munition will be carried at each end of the ship. With the increase in battery, special care has been required in developing these designs to secure an adequate rate of supply of ammunition from the magazines to the guns. For handling 6-inch and 3-inch ammunition, the ships have been provided with a central passage extending completely from the forward to the after magazines, and four side passages at each end to extend a sufficient distance forward and aft to provide for handling the ammunition within the armor protection, on the decks above. All of these passages are at the level of the upper platform deck, and such quantity of both 6-inch and 3-inch ammunition is stowed at this level as would probably be required in any action. The remaining ammunition is stowed where it can readily be whipped up by hand when time is available, from the lower to the upper platform.

For handling ammunition along the central passage, there will be ammunition conveyors, which are nothing more than traveling platforms, onto which ammunition can be loaded at one end and delivered abreast the various ammunition hoists at different points in its travel. Provision has been made by means of power hoists, to handle the 6-inch, 3-inch, and 3-pounder ammunition at the rate of seven pieces per minute. In addition to the power supply, there has been provided sufficient means for a supplementary supply of ammunition by hand, to interfere as little as possible with the power handling, so that, with the combined means of supply, it will be possible to supply ammunition to all of the guns at a rate equal to that at which they can be fired.

The full complement of the vessels, as flagships, will consist of: One flag officer, one commanding officer, chief of staff, 19 wardroom officers, 12 junior officers, 10 warrant officers, 814 men.

The masts will be fitted for the installation of wireless telegraphy.

The propelling engines will be of the vertical, twin-screw, four-cylinder, triple-expansion type, of a combined indicated horse power of 23,000. The steam pressure will be 250 pounds, and the stroke 4 feet.

The engines will be located in two separate watertight compartments. Steam, at a working pressure of 250 pounds, will be supplied by sixteen boilers of the straight watertube type, placed in eight watertight compartments, having combined grate surface of at least 1,590 square feet, and heating surface of at least 68,000 square feet.

LEADING TYPES OF 1902 FRENCH LIGHT-WEIGHT AUTOMOBILES.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The following descriptions of some of the French light-weight cars that have become prominent the past year, may be of interest to many of our readers. We have given considerable space to the description of the Renault car, as this deserves special mention, since it won the Paris-Vienna race last summer, thus proving the enduring qualities of a light-weight machine in a hard and rapid road test, and demonstrating that its staying powers equaled, if not surpassed, that of the heavy, locomotive-like car, that had heretofore been so prominent in France.

This machine has been designed especially to secure lightness and simplicity in the mechanism, combined with a sufficient motive power. Its design has been carefully studied, and it is no doubt due to this fact that it has proved so successful. The general arrangement of the parts will be noticed in the plan view of the frame, and in the different photographs. The motor, which is mounted in front, is, however, larger than the one shown; it is of the upright 4-cylinder type, and has been newly designed. The cylinders are mounted in pairs, as usual, upon a long aluminium crank case. The motor develops 24 horse power, and weighs 286 pounds, including the flywheel and friction clutch. The inlet and exhaust valves are superposed; the former are automatic, while the latter are operated from a cam-shaft. The front view shows the relative position of the motor and the water-cooling system. A large water-jacket surrounds the motor cylinders and valve chambers, and is closed at the top, for each pair of cylinders, by an aluminium cap which receives the water-tube. The water tank is of small dimensions, and is placed above and behind the motor. The radiating tubes are placed on each side and partly inclose the motor. The water circulation is carried out on the thermo-siphon principle, which is coming into use in France. The water circulates by gravity alone, the heated water coming from the top of the motor rising to the upper reservoir, from which it descends again through the cooling tubes, and enters the motor at the lower part. In this way the use of a water-pump is not necessary.

The carbureter is of the float-feed atomizer type The admission of gas is regulated by a governor on the motor, and also by a pedal adapted for the purpose, whose position may be fixed by a thumb-nut placed just below the steering wheel. During stops or long descents, the motor speed may thus be reduced to less than 400 or 500 revolutions per minute, or the motor may be stopped. The quantity of air entering the carbureter is also regulated, according to the speed of the motor, by a small handle placed beside that of the ignition shifting one. The method of electric ignition deserves mention, as the new system designed by M. Carpenter is employed. The spark-break is made much more quickly than usual. The trembler of the induction coil, instead of breaking contact directly, when it is attracted, does not do so until nearly at the end of its movement, when at the maximum speed; at this point it strikes against an auxiliary contact spring, making a very quick break. The resulting spark is much better, and the motor can be run at a higher speed.

The friction clutch and transmitting mechanism are shown in the diagrams. The friction clutch and flywheel are mounted together. Inside the flywheel, *V*, is a cone-socket upon which is applied the conical piece, *U*, of aluminium. The two cones are normally pressed together by a spring, *X*, and are separated by the rod, *Q*, which is operated by the pedal, *l*. A double set of ball-bearing collars are used to take up the thrust.

From the friction clutch the main transmission shaft passes first through the speed-changing box, and thence to the differential. This shaft is divided into two parts, one a square portion which carries the sliding set, *A E*, comprising the two gears, and one of the jaws of a clutch (seen between *E* and *D*). The second part, carrying the other jaw of the clutch, passes out of the gear box and through a double-jointed transmission rod to the differential, where it carries a bevel driving gear. The main shaft, made thus in two portions, may be operated as a whole when the clutch is in contact; or, by separating the jaws of the latter, the first part may be made to operate the second at different speeds by using the intermediate gear set below. The lower shaft carries a set of gears, *B G C*, for the two speeds and reverse. The transmission can be made either through *A B C D* for the first speed, *E G C D* for the second, or by direct coupling through the jaw clutch for maximum speed, by sliding the upper gear-set back and forth. The method of throwing the gears into contact is a special feature of the Renault machines. The lower shaft, *B G C*, rotates in a pair of eccentric bearings; it is not shifted to the right or left but can take a to and fro movement so as to approach the upper set. In this way the teeth do not engage in the ordinary way by a side movement, but strike each other face to face over their entire surface. The gears are first thrown opposite each other, then one set is applied to the other progressively, so that the teeth of one mesh with those of the other. In this way there is much less shock than usual in the speed changing, and the meshing of the gears is effected easily. Two movements are therefore necessary to change gears—one the shifting of the set, *A E*, and the second a forward and back movement of *B G C*. This is accomplished in a very simple and effective manner by a single movement of the lever. An upper shaft, *P*, operated from the driver's lever, carries a screw thread, *F*, which works in the collar of the gear-shifting fork, *F*. When the shaft is rotated, the screw moves the fork back and forth to shift the gears. To bring up the lower set, *B G C*, the same shaft carries a cam, *H*, on the right, which operates a rack. The latter engages with the bearing of the lower shaft, which is mounted so as to take a rotary movement. The shaft is mounted eccentrically in this bearing, and when the latter is rotated, the shaft is elevated or depressed, throwing the gears in or out of contact. A similar rack is used on the left side. The relative position of the fork and the cam is such that the two operations succeed each other properly; thus upon turning the shaft, *P*, the speed-changing takes place as follows: First, *B G C* is lowered; next the set, *A E*, is displaced laterally; then *B G C* is raised, throwing the proper gears into mesh. The reverse is obtained as usual by a supplementary gear, *S*, mounted on a separate shaft and engaging with *A*. Upon shifting to the extreme left, *A* drives *B* through the gear *S*, giving the reverse movement. The transmission is made direct through the clutch for the maximum speed. This system of direct transmission, which is coming into use, is a decided advantage, especially for the racing machines in which the high speed is nearly always engaged, as the use of gearing is dispensed with.

The maneuver of the upper shaft is obtained by a toothed sector, *L*, fixed on the shaft, *K*, at the extremity of which is the speed-changing lever, *J*. The sector engages with a small pinion, *M*, and turns it rapidly. On the same shaft with *M* is carried a bevel gear of larger diameter, which drives a small pinion, *O*, the latter being mounted at the extremity of the shaft, *P*. By this arrangement of double gears, a displacement, even slight, of the main lever, produces a rapid rotation of the shaft, *P*. The lever, in passing from one notch to the other, turns the shaft rapidly enough to allow of the three movements above mentioned. The gears which operate the shaft, *P*, are inclosed in a separate case of special form, mounted close to the speed-changing box, as will be noticed.

The main transmission rod carries a joint at the end of the speed-changing box and a second at the differential, affording a flexible transmission. The position of the joints is calculated so that when the machine is loaded the rod takes a horizontal position. The differential case is of steel, and has fixed to it two steel tubes, through which pass the main axles of the wheels. The side thrust of the axles is taken up by a ball-bearing collar mounted at each side of the differential case; these collars can be regulated from the outside by screw-rings. At the ends of the tubes are mounted the journals of the main axles, which are also provided with thrust bearings.

The Peugeot racing car, which has been quite successful in this year's events, differs considerably from the preceding. One novel feature is the use of a water-cooling device somewhat similar to that employed on the Mercedes cars. It is the first machine of any note in which such a system is used in France. The radiator is mounted in front of the motor, as will be observed; it is made up of a great number of short copper tubes around which the water circulates, its construction giving it a honeycomb appearance. The water is circulated by a centrifugal pump of large output, driven from the flywheel by friction, and sending the water from the motor to the radiator, where it is quickly cooled. In the rear of the radiator is a ventilating fan driven by the motor. This fan draws a current of air through it independently of the speed of the car. The cooling being thus aided by the fan, a much smaller quantity of water can be used, and in fact the 4 gallons which are contained in the water-jackets and piping system, are sufficient for the cooling without the use of a separate reservoir. In this way a considerable gain in weight is secured. The exhaust pipe has been made especially large, with a good-sized muffler quite near the motor, designed to reduce the back pressure to a minimum.

The friction clutch is similar to that used in the Renault car. Chain transmission is employed to drive the rear wheels. The speed-changing mechanism and differential are mounted together in a large, flat, aluminium box, leaving only the ends of the axles for the driving sprockets projecting on each side. The speed-changing device gives three speeds and a reverse. It is operated by a single lever placed at the side of the driver's seat. The movement is transmitted to a vertical shaft, which operates a fork used to shift the gears. These are of the ordinary sliding type, but are arranged, like those of the Renault, to drive direct on the fast speed. On this speed, the motor shaft is direct-connected with the bevel gear that drives the differential of the countershaft, so that the only loss in transmitting power is in the one set of bevel gears and the sprocket-and-chain drive employed from the countershaft to the rear wheels. The reverse is obtained by an intermediate pinion.

The Decauville light-weight car is another of the leading types. It is here shown with a four-seated carriage body; when used as a racer the rear seats are removed. The motor, *M*, mounted behind the radiator, has two cylinders of 4.4-inch diameter and the same stroke, giving 10 horse power at a speed of 1,000 revolutions per minute. A characteristic feature is the mounting together of the motor and speed-changing box, so as to form a solid piece. This secures a rigid transmission, which is independent of the movements of the frame, and avoids jamming of the bearings. The friction clutch is mounted between the motor and the speed-changing box. The latter has three speeds and a reverse, and is similar in principle to the others. Many of the new machines are adopting the method of direct connection between the motor and differential at full speed, also the double-jointed rod transmission. Here, however, the rod is short, and passes obliquely to the differential. A novel feature of the Decauville machine is the use of the small dynamo, which keeps the ignition accumulators always charged by means of a set of automatic switches. In this way the mishaps due to the exhaustion of the battery are avoided. The radiator is fed by a centrifugal pump, driven by the motor.

A light-weight car which has been especially prominent this year is the Darracq. When built as a high-speed racing car, as shown in the photograph, it has a 4-cylinder motor giving 20 horse power. The views of the frame show the same machine with a 2-cylinder motor of 12 horse power, which runs at 1,200 revolutions per minute. The arrangement of the mechanism resembles closely that of the preceding type. Behind the motor is the friction clutch, then comes a speed-changing box which has also the interlocking system for full speed. The shaft turns in ball-bearings. The differential carries at each end a steel tube which incloses the rear axles. Ball-bearings are used to take up the thrust of the axles. A jointed-rod transmission is also used from the speed-changing box to the differential.