worked for any length of time at the point of its maximum efficiency, except in a racing car. Differences in degree of efficiency at the usual road speeds depend upon many things other than number of cylinders.

In the early days of the six the usual system of production was to add two extra cylinders to a four-cylinder size already being built for the market. The six thus produced had a 50% greater cylinder volume than the four and the car became heavier and more expensive to operate. Both fuel and tire costs were naturally increased. Moreover, we knew little of six building, just as in years before we had known little of the four.

But the qualities of excellence of the six have awakened the popular demand. Sixes are now being built as sixes—not as fours with two added cylinders. Quantity production is bringing the first price to meet that of the equally well built four. Total annual maintenance cost favors the six.

Dimming Device for Electric Headlights

ALL over the country ordinances are being drafted and legislation introduced for the proper regulation of electric head lights.

In many localities (notably New York City) even electric side lights at the dash are taboo, unless frosted. The frosted or dimmed side lights become then, of course, merely warning signals to other users of the highway, and are of no assistance whatever to the driver in lighting up a dark roadway.

Moreover, dash lamps are objectionable as driving lights because of the reflection of the light from the polished surfaces near the front of the car into the eyes of the driver.

Therefore, the elimination of the sidelight as an unnecessary complication and current user, and the installation of a headlight dimming device meeting legal requirements but still lighting the roadway would seem the satisfactory solution.

Many makers are adopting this system for 1914, and I believe that it will be general for 1915.

Ordinances and State legislation will undoubtedly be directed along this line.

More than this, the removal of the side lamps adds beauty of line to the car. The present tendency in body design requires clean dashes—even concealed door hinges and handles.

Speedometer Drives

IMPROVEMENT at this point has been needed for years, and has been slow in coming.

All of us know how unsatisfactory has been the big ring gear attached to the front wheel and the small pinion which sometimes did, but more often did not, properly mesh therewith.

The changes at this point have taken two directions—one the elimination of the spur gears and the enclosing of the spiral drive within the steering knuckle of the front wheel, and the other the incorporation of the speedometer drive through spur gears at the rear of the transmission gear box.

But where the speedometer is driven from any element of the mechanism related to the drive of the rear wheels, there will always be encountered an error due to the slippage of the rear tires in transmitting the drive to the roadway and to the spinning of the rear wheels when out of actual contact with the road surface, as they frequently are at high speeds. Consequently, it would seem that the only accurate attachment would be upon the front wheel. Hence the enclosure of the spiral drive within the front wheel steering knuckle gives the correct solution of the problem.

Electric or Automatic Gear-Shifting Devices

HERE is an instance where missionary work is being done in the line of desirable future progress. It would be foolish to assume, however, that the gear-shifting devices at present announced and advertised represent anywhere nearly a finished state in the art. They are too complicated, too liable to give trouble, and the trouble is too hard to find when it does develop.

The shifting of gears must many times be done under the most critical conditions, and when questions of the personal safety of occupants of the car are paramount. All of us who have driven cars have been caught at some time or other in such predicaments, and it is a question whether any of us would care to risk damage to our cars and physical injury to ourselves to the success or failure in operation of a half-baked gear-shifting mechanism.

A great deal has been said in the trade papers within the last few weeks about the immediate advent of the leverless car, and, as a result, there will be many makers who will feel that they must rush into the equipment of an electric or automatic gear-shifting device, whether the net performance of such device may be good, bad or indifferent.

As a result of the trade paper campaign on the leverless car, there have sprung into sudden life a thousand inventors of pneumatic, electrical and mechanical gear shifts. The two or three smaller concerns who have announced automatic gear shifting for 1914 are making much of the "push the button and we do the rest" argument in their publicity headlines, but a year's experience will no doubt bring radical changes.

Some of the best makers of electrical apparatus deprecate strongly the advent of the electrical gear shift. They feel that the automatic shifting of gears will come perhaps in 1915, but that the work should be done by mechanical means rather than by electrical power.

Storage batteries and generators are even now large enough to present serious weight problems to the designer and the drafts upon their capacities for the current necessary in lighting, ignition and starting, are close to the limit. Moreover, electrical installations are a mystery to the average owner, while mechanical devices are more or less of an open book.

There is no objection to the employment of electrical means for "selection" of the gear to be shifted. But in the light of our present knowledge it would seem that the actual labor of moving the gear should be performed by mechanical means.

Sooner or later a satisfactory device will be developed. At the moment, as we have said, all such devices are necessarily half-baked and far from the finally acceptable form.

Left-Hand Drive

RECOGNITION of the advantages of the left-hand drive would seem to have become universal. Practically every new model of car has it. There are some instances where old models have been continued and the right-hand drive retained because of the impossibility of so changing the mechanism of the car as to permit of the location of the steering gear and pedals at the left.

In two or three instances where right-hand drive is being retained an effort is being made through the tipping of the steering wheel and the hinging of the front seat to obtain the advantage of easy ingress and egress through the right-hand door. This, of course, is a rather unsatisfactory arrangement. Not only do the extra operations of tipping the wheel and removing the driver's seat have to be performed each time the occupant enters or leaves the car on the right side, but the entire driving advantage of the left-hand position is lost.

This latter is of course of the greatest real importance, as everyone who has handled both right and left-hand cars very well knows.

Usually, also, where a right-hand entrance is provided on a right-hand drive car, the gear and brake levers must necessarily be located in a position not easily reached by the hand of the operator.

The right-hand entrance from the curb is a convenience, but the position of the driver at the left enables him to see and do many things impossible to the driver seated on the right.

Figures Showing Advantages of Left-Side Drive

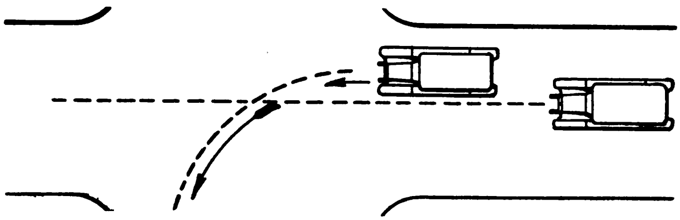


Figure 14

Car turning around in street or turning to the left into cross street. Driver in left-hand position enabled to see vehicles approaching from the rear.

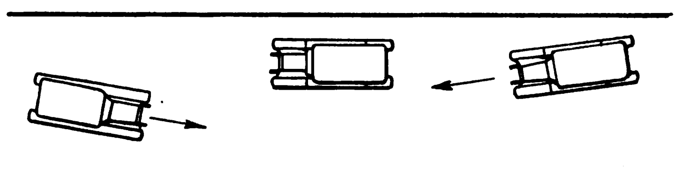


Figure 15

Car in the rear passing another going in the same direction. Driver in left-hand seat of rear car enabled to see vehicle approaching from opposite direction.

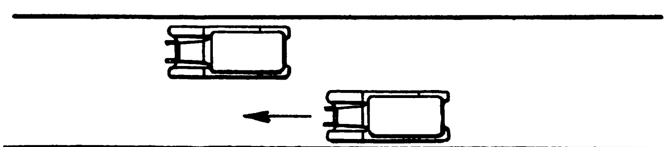


Figure 16

Car overtaking and passing another on the left according to rule of the road. Speed ordinarily high and amount of road given by overtaken car usually a minimum. Position of driver at left of overtaking car enables him to judge accurately of ditch clearance and room at left.

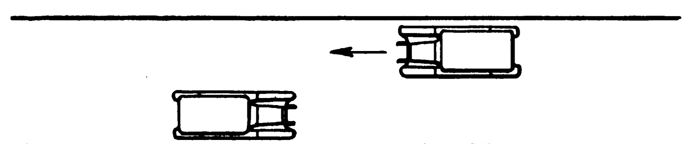


Figure 17

Meeting car going in opposite direction. The only instance where it is sometimes argued that driver should be on the right. But in meeting car upon narrow road speed should be slackened and the tendency is for each car to give as much of the road as possible. Hence it is not so essential that the driver be upon the right side in this instance as that he be upon the left side when overtaking and passing a car at speed as in Fig. 16.

The advantage of the position of the driver on the left when stopping at the curb is too well recognized to need discussion. Passenger in the right-hand front seat may step directly from the car to the curb without disturbing the driver.

All of these arguments have been threshed out in recent issues of the trade papers, and need only be touched upon here.

In Europe, in England, for instance, the rule of the road is "Keep to the left." All cars must therefore have right-hand drive. It is even intimated that early government action will prohibit the sale or use of vehicles with left-hand drive.

Here in America the rule of the road is "to the right," hence the logic, from the standpoint of foreign usage, of the left-hand seat for the driver in this country. As we have said, practically all new 1914 models will have left-hand drive. It is logical and is an improvement of permanent good.

The Streamline Body

THE term "streamline" is a marine one. In the sense of its present use it may be defined as that line or shape of a body which will encounter the least resistance in passing through any medium—as, for instance, through air for an automobile or through water for a boat.

Very naturally, the first automobiles ever built were known as "horseless vehicles." They looked the part. The bodies and, in short, the design of the entire vehicle followed closely on the lines of the horse-drawn road carriages of the period.

Nothing can be more indicative of this tendency than the old chestnut of a story about the automobile maker who ordered a lot of bodies from a big carriage shop. The bodies were delivered in due time and fitted to the running gears before anyone thought to question the presence of the whip sockets which had been fitted by the carriage works because of centuries of precedent.

It is little wonder that the motor car bodies of a few years ago look crude to us now. Progress in the motor car art and annual style changes in body lines have kept designers busy. Comfort—even luxury—combined with convenience and utility, has been the end sought.

The old-fashioned "carriage" body with motor beneath was but the forerunner of the "bonneted" touring car with open front and with rear door in the tonneau.

Side doors in the tonneau came next—then the straight line effects and fore doors. The hooded or hollow dash ushered in the torpedo style with its lowered seats and rakish steering angles. With each change in design greater comforts and conveniences have been added—cushions made softer, the upholstering better and the seats roomier.

In many of these changes we have followed the lead of Europe. While we may lead France and Germany and England in our manufacturing ability, we have had much to learn from these countries in comfort and luxury and in the refinement of detail.

Two years ago the Prince Henry or streamline body made its first appearance in Germany. That this body in its various adaptions marked a real and permanent advance in the art is beyond dispute. A design may for a moment attract attention, because of its peculiarities. It may even become a fad—for a time. But the streamline body, with its hood tapering smoothly into the body lines, with its cowled dash and its lessened wind resistance, with its slanted seats and its stylish appearance, cannot be called a fad.

During the two years since its origination it has been adopted in some distinct form by nearly every maker in Europe. Statement has been made in the foreign press that for 1914 scarcely one European maker will show a model with the old abrupt break between the bonnet and the body.

This movement on the other side of the water has reached us in America. Styles in motor cars affect us just as do styles in clothing. And this streamline body is more than a mere style. It is a big step forward in the perfection of the practical and comfortable road vehicle of the present and the future.

Auxiliary Seats

THE extra seats supplied for converting a five-passenger into a seven-passenger car usually are so attached that they are very much in the way of the knees of the tonneau occupants, and certainly do not add beauty of line or appearance, or roominess to the body.

Auxiliary seats made to fold against the sides of the tonneau at the rear of the doors are inconvenient also in that the occupants of the rear seat usually have to arise or move sufficiently to permit the seats to be swung outward into position.

With three people in the rear seat it is practically impossible to operate these side seats as ordinarily constructed without having one of the passengers stand up and move out of the way.

Some type of "disappearing" seat similar to that fitted to the 1914 HUDSON gives a much more convenient arrangement.

These seats fold down into a recess in the back of the front seat, leaving the foot room of the tonneau entirely unobstructed. The irons supporting the seats fold out of the way into slots in the floor and after the rug has been dropped back into place the rear of the car presents the appearance and has all of the foot room advantages of a very commodious five-passenger body.

These seats may be thrown into position for use instantly and without any movement or inconvenience upon the part of those already seated in the rear.

The advantages of this construction are too apparent to need discussion.

Luxury and Convenience

UNDER this heading little need be said.

We are all progressing as fast as we may. Easier springs, more luxurious upholstering, greater convenience and greater accessibility of those points which need attention, all give ample indication of the thought which is being given in this direction by our American motor car designers.

The quite general lengthening of wheel bases has made possible the full and wide tonneau door. It no longer is necessary that the lower portion of the opening be half lost to gain clearance for the rear fender of the short wheel base car.

Easy entrance and exit is made possible for front seats through the adoption of the center control. Top stays need no longer be dodged. Side curtains are now carried strapped to the top bows and they may be attached or detached quickly from the inside. Thus the curtains are kept in good shape—always ready for instant attachment by the passengers, who need not leave their seats during the operation.

All switches, gauges and minor controls are grouped at a point of the greatest convenience for the operator. Trunk racks at the rear are quite generally provided to meet the needs of the tourist. A good baggage capacity without cramping the passengers is a great everyday convenience.

Accessibility

AMERICAN cars are going into every corner of the world and into the hands of almost every class of people.

The percentage of the 1914 output which will be driven by chauffeurs and skilled mechanics is a small one. It may be said that the average owner will care for his own machine. It may also be said that the average owner has little time to spend in the care of his car. If he is to get the greatest good from his investment it must not be necessary for him to spend all his time free from business in tinkering with his machine.

Much attention has been paid to accessibility in the 1914 models. Facilities for adjustment and lubrication have been provided in better and easier ways than ever before. Grease cups of larger size have been generally provided. Sod pans beneath the chassis either have been eliminated or have been provided with openings through which parts are easily accessible.

The omission of the sod pan does more than merely increase accessibility—its absence facilitates the cooling of the oil in the motor base. Cooling ribs or fins are well worth adding to the exposed portion of the crank case.

Trunk Space

GOOD serviceable trunk racks should be fitted to every 1914 car. Not only is a good trunk or luggage space of daily convenience to every motor car user, but each year adds its thousands to the ranks of the cross country tourist. There is no more enjoyable or more healthful way to spend a vacation time—and certainly no greater convenience than the big trunk at the rear of the car. It may be taken into the room at the hotel each night. The luxury of clean or dress clothing may be enjoyed each evening. There are no grips, packages and suit cases to lose—or to stow away each morning, cramping the foot room of the tonneau and cluttering the dusty running boards.

To the suburban dweller a good trunk is a daily necessity. It is the convenient "catch-all" for the thousand and one packages which must go from town to "the farm" and from the home back to town. The baggage of the arriving or departing guest may be carried from or to the railway station. It need not be piled about the feet of the passengers—it may be stowed away on the rack at the rear.

A good trunk at the rear of a car adds to rather than detracts from the beauty of body line. The presence of tires and gasoline tank at the back prevents its proper attachment.

The trunk at the rear gives a finished and business-like appearance to the car—better certainly than two muddy tires plastered against the beautifully finished panels of the tonneau—hiding and spoiling the symmetrical lines of the car. Added weight at the rear is not a necessity for easy riding—proper spring design insures this quality. With a trunk in the rear the owner may suit his own ideas as to weight distribution. Tools and spare parts may be carried at the back if he so desires.

Durability of Finish

A PIANO is a highly finished bit of woodwork. It has perhaps come to be considered as the finest example of the workmanship of the craft. It is kept carefully dusted and polished. Not a drop of water is permitted to stand upon its finished surfaces. Even then the panels sometimes check, the finish becomes impaired and must be renewed.

Have you ever given a thought to the problem of a lasting finish for the exposed parts of a motor car? Have you ever considered the treatment given by the average owner to his car? Have you ever "cussed" an automobile maker because the paint has lost its lustre, checked or flaked off the bonnet or body panels of your car?

The painted parts of an automobile are usually given from twelve to twenty coats with a rubbing operation preceding each coat. An honest effort is made to have the finish right. But a car is exposed to all the varied weather conditions—extreme heat in the hot August sun, and twenty degrees below zero in winter. Dust, sand, rain and mud are the ingredients of its regular treatment week after week and month after month.

When the finished surfaces are cleaned, the work is either done hurriedly in a public garage or the hose may be "turned on" by the owner or his chauffeur. In either event, there is always a chance that the work may be done by unskilled hands.

The temperature of the water may be wrong, soap may be of poor quality, or the sponges and wiping chamois may not be clean. In any event, the chances are that the treatment may be brutal.

One poor job of washing may entirely ruin the lustre and quality of the finish for all time. The family automobile may have cost two to five times as much as the family piano, and its finish when new be far more expensive and better, but who ever heard of treating a motor car with one-half the care given a piano?

If we could enamel the whole car, we would come near to perfection in road vehicle finish. The hard, glossy surface of enamel baked on at high temperatures would stand any amount of use and abuse, but such parts as bodies cannot be given such treatment. Wooden frames and their glued joints will not stand the high heat, even if ovens of the necessary capacity were entirely practical.

In the 1914 HUDSON we have enameled everything possible. All metal work, such as bonnets, radiators, fenders, dust guards and a hundred and one other parts are given three coats of enamel baked on. Many of these parts in past years we have painted. Many other makers still are painting them this season. But the HUDSON owner of the new Six 54 will have the satisfaction of knowing that wherever possible his car has a finish not to be affected by weather or road use.

The Transmission System

THERE should be no excuse for trouble in the power transmission system of a 1914 car.

Few if any concerns will make changes in clutches, transmission gear boxes, universal joints, rear axles, or in any way introduce elements with which they have not previously had a thorough experience. There is no occasion for the introduction of experimental features or innovations of doubtful value between the clutch and the rear wheels.

Ten years ago there was neither experience nor engineering data upon which to base with certainty the design of the power transmitting elements of an automobile. We knew little then of the metallurgy of special materials. In fact, to the motor car industry may be ascribed much of the tremendous advancement during the past ten years along metallurgical lines.

Today the results of these years of experience have been made of permanent record. Engineering committees of the Society of Automobile Engineers have developed principles of design, tables of engineering data and specifications for materials for the guidance of the engineer and designer. There is no longer an excuse for clutches inadequate to transmit the power of the motor, or which jerk, drag and grab. There are no longer excuses for weak gears, weak shafts or sagging rear axle housings.

In purchasing a 1914 car the buyer has a right to expect a satisfactory service and a freedom from breakage in all of this transmission mechanism. Of course, in any type of machinery, the product of any manufacturing plant, there always may be found now and then a faulty bit of material which even the closest inspection has failed to detect. But breakages and troubles of this kind will be fewer in 1914 than ever before.

The three general systems of carrying the transmission gear will continue in evidence during the coming season. In the early days in Europe gear boxes were almost universally carried amidships, universal joints being supplied between motor and box and also between box and rear axle.

Since the first there have been some instances of the combination of the gear box and the motor forming a construction which has come to be known as the "unit power plant." During the past two years there has been a very strong tendency toward this unit type, especially for the smaller and medium sizes of cars.

The rear axle location for the gear box is practically unknown in Europe. The objectionable elements of the increase in unsprung weight and the added complexity of control have seemed to discourage the adoption of the gear box as a part of the rear axle unit. In America all three possible locations of the transmission gearing are quite common.

In the HUDSON Six 54 we use the unit power plant—the gear box attached close behind the motor and in reality a part of it. We believe our reasons for adhering year after year to this construction are good ones. We give them to you—you may judge for yourself.

1—Perfect and maintained alignment of motor, clutch, and transmission parts. Transmission entirely removed from any attachment to the frame and, hence, safe from any disalignment either during construction or in use on the road.

2—No need for universal joints between motor and gear box—wear in such joints sooner or later causes lost motion. If shafts become disaligned, friction with some power loss will result.

3—Control mechanism is the simplest possible, since clutch, pedals and control levers are all carried on the power unit. No long control connections needed as in case of gear box on rear axle—no necessity for maintaining extreme accuracy in distances between control levers and rear axle. Hence "drive" may be taken through springs and no necessity for radius rods or similar mechanism with joints needing lubrication and subject to wear and rattle.

4—Weight of gear box carried well forward in car, thus aiding in bringing the center of total weight nearer amidships, cutting down liability to skidding and tending to a more nearly equal distribution of weight and wear upon front and rear tires.

5—Avoids large increase in the unsprung or dead weight on the rear axle and thereby certainly reduces tire wear.

6—Transmission unit with clutch and controlling mechanism easily accessible for inspection or lubrication. Removal of front foot boards exposes entire unit. Much better care will be given parts when in easily accessible position.

From the viewpoint of the engineer, any one of the three gear box positions may, with proper design, be made to serve. As we have said, good American cars are built with each. But we must temper our theoretical and structural engineering with commercial sense. Cost of upkeep and ease of inspection are big items to the motor car owner. Hence the HUDSON unit power plant—the result of years of experience in building the best car for the most people at the least money—the result of an experience with many thousands of cars and covering all of the three different types of gear box location.

Multiple Speed Rear Axles

JUST now there is a good deal of talk of the multiple speed axle and of its points of advantage and disadvantage. Such constructions are not new, for axles of two, three and even four speeds direct have been tried out in years past. The interest in this type has been re-aroused by the announcement by a prominent American maker of a two speed axle drive for 1914. The advantages are claimed as twofold. The disadvantages are several.

This two speed axle is being fitted as an *extra* and not as a substitute for any part of the usual gear box. The question thus becomes not whether one form of speed change and transmission is better than another, but rather is the addition of the two speed axle justified in fact? Do its advantages so clearly outweigh its disadvantages that its general adoption is warranted by the makers of all kinds of motor cars? If the ordinary transmission box could be eliminated and the speed changes accomplished satisfactorily, without intermediate gearing, we should have arrived at a state of perfection sought for many years by the best brains of the industry. The driver objects to *any* gear change—he desires to do everything on one gear without change. Dozens of devices have been invented and many of them put into practical and even commercial use. Friction drives, hydraulic and electric clutches and transmission, etc., are examples in point. But we cannot seem to escape the penalties of any radical departure from accepted practice in design. Many have tried the multiple speed axle. Some have entirely eliminated the gear box as such. But there have always been penalties.

Every advantage must be weighed against its disadvantage. "Is it worth while?" is the final question confronting the engineer. The affirmative answer must be clear indeed to warrant a departure from successful precedent. We are too prone to magnify a minor advantage or saving in one direction and lose sight of greater expenditures in another.

Contrary to the pronounced tendencies of the times the maker mentioned has retained the large four-cylinder engine. This rear axle device, combined with this maker's usual three speed gear box, makes possible six different forward speeds. Hence, we arrive at the question: "Shall we prefer the four-cylinder car with six speeds or the more flexible six-cylinder car with four speeds?"

Now we believe that neither six nor any other number of speeds can ever promote the four-cylinder motor into the six-cylinder class. No increase in the number and complication of transmission gearing or its control can ever give to the four-cylinder four-cycle motor more than two impulses for each revolution or avoid the two positions of crank shaft dead center during that revolution. No increase in the number of transmission speeds can eliminate the vibration of the four at certain critical motor speeds or induce the steady pull of the over-lapping power impulses of the six at all speeds. A high rear axle gear suitable for use at the faster road speeds may *postpone* vibration to a higher car speed, but that is all.

We cannot believe that the adoption of such a device at this time can be said to denote desirable progress in motor car design. We would much rather incline to the belief that in the instance mentioned the two-speed axle has been fitted to give to a four-cylinder product more or less of an approach to the performance which the buyer has been taught to expect through the general adoption of the six-cylinder engine.

We consider that there are many disadvantages in the addition of a multiple-speed axle to a car. The transmission gearing is divided, part of it being placed in the ordinary gear box amidships, and a part of it—representing a serious weight consideration—is added at the rear directly upon the axle. Gears are added, bearings are added, jaw clutches and control mechanisms are added, parts are increased in size, additional joints are introduced into the driving system between the engine clutch and the rear wheels. All these things sooner or later require attention. They give added chance for backlash and wear.

For years engineers have striven for simplification in the driving system of the motor car and for the elimination of just such features as these.

The addition of unsprung weight upon the rear axle unquestionably means tire wear and expense. One of the greatest arguments in favor of the wire wheel has been that the unsprung weight on the tire has been reduced perhaps 25 to 30 pounds per wheel. Yet with this added rear axle speed mechanism we have several times this amount in increased dead weight.

The high gear of the two-speed rear axle is admittedly too high for city work, but the added weight is always present.

Each blow struck by the cobble stone to the tire is a harder one because of this increased and unsprung axle load. A very small increase in the percentage of tire wear will easily offset any fuel saving possible through the most intelligent use of the added gearing.

Where multiple speeds are provided in the axle in addition to the ordinary transmission gearing, a considerable cost must be incurred by the maker. Extra equipment of this kind costs money and without such equipment a lower list price on the car would be possible. The car owner, as the ultimate consumer, must pay for all added equipment. Upon the basis of 6,000 miles of average car use per year, 12 miles per gallon with gasoline at 20 cents, we have a total fuel cost of $100 per year. A $50 increase in selling price would require two and a half years of car use in the hands of the owner to balance the first cost to him of added rear axle speed equipment, even upon the extreme basis of a possible twenty per cent fuel saving. It would require the saving of five years upon a ten per cent basis. The service of the extraordinarily high gear depends upon the character of the car use—whether in city or country—whether upon good roads or bad—and upon the personal equation of the operator. Experience has shown that excessively high rear axle gear ratios are suited only for racing car purposes.

Ease, comfort and luxury are the peculiar advantages of the six. The six will run slower, will run faster and will run smoother at all speeds than any four, no matter what the axle gearing.

The effort of the engineer since the first has been directed toward the production of a car of maximum flexibility *without* gear change. With the six-cylinder engine this has been accomplished. Why not use the six—and the simplest possible form of transmission gearing?

Gasoline Systems and Piping

MOTOR car gasoline systems may be generally divided into two types: those having pressure feed to the carburetor and those having gravity feed.

With the pressure system the tank is placed sometimes beneath the front seat or body of the car, but more often at the rear. In such systems pressure used to be taken from some one of the motor cylinders and carried through a regulating valve to the tank. Later practice has dictated a small air pump operated by the motor.

A pressure of from 2 to 3 pounds within the tank is usual and is sufficient to force the gasoline from the tank to the carburetor under any condition of road or hill.

Comparatively long pipe lines, both for air and gasoline, a gauge for indicating pressure within the gasoline tank and a hand air pump introduced within the line for setting up initial pressure after filling the tank, are necessary with this force feed system.

Years ago, practically all gasoline systems were of gravity-feed type. The generally accepted location of the tank was beneath the front seat, but changes in body design, the lowering of the seats and the deepening of upholstering rendered this front-seat location impractical because of the impossibility of obtaining gravity flow to the carburetor upon steep hills from a tank so located. The advantage of the gravity feed from the standpoint of simplicity has always been admitted and with the types of body developed abroad during the past two years and being adopted in America for 1914, there has come a new application of the gravity-feed system.

A common location of the gasoline tank in cars upon both sides of the water will be either in the front of or as a part of the "cowled" dash. Indeed, quoting from the technical forecast of the Paris Show, to be held in Paris in October, 1913, "gas tanks will either be on the front of the dash board or under the scuttle dash." This forecast is by Mr. W. F. Bradley, the European engineering representative of the Class Journal Co. and will be found in brief form upon page 4 of the July 3rd issue of the *Automobile.*

The body designs which have come into popularity both in Europe and in America encourage a return to the old time simplicity of the gravity system. Unions and joints are fewer, pipe lines are shorter, air pressure, pumps and gauges are not needed. Troubles are much less liable.

Weight is saved because of the more protected position. Lighter tanks and lighter fastenings may be used.

Moreover the weight of fuel and tank is so located as to aid in bringing the center of weight of the car more nearly amidships—thus insuring a more uniform tire loading and tending to lessen skidding.

Fire Risk and Tank Location

THE element of fire risk does not favor any one of the tank locations as against the other.

Fires almost invariably originate in or near the carburetor. The sod pans provided for the protection of the motor and its accessory parts too often are so constructed as to trap and retain any oil drippings from the power plant or gasoline leakage occasioned by a "flooding" carburetor or broken pipe line. So whether a fire is started by a "back-fire" caused by a too lean mixture, by an electric spark or by a hot exhaust pipe, it is almost invariably the contents of the sod pan which add "fuel to the flame."

A hot exhaust pipe will not ignite gasoline but a red hot exhaust line will sometimes start a dull fire in oily wrappings or wooden body parts, and the motion of the car will serve to fan it into a blaze. I have known fires to start by spontaneous combustion among greasy rags and waste carelessly thrown into compartments beneath the seats.

The particular location of the fuel tank has little or no influence upon the net result of a fire because it is not the gasoline which remains in the tank that causes the trouble. The tank and its contents may be depended upon to come through any ordinary fire unharmed.

There are many cases which could be cited in the old days of the wooden body where woodwork and the other inflammable parts of a car have been consumed without in any way affecting the gasoline tank located beneath the front seat in the heart of the blaze. The very presence of the liquid in contact with the tank walls prevents the melting of the solder and the opening of the seams, etc.

In cars as they will be built for 1914 little wood is employed. Body frames and floor boards will be about the limit.

For instance, in HUDSON cars even dashes, running boards and toeboards, as well as the bodies, are of pressed steel.

But the greatest single insurance against serious damage by fire will be found in the elimination of the "sod-pan." The plates between the engine and the frame side members are so formed and so perforated that no oil or gasoline leakage can collect. The fly wheel is so protected that oil drippings cannot be thrown upon the asbestos muffler pipe covering.

The high tension wiring is all enclosed in metal conduits. High tension terminals are insulated. Gasoline line unions are provided with extra long shanks or sleeves which so steady and guide the copper piping that the old familiar trouble of breakage at the union is entirely prevented. Such gasoline pipe fittings have been standardized by the Society of Automobile Engineers and should be insisted upon by the purchaser.

These features mentioned are not exclusive with the HUDSON. Some or all of them may be found on other good cars of new model.

But these features do reduce the fire risk to a minimum, and this, after all, is far more sensible than furnishing a fire extinguisher to cure a trouble which might easily have been prevented in the first place by a little care in design.

Fuel tanks under the body are inaccessible for filling or repair even did our modern body design permit this location. If hung at the rear these tanks must be made heavy enough to withstand the damage from stones thrown by the wheels. They should be made of pressed or drawn steel and even then cannot be made strong enough to withstand damage from minor collisions so frequent in congested traffic.

This rear location is generally inaccessible for filling when trunk and rack are fitted, and after each filling and often several times each day the auxiliary hand pump must be used to supply pressure to the tank for starting.

In the case of the dash location of the fuel tank, as in the instance of the HUDSON and many of the new foreign models, the tank is protected from all external damage. It is accessible for filling and easily removable for repair. It is free from all distorting influence or twist of the frame. It is protected in front by the solid metal dash and beneath by the metal foot board and body parts. The gauge is in plain sight at all times. The shut-off valve is instantly accessible. All the advantages of gravity feed to the carburetor are had. Any leak may be detected at once because of the tank's location in the open and above the floor of the driver's compartment.

The rear of the car is left free for the attachment of a really serviceable trunk rack, and the space beneath the driver's seat may be utilized for the tools and batteries, usually requiring boxes on the running boards.

In short, the tank in the dash cowl of the "streamline" body utilizes space otherwise wasted, and presents marked advantages not found in any other location.

Electric Wiring

TO many of us it has undoubtedly seemed a great joke that while an insurance policy could be taken out upon a $5,000 automobile with little or no more red tape than the scratch of a pen, it has been necessary to have a formal inspection of the wiring system of a $500 garage before obtaining fire protection upon it.

During the past two years the electrical equipment of a motor car has become a much more serious problem than in the past. There was a time when the magneto, the dry cells or the small storage battery and the spark coil were wired up carelessly and with little attention to the quality of insulating materials or methods of supporting this wiring; but with the advent of the complete electrical equipment there has necessarily been a great change. Heavier currents and different voltages must be dealt with. Lighting and starting operations must be dependable to the last degree. "Missing," short circuiting and the other ills of ignition will no longer be countenanced by the car user or accepted by him as among the ineradicable ills of the horseless vehicle.

Experience has taught much during the past two or three years. Many of the principles of installation and insulation which have maintained for years in the building trades have been adopted for automobile wiring.

High tension cables are now encased in metallic conduits. Terminals are protected with insulating material. Upon many connections, where dependence has in the past been placed in screws and clamps, 1914 practice dictates permanently soldered unions.

Joint work between committees of the fire underwriters and of the Society of Automobile Engineers will soon result in standard specifications for wiring. These must be adhered to by the makers before insurance policies will be written upon the cars of any manufacturer.

The fire risk of 1914 from defective wiring will be much less than during any past season.

Greater Gasoline Economy

MUCH has been done for 1914 in this direction.

Years ago in Europe it was realized that a setting of the carburetor for economical performance at average road speeds could not be made to give the extreme acceleration which many American makers have sought to attain during past seasons.

In observing the performances and the greater mileages per gallon of fuel, of European cars, we have been brought to avoid the carburetor settings which permit of excessive acceleration.

Carburetor settings for such accelerations result in uneconomical road performances and in the hands of the inexperienced or reckless driver may work continual damage to the car.

The dropping in of the clutch, and the spinning of the rear wheels with a wide open cutout may give a spectacular performance, but it is one that is sure to be costly to the owner and of little advertising value to the maker of the car.

We are seeking nowadays for smoothness, evenness and sweetness in "getaway" and performance and are getting greatly increased economies with the carburetor settings which attain these results.

Many devices called "economizers" are being put on the market. Where carburetor settings are too "rich," such devices may increase mileage, but where settings are for road performance rather than for maximum acceleration, little if any gain will be shown.

A hot air connection should be fitted to all carburetors if the best results are to be obtained from our present day fuels.

Easy starting may be assured through the use of an electrical heating coil in the intake pipe.

Remember that the frequent screwing down of grease cups and the proper lubrication of all working parts will go a long way in cutting down gasoline bills.

Self-Starters

THE electric self-starter would seem to have conquered the field.

Whether such equipment is in the form of the three-in-one unit, including starting, lighting and ignition, or in the two-in-one unit, including lighting and starting, with magneto ignition, or in any other combination, there seems to be little difference.

But it is safe to say that the three-in-one unit (whose greatest exponent is Delco) has the better of the argument, so far as the number of cars actually equipped and in successful operation. The various forms of acetylene or gasoline starters and the various applications of the starter of the compressed air type, would seem to be relics of the past.

America leads easily in the development of the self-starter. Europe yet has done little or nothing with it. Even at the Paris show next October little progress in this line will be shown. The electric starter has become a feature of our American design, and it but remains for us to so perfect its mechanism that it may be made as dependable as are our motors, our transmissions or our axles.

But just because a motor starter is an electric starter is no particular guarantee as to its successful performance. All such apparatus is made up of about the same kind of ingredients. Wire, insulating materials, iron, steel and copper are about the same the world over. But brains and experience are needed to mold these raw materials. Tools and manufacturing processes are merely a means to the end. Too much theory without practical commercial adaptation has spoiled a good many mechanisms called starters.

There are only two or three good ones. Be careful!

Easy Steering

INSUFFICIENT attention is given by many makers to the feature of easy steering.

On a large majority of the cars produced the bearing surface provided for carrying the load upon the front steering knuckle is inadequate. The pressure becomes so high per square inch of bearing surface that the lubricant is forced out and an excessive amount of friction results.

Frequently, too, insufficient attention is given to the protection of these bearings from dust and sand.

Another great cause of hard steering is that, although a grease cup may be provided for the squeezing of lubricant between these heavily loaded bearing surfaces, a very small percentage of car users turn them down, as they should.

There are two methods of overcoming hard steering, chargeable to these conditions. One is to provide a plain thrust bearing, ample for the load to be carried, fit a grease cup that is not a toy, and a dust cap, protecting the thrust surface from all foreign matter.

The other way to insure easy steering will be found on the 1914 HUDSON. Here a roller bearing is supplied for carrying the load of the car. This bearing is placed at the top of the wheel pivot and practically eliminates friction at this point.

Another feature of the Hudson front axle contributes much to easy handling.

The steering pivots are so thrown out of the perpendicular as to bring an extended line of the pin axis in contact with the ground just forward of and in line with the point of contact of the wheel with the road. This construction makes a great difference in the ease of steering. One need only sit for a few minutes behind the steering wheel of a car thus fitted to appreciate the advantage gained. One may literally steer the car with two fingers.

Brakes

NINETEEN-FOURTEEN will see greater attention than ever before paid to this very important element of motor car design and operation.

Cars are in general faster, and in many instances heavier than during past seasons. Even where "fourteen" models are lighter than in the past, because of this very decrease in weight, and because of the increased power from motors through a lightening of the reciprocating parts and refinement of detail, the possible car speeds upon the road will be greater than ever. Hence, the absolute necessity of dependable brakes.

Increased braking surfaces, better equalizing devices and an easier or softer action will be found.

Brake action has come to be recognized as a very considerable element in the cost of tire up-keep. Hence, the effort of the designer to supply a braking system that will control the car at any and all speeds, but which will be so easy in its action as at no time to skid the wheels, unless jammed on hard in an emergency.

Pay particular attention to the brake action of any car before purchasing. Safety and tire expense depend upon the quality of this action.

The Crowned Fender

SOME of us remember the day not so many years ago when automobiles were sold in this country without wheel fenders as standard equipment. "Fenders $15.00 Extra" said the maker's catalogue; and they were very crude fenders at that.

As a matter of fact, except for the addition of splash aprons, improvements or changes in fenders have been rather few. Even yet they frequently are made so narrow as barely to cover the wheels and when so fitted afford scanty protection to the occupants of the car, particularly if a cross wind happens to be blowing.

The style of "flaring" front fender was particularly bad under this latter condition.

A great majority of rear fenders have for years been made just long enough or just scant enough so that the mud thrown upward by the wheel would spatter the car top when folded down out of commission.

It is strange that fender improvements have been so long in coming.

The crowned fender is the popular style for 1914. Moreover, it is of real and practical advantage and as such will be a permanent fixture of the cars of the future.

This type is not a new invention of the year—it has been used for several seasons by one or two makers. But 1914 is seeing its general adoption—even in spite of the increased cost of production.

The shape follows that of the wheel more closely than does any other; and the real purpose of a fender is much better served. The improved appearance of the car can best be appreciated by comparing it with a machine equipped with the old style flat fender.

To afford proper protection the fenders (and running boards) should extend at least three or four inches beyond the plane of the tires and should so conform to the shape of the wheels in front that no mud or water can be thrown into the air to be later blown back against the windshield or into the faces of the passengers. The shape at the rear should be such that no mud can be thrown on the top when it is folded down. This latter condition can be checked by means of a straight edge, held tangent to the rear tire and just touching the tip of the rear fender. If this straight edge clears the top in its folded position, then no mud can be thrown upon it.

It goes without saying that the space between fenders, running boards and frames or bodies must be entirely closed in.

The Proper Material in the Proper Place

EVERY now and then someone advertises a "chrome nickel steel car."

Sometimes the name of some other high grade or very expensive metal fills in the head line. Now, these more or less special materials properly heat treated make very excellent motor car parts.

Many such materials call for delicate and expensive treatments and are very costly to machine. Where extreme lightness combined with strength is a prime requisite, or where heavy shocks and strains are to be taken upon a comparatively small part, the use of these classes of materials is advisable. But great care must be taken by the designer to use the proper material in the proper place.

Such special materials cost the manufacturer a great deal of money, and he in turn must increase the selling price of his product accordingly. It is the ultimate consumer represented by the motor car owner who must finally pay for the materials which go into a car.

Now, there are a hundred and one instances in automobile construction where quality of material cannot be made to compensate for a lack of size in a part. For instance, and contrary to the popular belief, if a crank-shaft is so designed that it is found to "spring" between its bearings or points of support, a change to a better grade of steel will not help the trouble. The shaft must be made heavier in the cheeks and the diameter of the pins increased before greater rigidity can be had. An increase in quality will increase the life of the shaft or the number of vibrations it will sustain without breakage, but not its rigidity.

There have been instances where cars have been produced for the market with motor crank-shafts cut from a solid slab of chrome nickel steel at an expense of perhaps more than one hundred dollars per shaft.

An ordinary dropped forged carbon steel shaft, properly heat treated and really better for the particular purpose, might cost completely machined, between ten and twenty dollars—probably not to exceed fifteen. At the most, the chrome nickel steel shaft could give no better service than the dropped forged shaft, for neither shaft could be broken by the loads thrown upon it.

The determining factors in design, rigidity and ample bearing surfaces have little or nothing of dependence upon such special qualities of the steel. But the purchaser must necessarily pay the difference in cost to the manufacturer. The car having the motor with the chrome nickel crank shaft must list at a higher price if its maker is to remain in business.

Therefore, beware of the cars advertised as built throughout of special materials.

There are many other points than the one cited where materials may be used improperly or foolishly. The designer must choose the material suitable for the place in which it is to be used if the best car value for the price is to be given.

Progress in metallurgy has been hard put to it in keeping pace with the demands of the automobile industry. The composition and heat treatments of metals for motor car purposes are more thoroughly understood today than for almost any other manufacturing line.

Better grades of cast and malleable irons have been developed. Alloy steels have come profusely into use. Finer grades of aluminums, bronzes and sheet steels have been made available.

The greatest possible stress is laid upon proper heat treatments. Pistons and cylinders and many other parts are now thoroughly annealed before being ground to finish. These annealing and heat treating processes relieve the metals of internal strains and prevent those distortions which were once so common after the parts had been finished.

Heat treated drop forgings of the higher grades of carbon steels are universally used for such parts as crank-shafts, connecting rods and clutch driving members. Heat treated nickel and chrome nickel steels have come quite generally into use for transmission gears, shafts and rear axle driving members.

Such bulky and weighty parts as engine crank cases and transmission gear cases are almost universally made of the better grades of aluminum. Aluminum combines lightness with great strength, and is the ideal material for such parts. There are cars where these parts are made of manganese bronze or of cast iron. The bronze possesses great strength but introduces weight. The cast iron possesses the advantages of neither aluminum nor bronze, for it adds three times the weight of aluminum and its strength is much less than either.

Try the Other Car

THE average man does not ride in any other car than the one he owns.

If this car is a four-cylinder machine, the sum of his automobile experience is apt to be restricted to this type.

There are many thousands of four-cylinder owners in this country who have never ridden in anything else and cannot therefore be expected to realize the delightful "feel" of the six.

A hundred miles behind the steering wheel of a good six will make any man dissatisfied with a four.

Try it!

Remember that new sensations make life better worth the living, and that there is nothing of mystery in the excellence of the six.

"The Hudson Six Rides
Like Constant Coasting"