THE NATIONAL TOURING CAR.

A company which has up to the past year been identified chiefly with the electric vehicle industry, but which then brought out also a gasoline machine, that, with the improvements and changes wrought upon it, is now one of the best-built and up-to-date cars on the market, is the National Motor Vehicle Company, of Indianapolis, Ind. A thorough inspection of the company's plant and a ride at high speed over the rough roads in the vicinity, convinced the representative of this journal that the National car is one that will stand abuse.

The general appearance and some of the details of the car are shown herewith. A four-cylinder vertical motor specially made by the Rutenber Company is used. The view showing the motor taken apart gives a good idea of its appearance. Separate, integrally-cast cylinders having mechanically-operated, interchangeable inlet and exhaust valves in a common valve chamber are bolted to the crank case. The bore and stroke of the cylinders and pistons are 4¼ and 5 inches respectively and the compression 80 pounds. The valve stems are raised by plunger rods having rollers against which the cams strike. The bronze bushings for these plungers, seen bolted to the crank case, are removable and can readily be replaced. There is but one cam shaft, supported in three bearings. The aluminium crank case is divided into four compartments, and the crankshaft has five bearings. The three center ones hold the shaft in place when the bottom of the crank case is removed to adjust the crank or wrist-pin bearings—a feature which is found on most four-cylinder cars this year. Besides this, there are liberal hand holes in the crank case, as shown. Babbitted adjustable bronze bushings are used throughout. The pistons have four ¼-inch rings and hollow wrist pins. The connecting rods are drop-forged, and the crankshaft also is a forging. The flywheel is bolted to a disk on the crankshaft. The contact box in front of the dash is on the end of a vertical shaft driven by spiral gears, and in the same casing is a ball governor which operates on the spark, and can be set for any desired speed by a lever on the steering wheel. The main control of the car is by a throttle pedal, as well as by a throttle lever on the steering wheel. A gear water-circulating pump is driven direct from the single cam shaft of the motor by means of an ingenious detachable coupling. The removal of four bolts disengages the whole pump. The cylindrical honeycomb radiator is backed by a six-bladed, belt-driven, ball-bearing fan 19 inches in diameter and geared to run three times as fast as the motor. On account of the shape of the radiator, the fan produces a draft of air throughout its whole extent. Jump-spark ignition is used, the current being furnished by a belt-driven Apple dynamo, and the secondary wires from the four spark coils to the plugs being rubber covered and run through fiber tubes. Chain connections, which act as spark gaps, are used to the plugs.

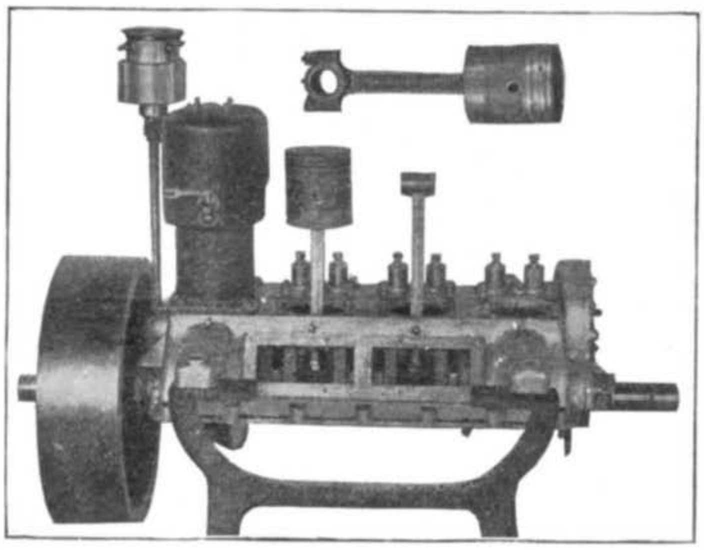

Fig. 2.—MOTOR PARTIALLY ASSEMBLED.

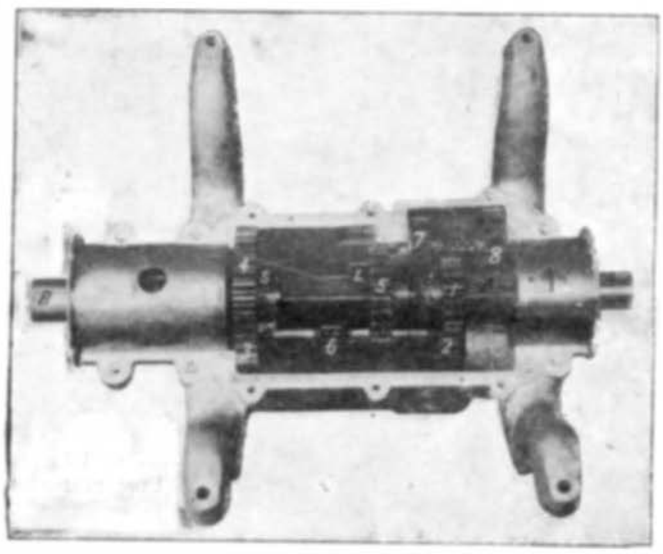

Fig. 3.—TRANSMISSION GEAR WITH BALL BEARINGS.

The clutch of the new National car is constructed according to the latest French practice. A cast aluminium cone, leather-covered, has six slightly-arched, flat steel springs, placed in suitable pockets between the cone and the leather. These springs press out the leather slightly and cause the clutch to take hold easily—so easily, in fact, that the car can be started gently on the high speed with the engine running very rapidly. The clutch is interlocked with the brakes and gear-shifting lever so that the application of either brake or changing the gears throws out the clutch automatically. The usual clutch pedal operates the clutch also in the regular manner. The clutch is connected to the transmission through a universal coupling that allows of fore-and-aft movement as well as misalignment. Both the main shaft and the countershaft of the transmission run on ball bearings. The former has two rings of balls at each end and the latter but one. The balls are of large diameter, and all the bearings can be readily adjusted from the outside of the case. The entire top of the case can be removed for inspecting the transmission without disturbing any part of it, as can be seen from the cut, Fig. 3. The operation of the gears is typical of the modern three-speed sliding transmission. The main shaft is squared and carries the sliding set of two gears, 1 and 5, cut from one piece. A groove, *G*, between the two gears receives a shifting fork for sliding the set. This fork is mounted on a rod that can be slid lengthwise of the case from the outside. The end which is connected to a lever passes through a stuffing box with felt washers, while the other end moves in a sealed tube attached to the gear case. All these provisions are made to keep out the dust. The shorter of the two levers at the side of the car slides the gears. The position shown is low speed. The drive is here from gear 1 on the square shaft, *A*, (which is connected to the clutch and has a bearing in the rear shaft, *B*, at *S*), through gears 2 and 3 on the lay shaft, to 4 on shaft *B*, whence the power is transmitted through the universal joint and longitudinal driving shaft (see plan of chassis) to the rear axle. By sliding gears 1 and 5 to the left until 5 meshes with 6, the intermediate speed is obtained; while sliding the set still further causes lug, *L*, to slip into space, *S*, between the corresponding lugs on gear, 4, thus locking *A* to *B* and giving a direct through drive on generous ball bearings from the motor to the rear axle. The reverse is obtained by causing gear, 1, to mesh with gear, 8, and gear, 2, with gear, 7, which is slid in mesh with 2 automatically by 5 engaging a washer beside 7 as it slides sideways, and thus pushing 7 along into place against the compression of the spring, which thrusts it back out of mesh as soon as it is released. Thus, although the lay shaft is turning all the time when the main shaft is revolving, the reverse pinions are idle except when in use. So compact and light is this transmission that it weighs only 70 pounds, while the weight of the motor is 380.

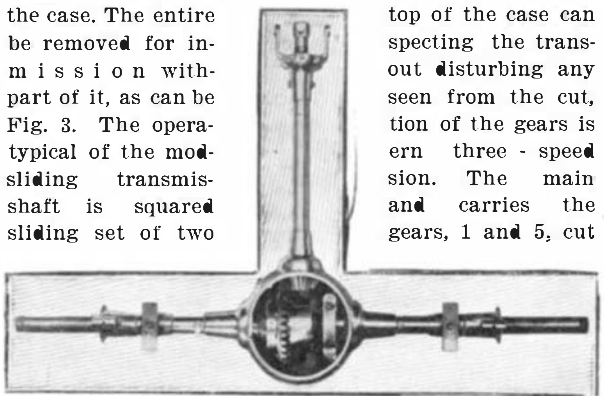

Fig. 1.—PROPELLER SHAFT AND REAR AXLE, WITH DIFFERENTIAL COVER REMOVED.

The longitudinal driving, or "propeller," shaft as it is usually called, runs in ball bearings in a steel tube extending from the globe-shaped differential casing to the rear end of the transmission case, where it is supported by a yoke pivoted on a cross-member of the frame (Figs. 5 and 6) so that it can move back and forth sufficiently to allow for the up-and-down movement of the frame. A protected universal joint between the transmission gear shaft and the propeller shaft completes the line of shafting. The bevel pinion fits on a squared end of the propeller shaft and is held in place by a nut and cotter key. The gears used are of four pitch, both hardened; and a speed reduction of 3 to 1 is obtained.

The construction of the rear axle is such that the rear axle tubes extend through the wheel hubs. On the outside ends of these tubes suitable cones are provided, the outermost of which is adjustable by nuts threaded to the exterior diameter of the tube, thus providing a double, adjustable ball bearing for the wheels entirely independent of the driving axle. The differential case is securely brazed to the two lengths of cold-drawn tube, thus making one homogeneous whole from outside to outside of wheels. It is provided with a removable cap (Fig. 1) by dividing it above the axle lugs in a horizontal plane, thus providing means of inspection of differential gears by simply unscrewing this cap. Inside the case two rows of balls affixed to it provide ball bearings for the hubs of the differential. One of these bearings is equipped with a split cap, which, being held in place by two studs, can be removed, and when removed allows the withdrawal of the entire differential and large gear intact through the opening in the top of the case. Thus we have the wheels turning on the outside of the rear axle tubes, and the differential revolving on its own bearings inside the case, but independent of any strain or stress from weight of car or load. Application of power to the wheels is obtained by means of the two inner axles engaging the gears in the differential by means of squared holes in said gears, the outer end of each axle fitting a squared jaw clutch, which in turn engages its mate upon the hub of the wheel, this engagement being made at the outer end of the hubs, and the whole being covered by dust caps. The advantages of this system are the perfect running of gear and pinion, they being firmly held in place by their bearings; freely-turning wheels due to double ball bearings; a rear axle without joint from outside to outside; the removal of all side thrust from the differential. The adjustment of the wheels does not affect their bearings. As an additional precaution, although not necessary with this system, a truss rod of circular section, ⅝ inch in diameter, extends from the brake support on one side downward and under the center of the spherical case to the brake support on the opposite side. This system also dispenses with reach rods, while the rear axle is provided with movable spring perches mounted on the axle, so that it can rock back and forth without straining the springs. The differential is of the spur gear type, and is of heavy construction. The National Company in

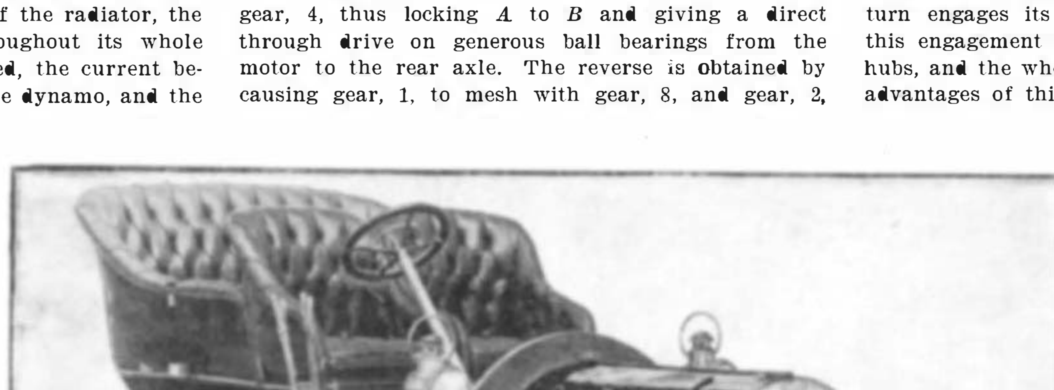

Fig. 4.—THE NATIONAL 24-HORSE-POWER TOURING CAR.

the liberal use of ball bearings are following the latest practice of the best French engineers, some of whom carry the use of ball bearings even to the engine crankshaft bearings. The liberal use of balls undoubtedly reduces friction, and enables the engine to deliver the maximum amount of horse-power to the ground.

The car is fitted with 34-inch artillery wheels, all of which run on double adjustable ball bearings, fitted with ball retainers and made dust-proof by means of felt washers. The front wheels turn upon heavy drop-forged spindles, which are a part of the combined forged knuckle, spindle, and steering arm. The wheels are shod with 4-inch tires, and have the standard tread. The hubs are fitted with spherical dust caps. The rear hubs carry brake drums 13 1-12 inches in diameter with 1½-inch internal face, which provide the friction surface for the internal-expanding metal-to-metal brakes. The system of bearings provided for the wheels allows for the replacement of wearing parts. Replacing the cups, cones, and balls makes a new bearing, regardless of length of service.

On the rear side of the dash, as shown in Fig. 5, are four spark coils in a case and four sight-feed oilers, as well as a snap switch for the ignition current. Extending through the dash is one end of the compression relief rod, which engages the four relief cocks on the cylinders of the engine. The oil supply cut-off extends through the dash also. The oil can be regulated by a button, which is on the end of this rod. The oil is fed to the bearings of the transmission, the universal joint, and the motor crank case.

A good feature of this car that might pass unnoticed is an extra set of lever arms on the steering knuckles, connected by an extra tie rod. In case one of the lever arms should break, as sometimes happens, the extra set would still steer the machine. The main frame of the car is of pressed steel, and the machinery is all carried on a sub-frame. The car has a long wheel base, which contributes to its easy-riding qualities. The ease of control and of adjustability of mechanism, besides several features of the latest foreign practice, stamp it as one of the most up-to-date American cars.

Sir Oliver Lodge on Internal Combustion Engines.

For about two hours last December Sir Oliver Lodge interested a large number of members of the Automobile and Cycle Engineers' Institute, assembled in the hall of the Institution of Mechanical Engineers in London, with an address, illustrated by lantern slides, and experiments with apparatus, on the subject of ignition as applied to internal combustion engines.

Sir Oliver said he would make no distinction between oil engines and gas engines, but take a general survey of the whole subject. From the point of view of combustion, a gaseous mixture was the best. For the purpose of ignition the combustible mixture had first to be raised to a temperature at which combustion took place, and it then spread until it ignited the rest of the gas. Rarefaction, or diminished pressure, would prevent ignition spreading, while a rise of temperature would assist combustion or explosion. The lighter the explosive gas the quicker was the movement of the molecules, and as it had been found, he said, that in gas engines the quickest combustible mixture was that in which there was a slight excess of hydrogen, or the lighter material, one would have thought that an excess of either material would be a disadvantage; but that did not appear to be the case, although an excess of the heavier material proved disadvantageous because the atoms forming it were moving more slowly. The effect of a diluting material was the same as that of rarefaction. Each gas occupied a space independent of the rest, and dilution with other gas might have a

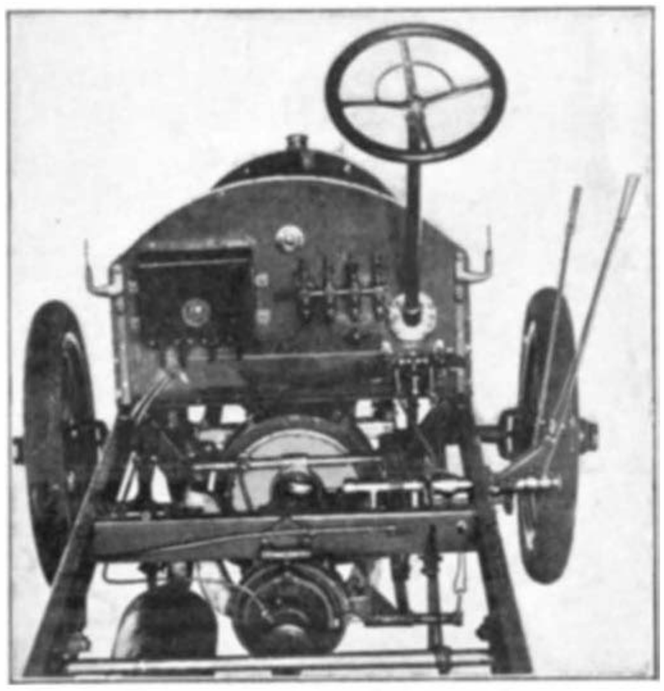

Fig. 5.—BACK OF DASH, SHOWING ENGINE FLYWHEEL AND UNIVERSAL JOINT OF PROPELLER SHAFT.

retarding effect on combustion. In a weak mixture the line of explosion would be a meandering one, and the explosion would be slow. To increase the rate of combustion the gas must be compressed and then ignited in more than one place. It was sometimes asked whether it was better in a cylinder and piston to ignite the gas near the piston or near the base of the cylinder. In a high-speed engine the best place would be near the piston, so that the force of the explosion might be exerted on the piston before it could move away. The quicker the speed of the engine the more combustible must be the material used. In a slow-speed engine a slow-burning mixture might be used without advantage, because a more lasting blow—more of a push—was obtained. If the walls of a gas engine cylinder were cold there was bound to be a certain amount of unburnt materials. If they could have the walls of the cylinder red hot they would obtain better combustion. He could not think the principle of a water gas engine was right or final, because in it the temperature of that which they wanted to be hot was lowered. If only they could let the air and gas into a hot vessel it would certainly be more economical. It did not seem beyond the province of invention to achieve that result. He thought the subject of ignition important, and it was in that direction that advance had largely been made. The idea of modern guns —barrels, powders, and shot—was not very different from what it was years ago. It was in the ignition arrangements that the modern rifle differed chiefly from the ancient weapon, and the same was the case in engines. Sir Oliver then illustrated several methods of ignition—the tube ignition method, the incandescent tube igniter in which the time of explosion is regulated by the screwing in or out of a timing plug, Wydt's electro-catalytic igniter, and the Clerk engine, with bolt igniter, in which a piece of metal kept hot by the previous explosion causes an explosion as soon as the gas is compressed by the return of the piston. Having shown that a little spray of oil injected into compressed hot air is all that is needed to secure ignition, the lecturer pointed out that the temperature of the highly compressed air lasted only a short time because it was in touch with cold surfaces. In motor cars and portable engines especially flame ignition was hardly ever employed, and therefore electric ignition had come to the fore. Electric ignition might be regarded as almost the natural method of setting up combustion. Sir Oliver showed a number of experiments in electric ignition by both low and high tension methods. Finally he illustrated the quickest method of obtaining an electric spark—a plan which he described as equivalent to the release of an electric spring. From a coil two wires were carried to a couple of Leyden jars in order to charge them, and the discharge from the interior of those jars caused a spark where points on the charged wires were brought into juxtaposition. But if from the external casing of the jars other wires were carried and their points were brought toward each other, a spark could be obtained which could not be stopped by the interposition of an electric-light carbon or wet blotting paper, or by the points being smeared with a mixture of lampblack and oil, or being placed under water. His son had told him of the trouble sometimes experienced with motor cars owing to failure of ignition, and he thought the second spark of which he had spoken was what was needed to remedy this. He was informed that people often wanted to economize in the ignition arrangement of motor cars more than in any other part; but that seemed to him false economy. There was much that was beautiful and well and skillfully designed in connection with these engines, and sometimes the ignition part was not equal to the rest. He thought more attention should be directed to those parts.

Important alterations have been made concerning the international contest for gasoline-propelled boats for the Harmsworth trophy. Henceforth the start is to be a flying one, all competitors starting together by signal. The course is to be extended from the present length of between 6 and 12 knots to one varying from 30 to 35 knots, so that opportunity is provided for the evolution of a better type of boat. All angles also must not be less than 120 degrees, and the length of each round is not to be less than five nautical miles.

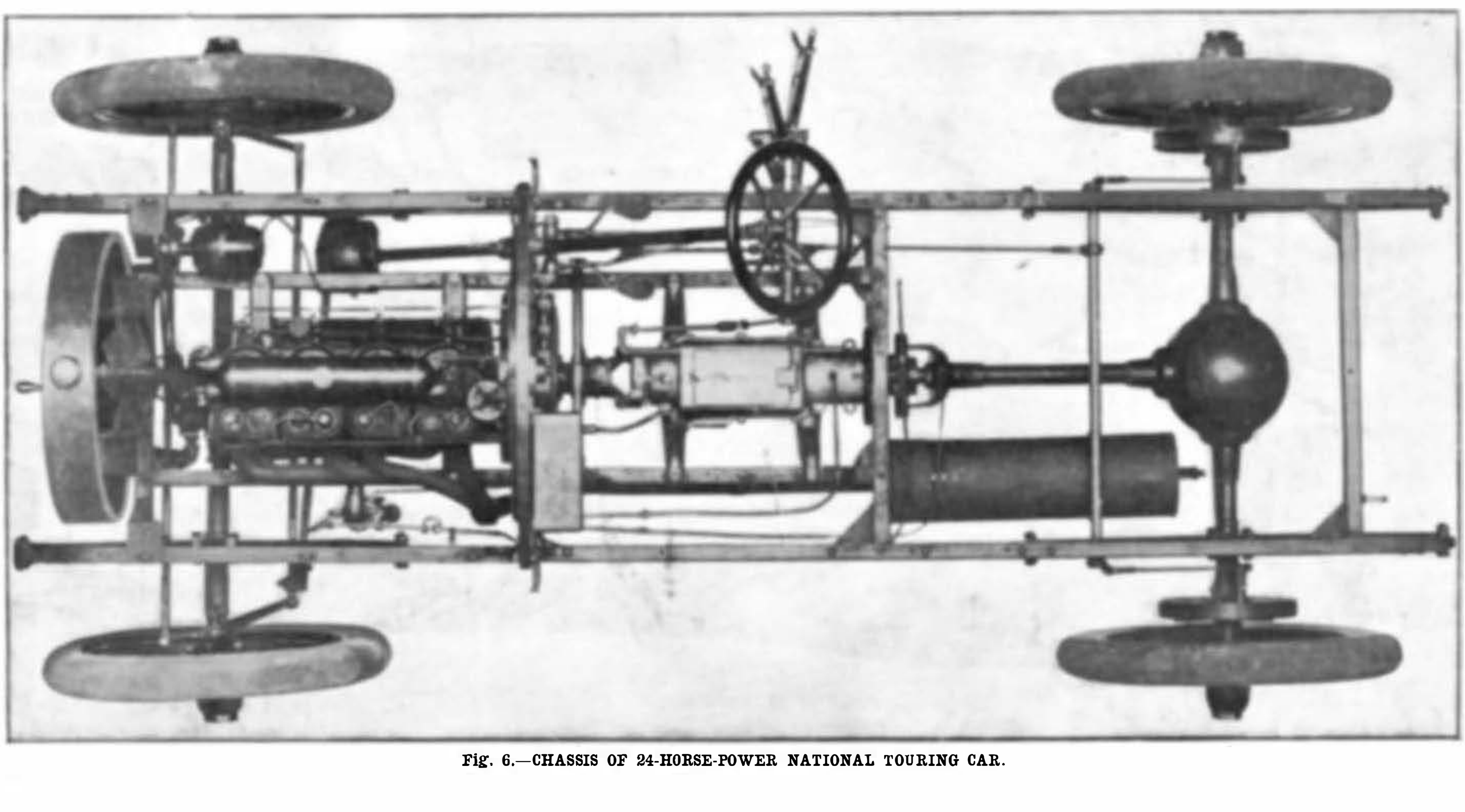

Fig. 6.—CHASSIS OF 24-HORSE-POWER NATIONAL TOURING CAR.