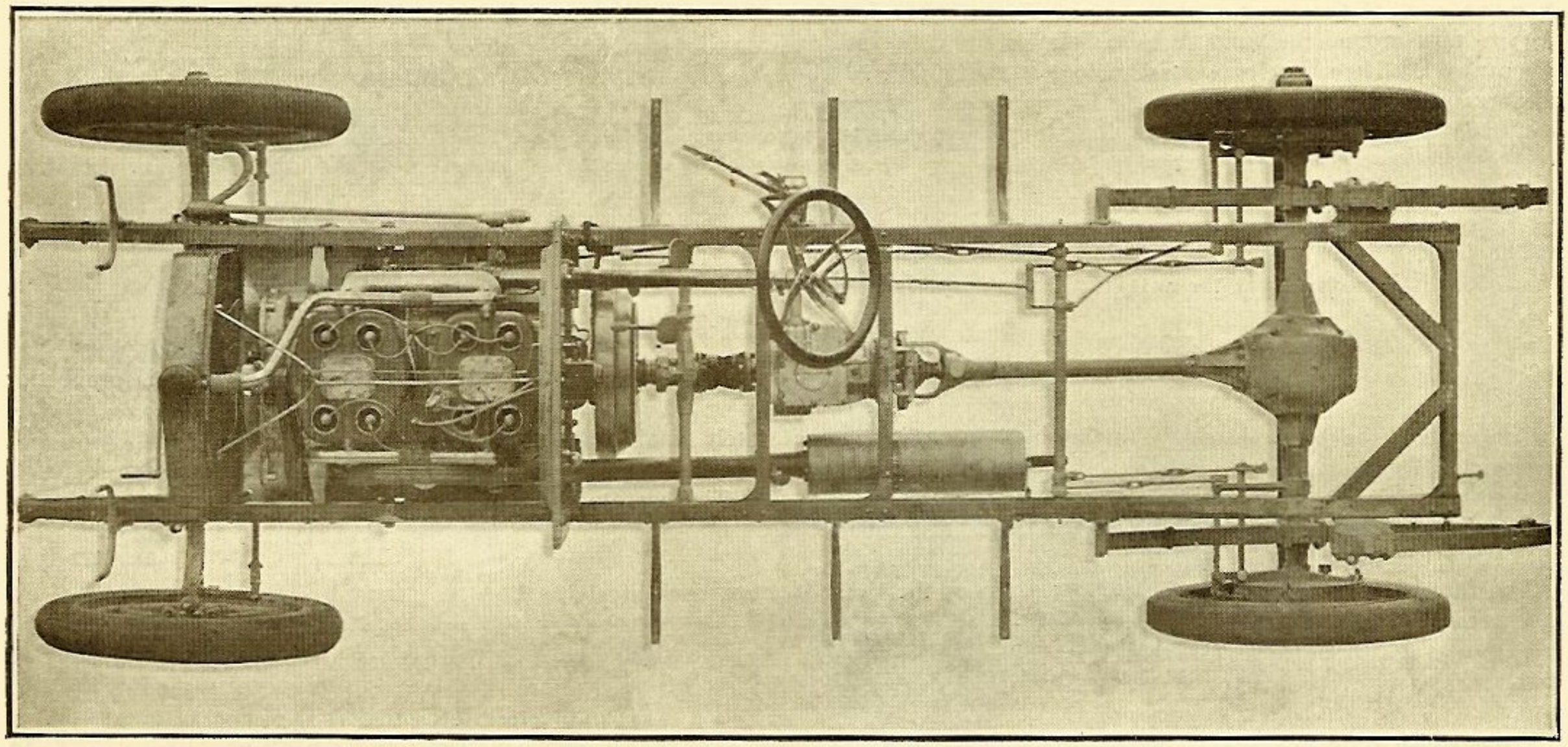


Fig. 1—Looking down on the National chassis, showing power plant, suspension and assembly of units

Details of National Construction

No marked changes characterize the new season's models of the National Motor Vehicle Company, of Indianapolis, Ind. The new models will be known as the National "40," Series S, and a numerical suffix will be used to designate the particular style of body. The changes that will be made will be along the line of refinements, in view of a year's experience, both on the road and in the racing field. Improvements in manufacturing operations designed to eliminate wear and noise have been carefully studied and nothing has been left undone to render the car satisfactory in every way.

The general appearance of the chassis may be seen from the plan view shown in Fig. 1, which discloses a four-cylinder motor attached to the main frame, cone clutch, three-speed transmission, and live rear axle drive. The method of operating the brakes is also shown in this illustration.

The motor has four cylinders, cast in pairs, and thoroughly annealed, the bore being 5 inches and the piston travel 5 11/16 inches. Fig. 5 shows a front transverse section through one-half of a cylinder together with the base chamber. The cylinders are cast with T-heads and the intake and exhaust valves, which are made of nickel steel, are placed on opposite sides. The valve V has a cone seat S1 and reciprocates in a bushing B which is inserted into the cylinder casting. The cam operation may be seen by referring to the cam C1, upon which a roller R rides. The push-rod P1 is fitted at its upper extremity with adjusting nuts N, and the roller R is held in constant contact with the cam C1 by means of a spring S2.

The method of attaching the exhaust manifold E and the water manifold W is unique. The yoke Y has a forked end F and a single arm A so that when the nut N1 is tightened upon the stud S both manifolds are maintained firmly attached to the cylinders, thereby eliminating a large number of connections.

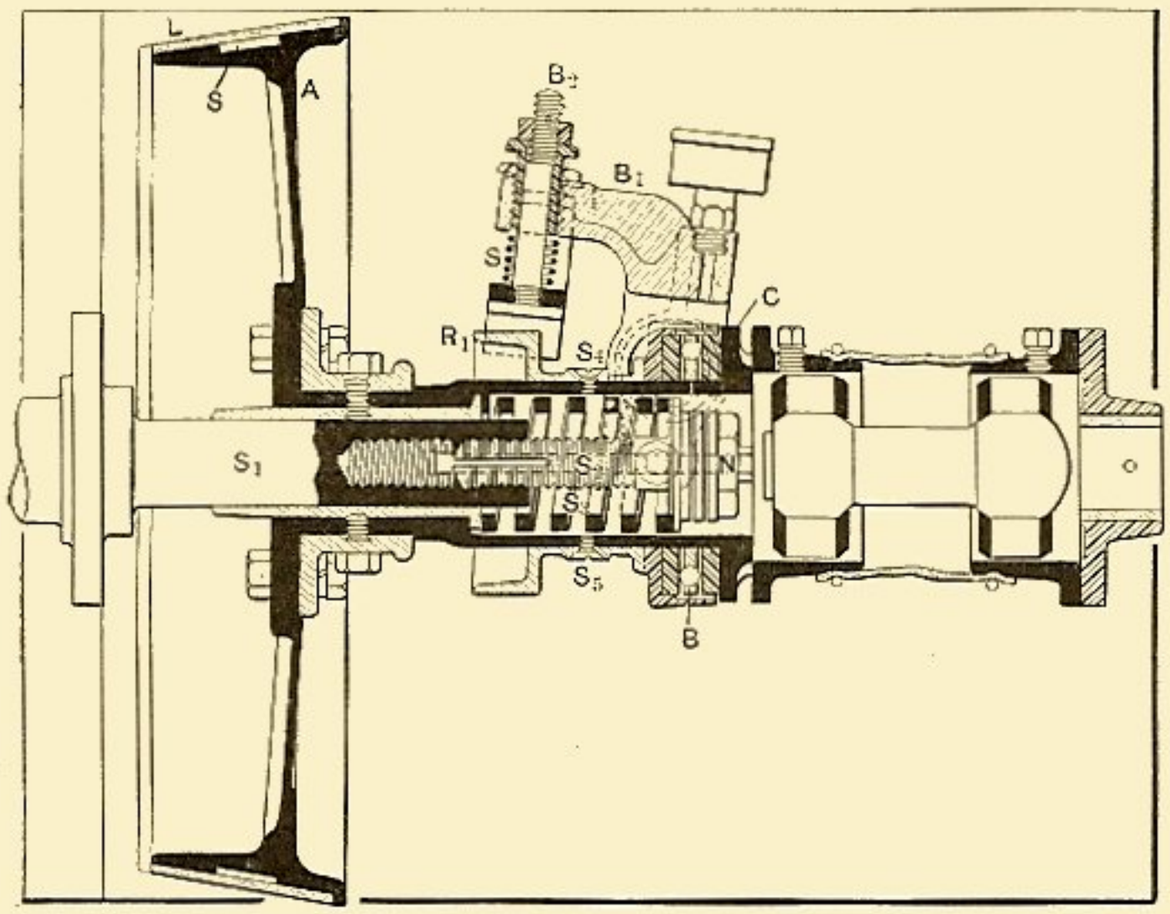


Fig. 2—Detailed view of the National cone-type clutch and universal joint

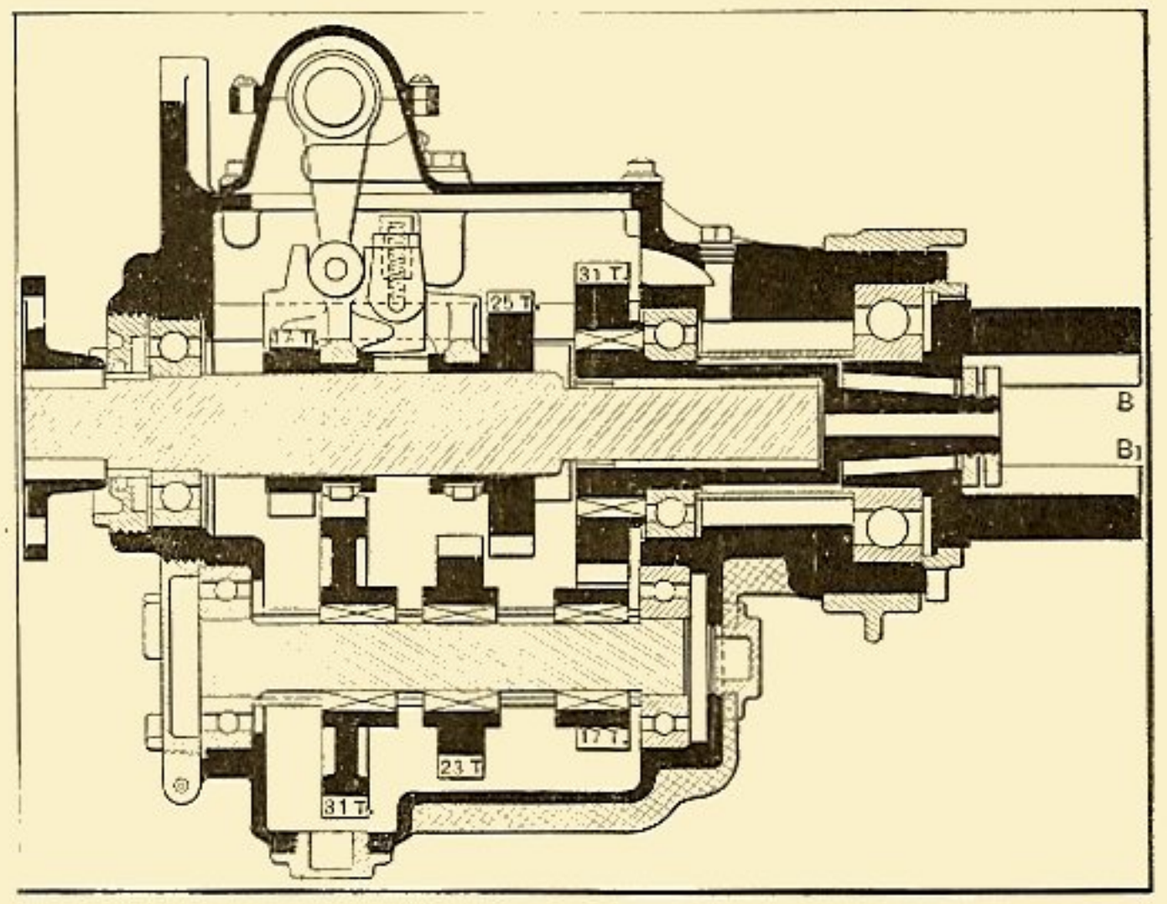


Fig. 3—Horizontal section through the three-speed and reverse selective transmission

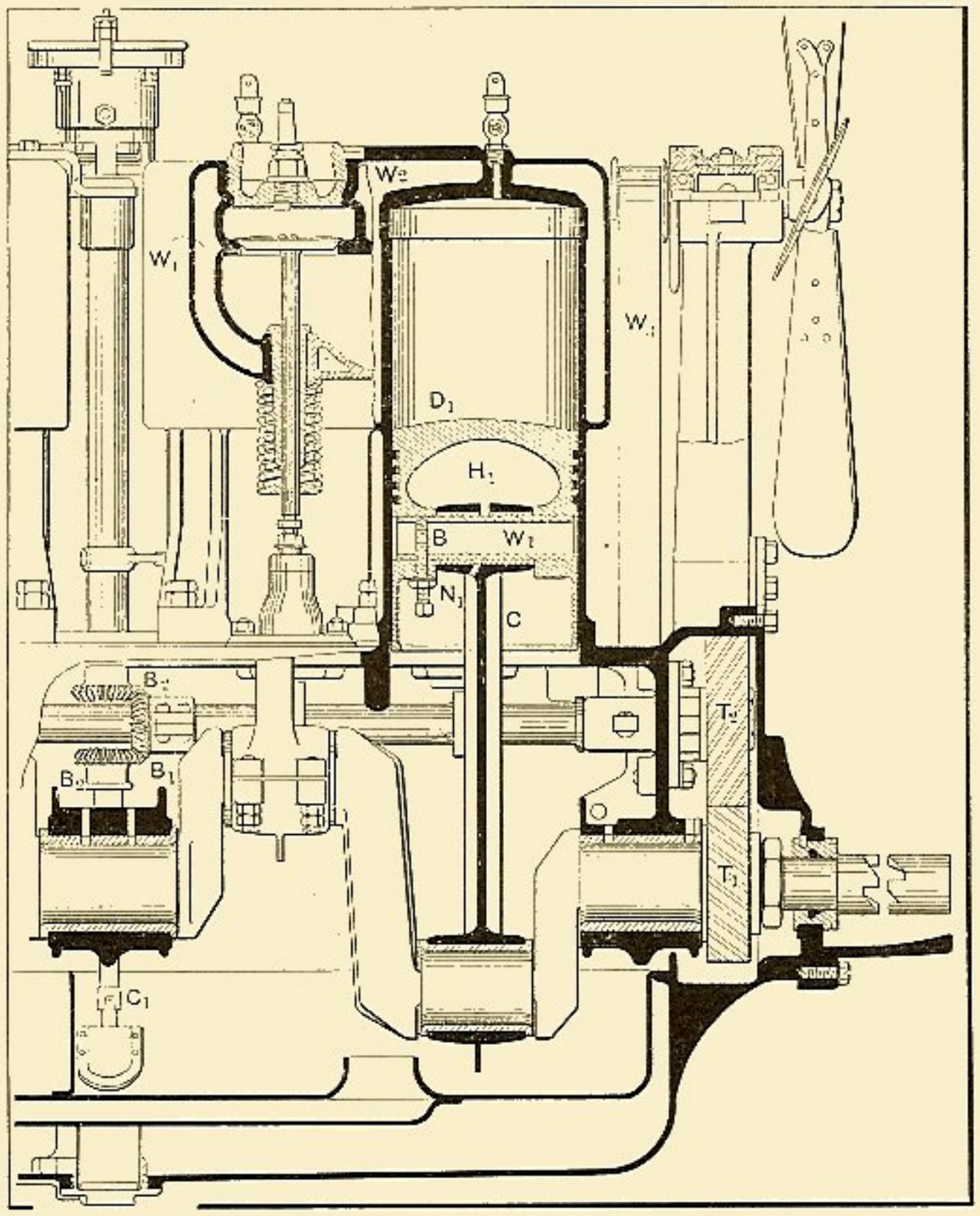


Fig. 4—Plan section of National motor, showing oiling, ignition and cooling systems

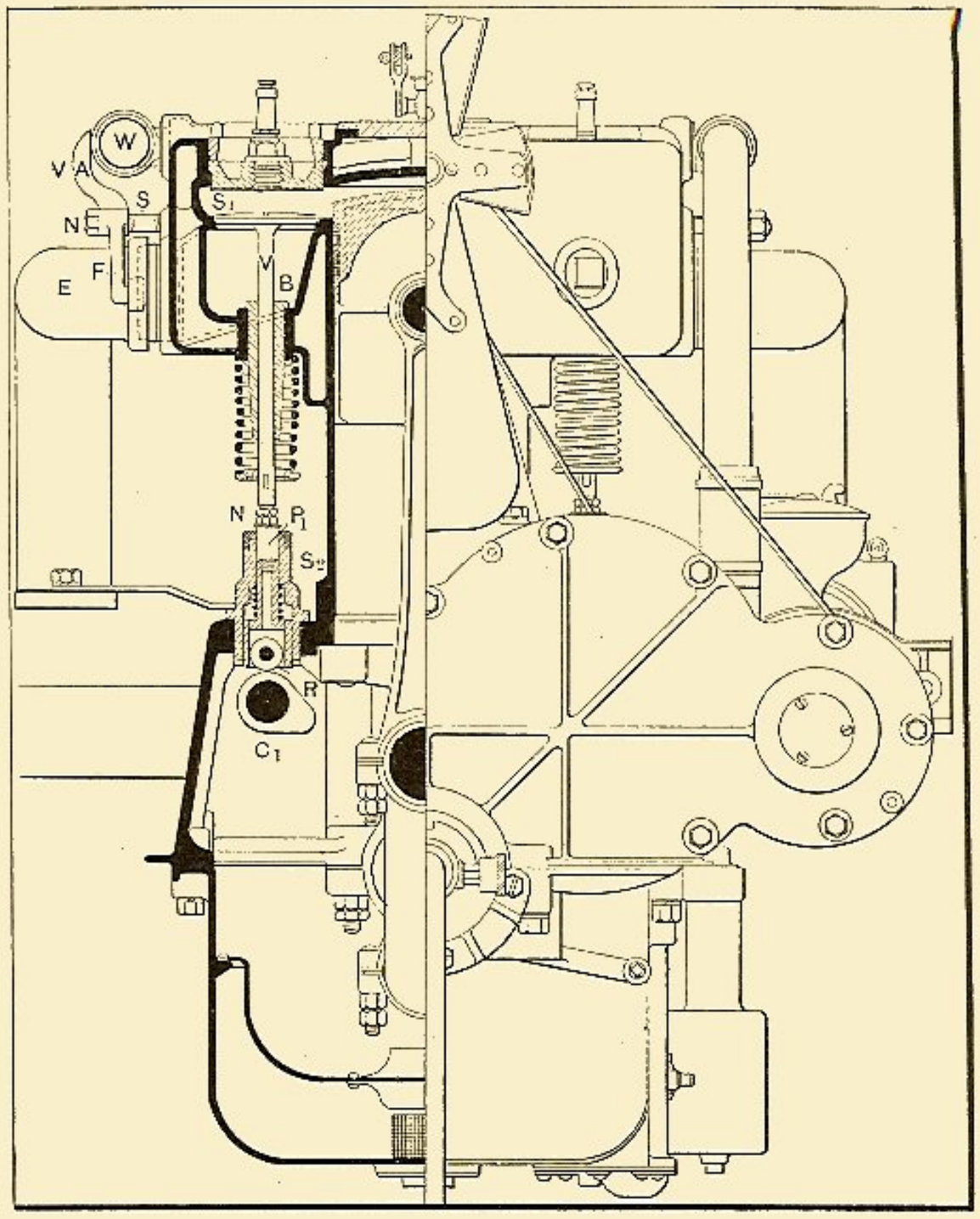


Fig. 5—Front transverse section through an engine cylinder and part of the base-chamber

The plan section of the motor, Fig. 4, discloses the method of operating the oil pump and distributor by means of bevel gearing B1, B2 and B3. The pistons have a slight dished top D1 and the wrist pins W1 are hollow. The method of mounting the piston wrist pin and connecting rod is shown in this illustration, and it will be seen that the wrist pin and piston are united by means of the bolt B and locked in position by the nut N1. This allows the connecting rod C to oscillate upon the wrist pin W1 and the small end of the connecting rod has a hole drilled above in order to permit the lubricant to enter. The oil pump being driven by the shaft attached to the bevel gear G2 can be removed from the lower half of the base chamber without disturbing the position of the above-mentioned gear wheel, as there is a tongue joint C1 interposed between the pump shaft and the operating shaft.

The water jacketing of the motor is shown at W2, W3 and W4. which illustrates the manner in which the cylinder is cooled to the point where the heated gases obtain.

The timing gears T1 and T2 are skew-cut, a practice which has been found to eliminate a considerable amount of noise from these parts. The crankshaft is mounted on three main bearings, made of Parsons white bronze.

Fig. 6 shows the exterior view of the motor. From this it will be seen that the support S1 by means of which the motor is attached to the frame at its forward extremity is bolted to the upper half of the aluminum base chamber instead

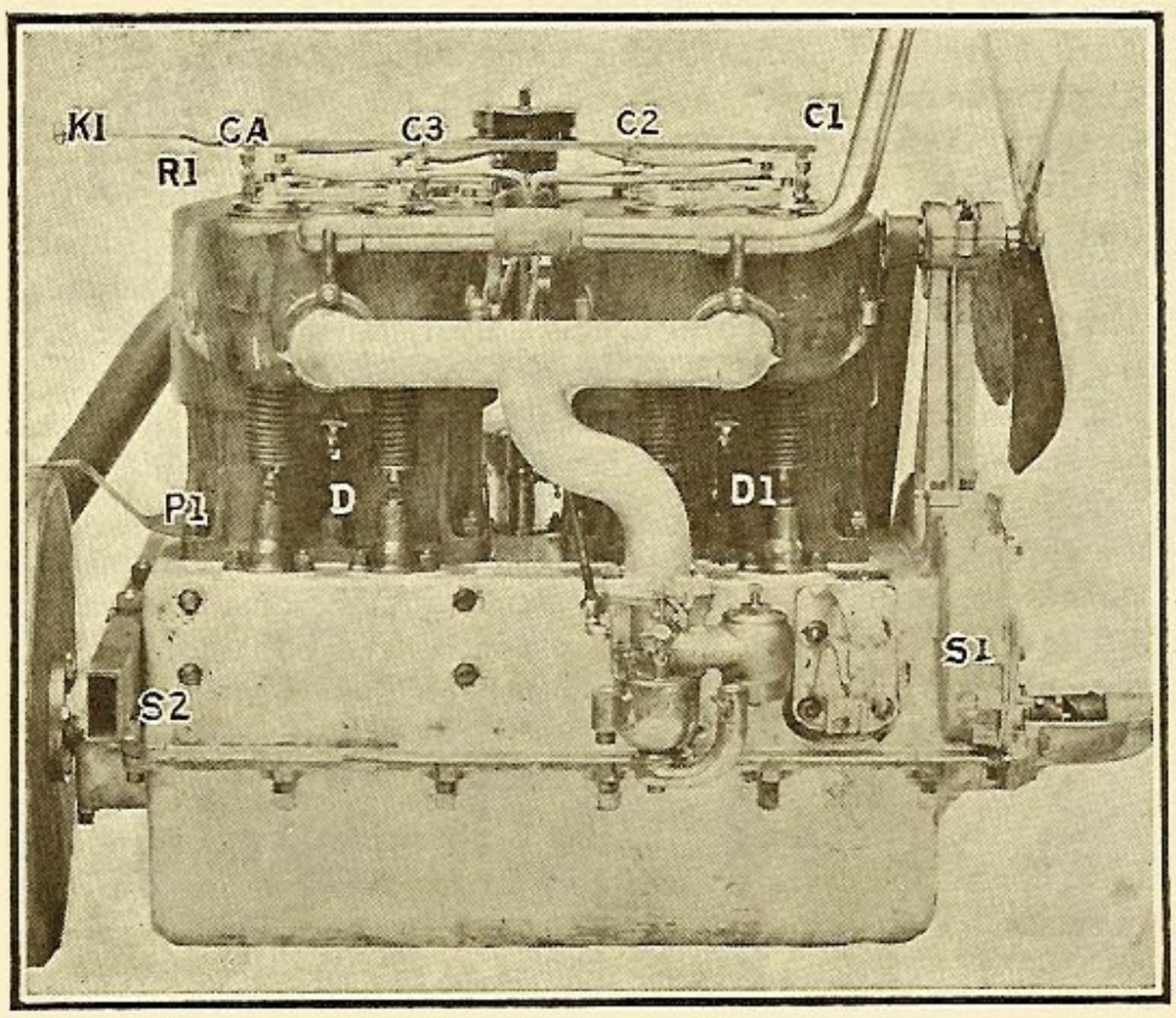


Fig. 6—Intake side of motor, showing substantial supporting members, carbureter and cocks to drain water from jackets

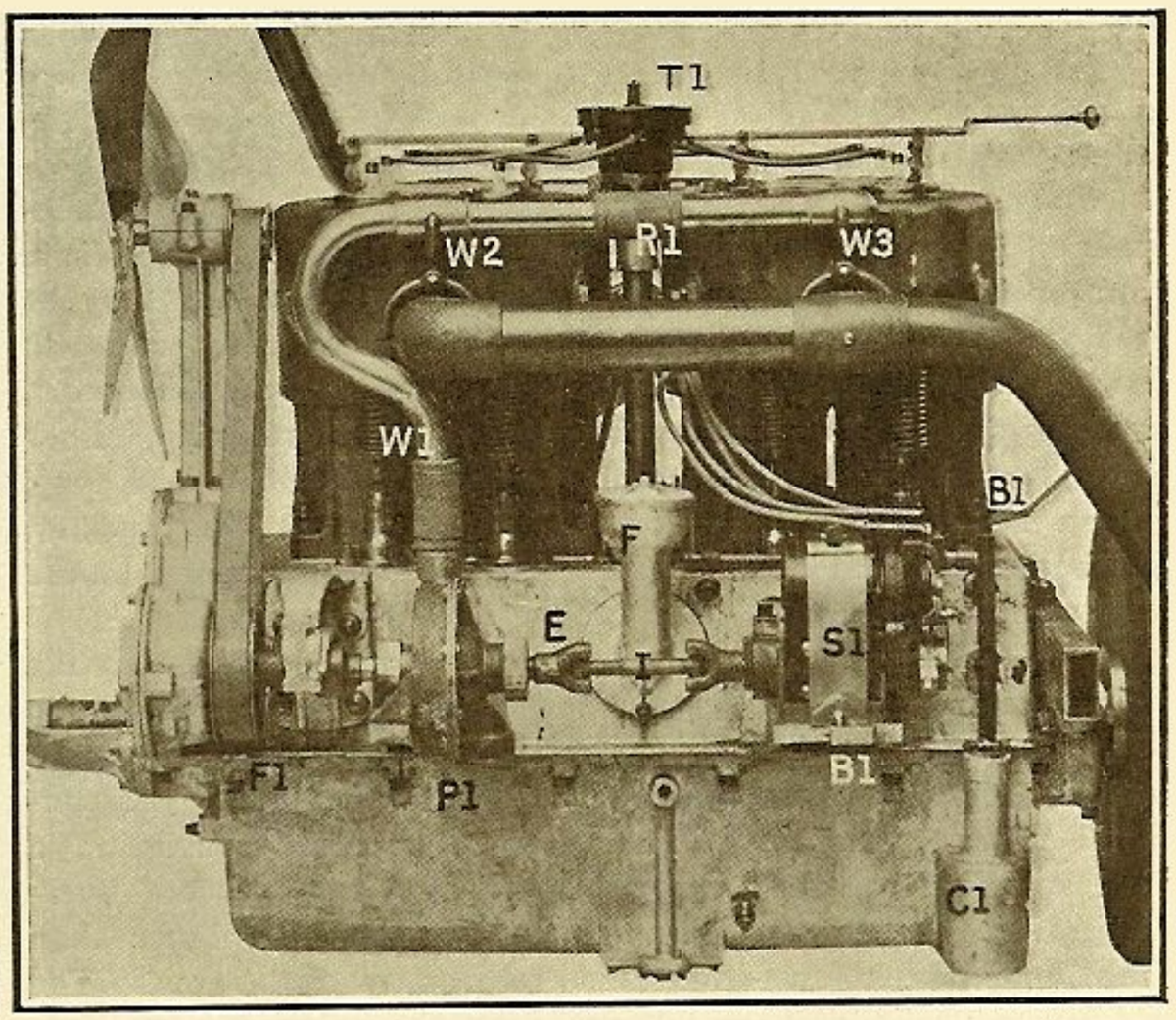


Fig. 7—View of the exhaust side of the motor, showing magneto, water pump, oil filler hole and cork-float indicator housing

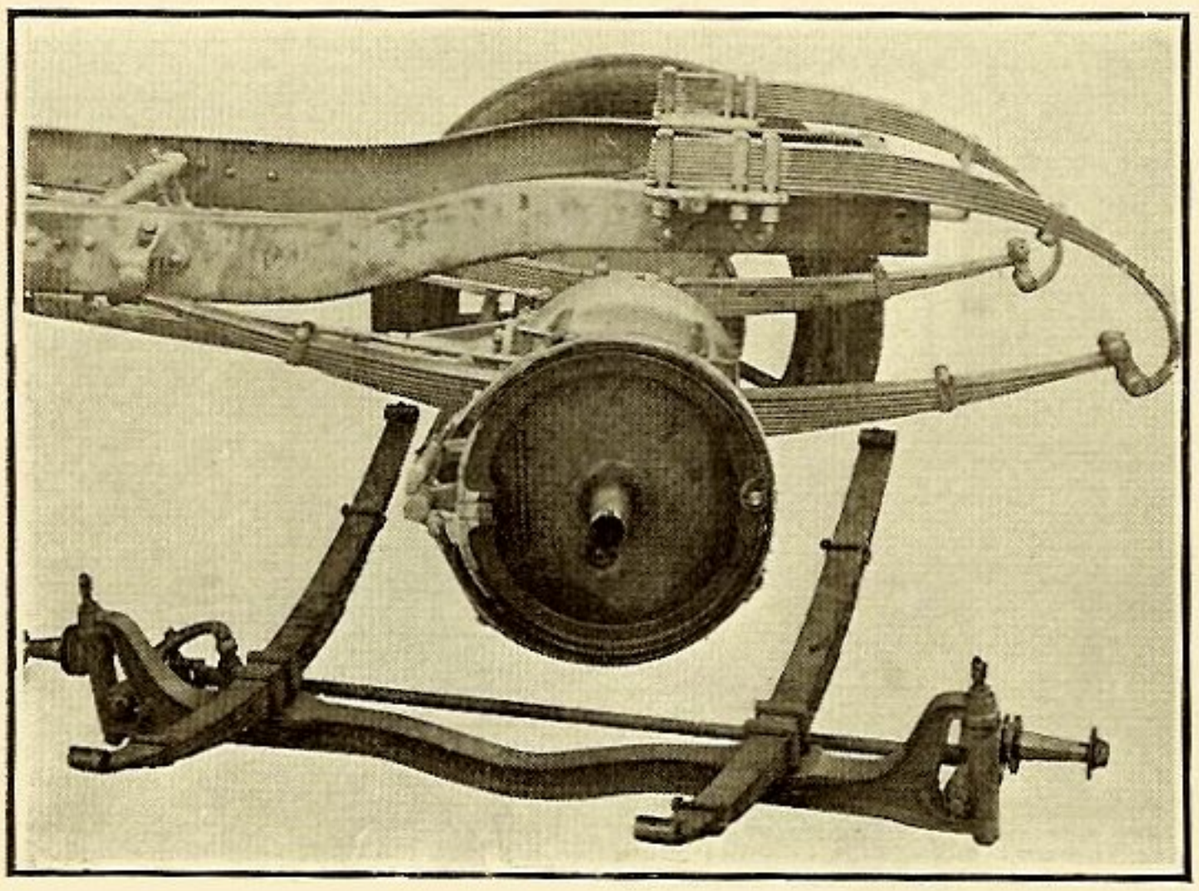


Fig. 8—Showing suspension of National front and rear axle, as well as brake construction and differential in perspective

of being cast integral therewith and the rear support S2 is attached to the motor by means of long through bolts. Drain-cocks D and D1 are provided, thus rendering it possible to drain off the water entirely from the cylinders. The compression cocks C1, C2, C3 and C4 are placed in the heads of the cylinder and can be operated by the knob K1, which passes through the dashboard and is attached to the rod R1, which in turn is attached to the arms of the cocks. In order to facilitate the timing of the motor a pointer P1 is provided and the flywheel is marked with the various settings for the valves and the ignition.

The exhaust side of the motor is shown in Fig. 7, in which the timer T1 can be seen. The fan pulley F1 and water pump P1 are driven by gearing from the half-time shaft, and the water is conveyed from the pump, which is of the centrifugal type, to the pipe W1 and enters the cylinders at the points W2 and W3, a piece of rubber tubing R1 being placed between the two pipes to take care of any vibration. Tapered nipples are used on the intake, exhaust and water pipes, thereby doing away with all packing joints.

The pump shaft carries an extension E which drives the intermediate shaft I, which in turn drives the magneto. By undoing the strap S1 it is possible to remove the magneto from its base B1 and all alignment between magneto and pump is taken care of by the shaft I. Oil is poured in the base chamber through the large filler F, a cork float within the housing C1 serving to indicate when the correct level has been attained by means of a small ball which is attached to the float.

Two sets of spark plugs, located in the valve caps, are provided, and besides the magneto ignition a separate and independent ignition is provided by means of storage battery, single vibrator coil and distributor. Either or both systems may be used at will. A double distributor, Splitdorf magneto, with two sets of plugs and storage battery is used on the roadster model, and this system fires both sets of plugs simultaneously, either battery or magneto. The carbureter is of the float feed type, with a 1¾-inch connection on all models, except the roadster, which has a 2-inch connection. A metal strap attached to the base chamber holds the body of the carbureter rigid.

Oil is taken from the base by a pump and delivered to the sight feed on the dash, whence the oil is returned to the main bearings. A false bottom is fitted inside the base, forming troughs for the connecting rod scoops to dip into. A continual flow occasioned by the pump fills these troughs to a level sufficient to insure proper lubrication and prevent over-lubrication. When the level of the oil becomes higher than the standpipes it overflows and returns to the sump. The pistons and cylinders are lubricated by the splash of the connecting rods and above the main bearings cups are provided to maintain a constant flow of oil to these parts.

The clutch is a cone type and is shown in detail in Fig. 2. The aluminum member A is faced with a leather covering L, beneath which six flat springs are provided. These cause the leather to bulge at six points, thereby insuring an easy engagement. The spigot S1 is drilled and tapped and accommodates the bolt S2; the spring S3 is held in tension by the locking nut N, and disengagement is brought about by causing the collar C1 to recede. A ball thrust B is provided to take care of the thrust during the disengagement. Attached to the disengaging arm there is a bracket B1 which is fitted with a through bolt B2, the lower extremity of which is provided with a leather-faced surface. As the disengagement arm is operated by the clutch pedal the bracket B is caused to descend and to come into contact with the ring R1, which is attached to the main body of the clutch by set-screws S4 and S5, thus preventing continued spinning of the clutch when disengaged and facilitating changing from one speed to another. The spring S prevents any gripping action of the clutch brake.

The transmission is of the selective type, giving three speeds forward and reverse. The shafts, as may be seen from Fig. 8, are carried upon annular ball bearings, and packing glands are provided so that oil can be used for lubrication instead of grease. A universal joint, shown in Fig. 2, is placed between the clutch and transmission, taking care of any disalignment that may be occasioned by the bending of the chassis frame, due to inequalities of the road surface as well as slight faults of assembly. The gear is supported upon two cross members of the chassis frame, as may be seen by referring to Fig. 1.

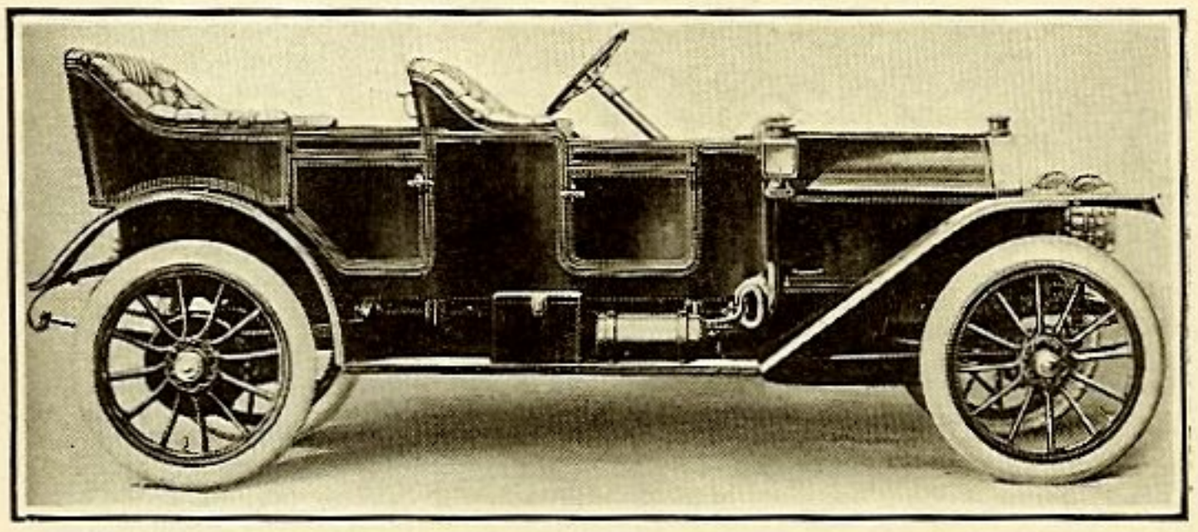


Fig. 9—Side view of seven-passenger, fore-door type of touring car and neat arrangement of accessories on footboard

Power is transmitted from the gearbox to the live rear axle by a 1⅜-inch propeller shaft enclosed in a casing extending from the rear axle housing to a forked joint at the forward extremity. This fork is hinged upon a bracket attached to a cross member of the frame, and the torque is taken up therein. A section of the live rear axle, which is of the full floating type, is shown in Fig. 11, from which it will be seen that roller bearings are employed throughout. This illustration also shows the method employed for operating the brakes, acting upon the rear wheel drums. By removing the cover over the rear axle it is possible to remove the differential parts.

The suspension in the National is taken care of by means of semi-elliptic springs at the front, attached to an I-beam axle, as shown in Fig. 8; the rear suspension, however, is of the three-quarter elliptic type and the method of attaching the springs to the chassis frame is shown in the same illustration.

The wheels are fitted with 36 x 4-inch tires, but the buyer has the option of choosing 34 x 4 1-2-inch on the speedway roadster and 37 x 4 1-2-inch upon the touring cars and the limousines.

MANY of the Sheffield, England, physicians have abandoned their horses and carriages and gone in for automobiling for practical use. Fifty per cent. of the cars in use in Sheffield are of the high-power touring type. The same rule prevails throughout the United Kingdom.

To Fit Car to Buyer

(Extract from a paper read before the British Institute of Carriage Manufacturers in London, Sept. 4, 1911. by Mr. Herbert Austin.)

IF at the commencement of the automobile era it had been possible to realise the extent of its use to-day, and of the demand for speed and luxury, closer attention would no doubt have been paid to the creation of a vehicle designed to meet the entirely different conditions caused by the advent of the new means of locomotion. This evolution is going on every day, and perhaps the gradual change is for the best, as had it been too sudden the public might have objected more strongly than it did, and the conditions appertaining to the use of the automobile would have been so much more difficult to cope with.

The demand to-day is for seats to be low, and they must, therefore, be sloped downwards toward the back. This means taking up more room lengthwise on the chassis, and unless the accommodation at the back can be curtailed the body must overhang more or the chassis will have to be lengthened to conform with the requirements.

To be able to provide for variations in the dimensions of drivers and the positions they wish to be fitted, an adjustable seat has been designed by the author. This seat can be placed in any position that could possibly be required, and attached to it is a steering column and pedals. All the holes for adjustment are marked so that a record can be taken of the position most convenient to the customer and enabling the manufacturer to copy the dimensions found in the car delivered to the buyer.

Of course, the positions allowable with a standard body are limited, and these limits are noted on each design. Some provision would have to be made in the steering column and pedals for each make of chassis, but this would not be a big matter.

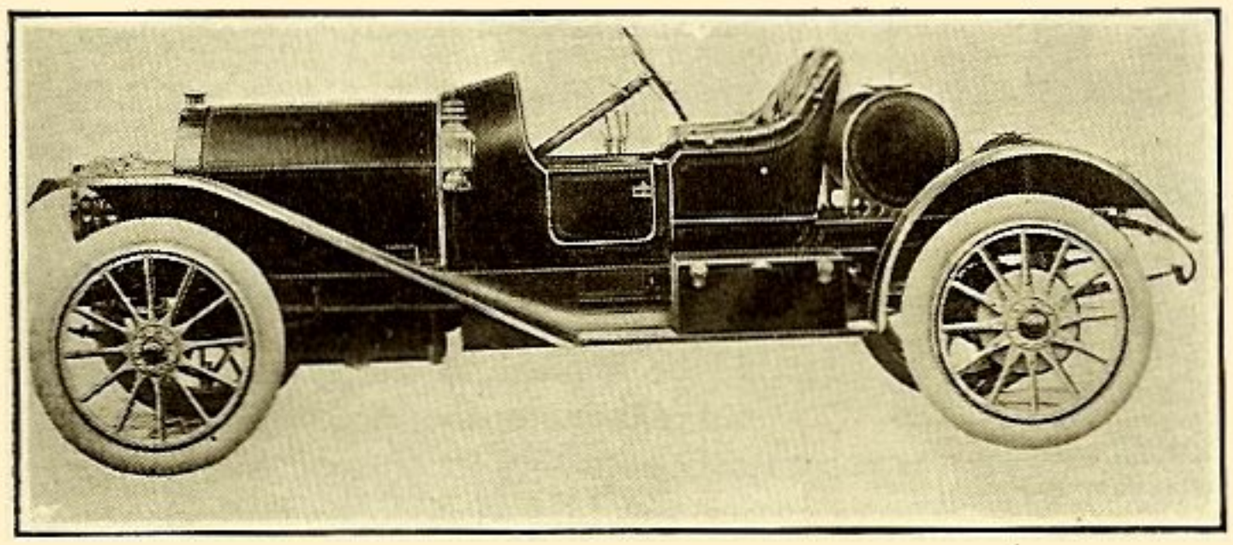


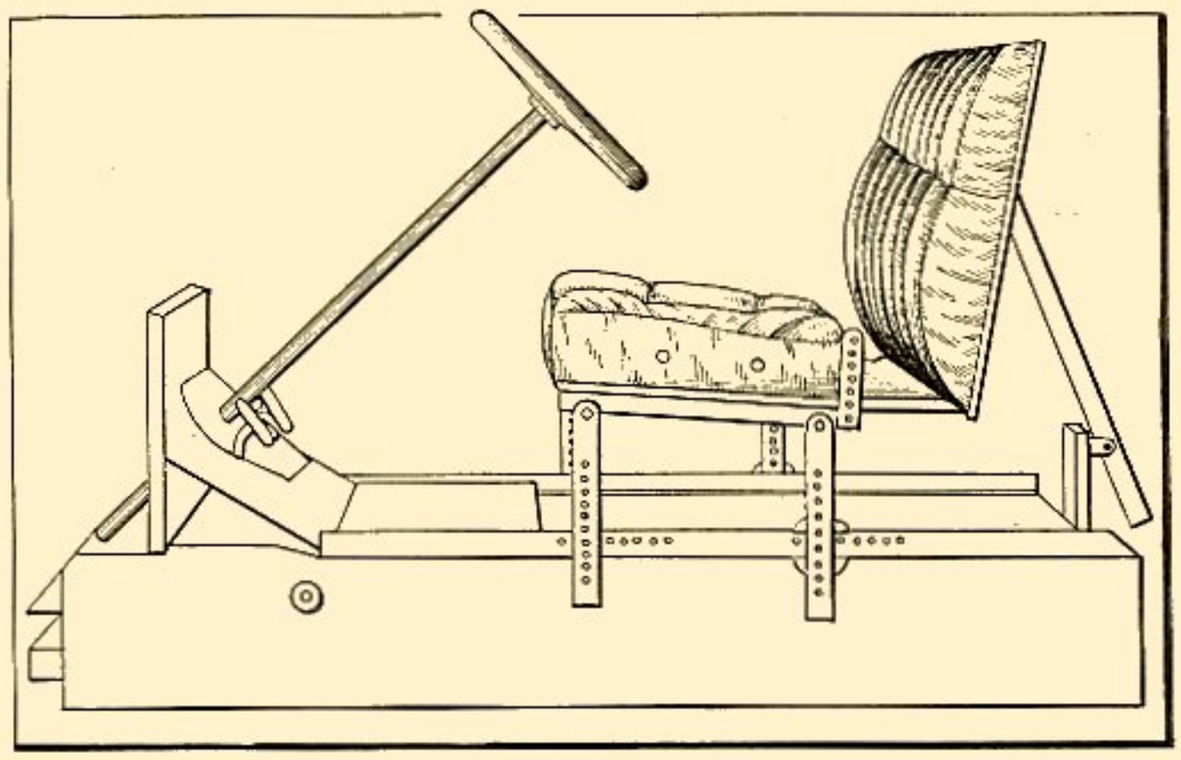
Fig. 10—Showing the National speedway roadster, indicating comfort for the driver and showing large gasoline tank

The space between the seatboards and the footboards was always considered a convenient place to put spares and tools in, but this is gradually disappearing, the total height of the seat being now much lower and the cushions much thicker than they were formerly.

On a long journey when driving a car having a low-confined seat considerable discomfort is sometimes experienced in being forced to keep to one position, and in hot weather the discomfort is accentuated. With the higher seats and more upright steering column formerly used, one could move about a little, and in this way prevent to some extent the fatigue arising from continued driving.

An adjustable driving seat is no novelty on a horsed-carriage, and as it is infinitely more necessary to be able to sit in a suitable position to drive a car, an adjustable driving seat will become popular on some types of automobiles as soon as the public awakes to their advantages.

Where both the brake and change-speed levers, or only the former are outside the front seat panel, the height of the arm rest to driver's seat is important, particularly on some makes of chassis. Even an extra inch will make it extremely uncomfortable to operate the levers which are outside the confines of the car body.



Adjustable seat, with dummy steering wheel and pedals, to enable the builder to fit the car seat to the buyer

Heat Due to Combustion

ACCORDING to accepted authority, the fuel values in British thermal units per pound of the contents of gasoline are as follows:

Carbon burned to carbon monoxide	4,100 B.t.u.
Carbon burned to carbon dioxide	14,500 B.t.u.
Hydrogen burned to water	62,032 B.t.u.
Hydro-carbons burned to carbon dioxide	20,000 B.t.u.

From the above it will be seen that a small proportion of hydrogen in the exhaust products of combustion of a motor represents an enormous weight. It will also be noted that unburned gasoline in the exhaust represents a very considerable waste, and that carbon monoxide, if it exists instead of carbon dioxide, lowers the thermal value of the fuel as used from 14,500 to 4,100 British thermal units.

Correct Tire Pressures

There is great variation in the pressures recommended by the different tire manufacturers. The following is probably a fair average for ordinary loads on the wheels:

Diameter of tire, Inches	Air pressure in tire. Lbs. per sq. in.
2½	45
3	55
3½	65
4	75
4½	85
5	90
5½	95

Lower pressures are used by some, especially for light loads. The pressures run considerably higher in several cases for heavy loads.

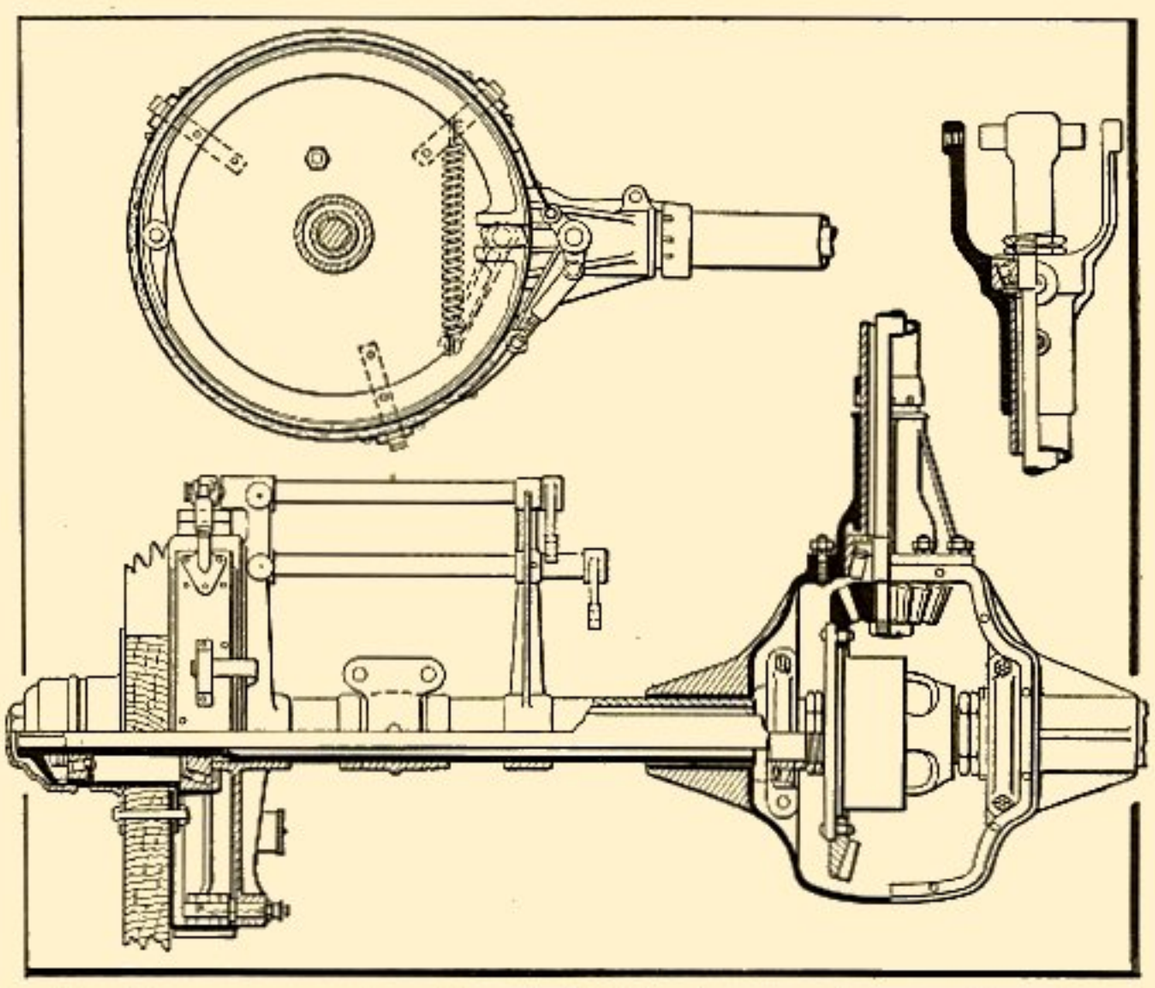


Fig. 11—Transverse section through National rear axle assembly, showing details of brake construction and differential