beds at the bottom of the new sea. To achieve similar results (though as far as I know an unrecognized fact) is one of the purposes of the saltness of the ocean; that is, that the evaporation of chlorine assists in producing rains; and, again, another purpose is that the evaporation of chlorine from the ocean provides the chlorine constituent of the ozone of the air.

It might not be an absurdity to anticipate that the permanent preservation of the Salton Sea would reclaim the arid waste, and make the desert to blossom as the rose; prevent and do away with the "hot winds" that sweep up from New Mexico across western Kansas and up into Nebraska, destroying millions of dollars' worth of crops; save the government millions of dollars that would otherwise be necessary for irrigation projects, which produce only small local results at great cost in comparison with the extensive benefits which might possibly be permanently secured without cost and without attention by the retention of the new sea.

There seems to be a chance for realization of anticipated hopes, and the matter may be worthy of serious consideration, as with sufficient rainfall the section now known as the arid Southwest would develop into the most wonderfully fertile region of the entire country.

M. REED.

Chicago, December 1, 1906.

THE MOTIVE POWER OF A 25¼-K[illegible]ER.

One of the most impressive manif[illegible] of the power of the modern steam engine is [illegible] of an up-to-date freight locomotive starting [illegible] forty or fifty cars, and gathering way, unti[illegible] mass is thundering over the rails at a s[illegible]r 30 miles an hour. When we attempt [illegible]ided strength to move a heavy piece of [illegible] der- stand very well what is meant by [illegible] To move a single loaded freight car [illegible]an power, it is necessary to cr[illegible]as [illegible]ny men as can lay their hands o[illegible]inst it in a united propulsive effort. And hence, [illegible]en we see not one, but forty or fifty loaded cars, started from rest and swung into their full stride by a single locomotive, the latter becomes symbolical in the popular mind of majestic power.

It is for this reason that, in our attempt pictorially to represent the horse-power which will be necessary to drive the new Cunard liners at 25¼ knots an hour, we have taken the average-sized freight locomotive as our unit of comparison. The least amount of power which the designers of the "Lusitania" and "Mauretania" found would be necessary to drive these ships at their contract speed was 68,000 horse-power. Now, the horse-power of the average freight locomotive is about 2,100, and, consequently, the total thrust on the four propellers of each of these ships will be equal to the total pull exerted by thirty-two modern American freight engines. One of these locomotives could haul on the level a train of fifty cars, whose total length would be just a third of a mile. Consequently, the whole 68,000 horse-power of the Cunarder, expressed in terms of locomotive work, would be sufficient to haul a train of 1,600 cars, whose total length would be over five miles. In our front page illustration the artist has given a graphic representation of these figures by grouping together sixteen double-header freight trains on parallel tracks.

To develop a minimum of 68,000 horse-power, and a maximum that will possibly run up to 75,000 or 80,000 horse-power, calls for a boiler and engine plant of truly titanic proportions. Steam will be supplied by twenty-five cylindrical boilers, of which twenty-three are double-ended and two single-ended, the former being 17 feet 3 inches in diameter and 21 feet long. The coal will be burned in these boilers on 192 furnaces, the total area of whose grates would be represented by a square measuring 64 feet on each side, containing about 4,000 square feet of surface. Night and day, an army of several hundred firemen will be continuously shoveling coal into these furnaces, where it will be burned at the rate of about 1,000 tons every twenty-four hours; and to insure that the coal is burned at a fierce white heat, the air will be forced through the grates continuously by means of powerful electrically-driven fans, the rush of air being also assisted by the four great smokestacks, through which the products of combustion will be discharged high up in the air at about 150 feet above the level of the grate bars.

These smokestacks are worthy of special mention, for in addition to their great height, they will be far larger in sectional area than any that have been previously constructed. In order to present less resistance to the atmosphere, which, even on a day when there is not a breath of air stirring, will be, on account of the great speed of the ship, equivalent to a 30-mile gale, the smokestacks will be made of a general elliptical section, slightly more pointed at the ends and not so flat on the sides as the sectional view shown on our front-page illustration. Each smokestack will measure 17 feet 6 inches on its minor axis and 23 feet 6 inches on its major axis. That these are extraordinary dimensions is shown by the fact that two large limousine automobiles could be contained within one of the smokestacks, one standing in the direction of the axis and the other transversely to it, as shown in the illustration referred to. Another standard of measurement is afforded by the fact that two modern steam railroad tracks could be laid side by side within one of these smokestacks, and full-sized trains run within it with a slight clearance in every direction.

When the completed engine room is entered, it will be found that the machinery has been designed on the same colossal scale. Here are four turbines driving as many shafts, the two outer shafts being driven by two high-pressure turbines and the two inner shafts by two low-pressure turbines; while at the after ends of the low-pressure turbines, and on the same shaft, are two additional turbines for driving the ship astern. Each high-pressure turbine casing is 10 feet in internal diameter and 25 feet in length. These are big dimensions, but the surprise will come when one enters the low-pressure turbine engine room; for each of the low-pressure turbine casings has an internal diameter of 16 feet 6 inches. Here again, for comparison, we turn to the modern locomotive; for if a pair of rails were laid along the bottom of one of these massive cylinders, it would be possible for one of the largest of our modern express locomotives to pass through the casing and still have a slight clearance between its smokestack and the walls of the cylinder. As a matter of fact, this casing is larger than the cast-iron tube of the Subway tunnel, now being driven from the Battery to Brooklyn, which has an internal diameter of 15½ feet.

Attention is directed to the comparative profile diagrams at the top of the front-page engraving, in which is shown the rapid growth in size of turbine-propelled vessels. The diagrams start with the year 1894, when the little experimental "Turbinia" made her phenomenal speed, and finish with the year 1907, in the summer of which the new turbine Cunarders will make their maiden voyages to this port. The diagram is based upon a paper recently read by the Hon. C. A. Parsons, the inventor of the marine turbine, at a meeting of the Institute of Marine Engineers of Great Britain. The "Turbinia," which was built especially for experimental work, was launched in 1894, and her first engine was of the radial flow type, and gave about 1,500 horse-power. The success of the "Turbinia" led the British government to build two destroyers, the "Viper" and "Cobra," the first of which made a speed of 36.86 knots, which is equivalent to 42.5 miles per hour, the speed of the "Cobra" being slightly less. The "Viper," by the way, holds the record as the fastest vessel of any kind yet constructed; for, as far as well-attested official records go, no vessel of any kind has approached within several knots of this speed.

The next advance, shown in the diagram, was represented by the river Clyde passenger steamer "King Edward," 1901, which was 250 feet long, of 562 gross tonnage, and 3,500 horse-power. She was followed in 1903 by the "Queen," built by the Southeastern and Chatham Railway Company, which was 310 feet long, of 1,676 gross tons, and 7,500 horse-power. The turbine having proved itself for river and channel service, the next advance was the bold one of installing turbines in an ocean liner, and Allan Line steamers, the "Virginian," and "Victorian," each 520 feet in length and of 10,754 gross tons, were equipped with turbines of 12,000 horse-power. It was found that in these larger sizes important modifications of design were necessary, and the lessons thus learned were incorporated in a much larger ship, the "Carmania," built in 1905 for the Cunard Company. This vessel is 678 feet long, 72 feet beam, and 52 feet in molded depth, her gross tonnage is 19,524, and her horse-power 21,000. In the summer of 1907 the "Lusitania" and "Mauretania" will serve to put the marine turbine to a supreme test. These vessels are so much larger than anything existing as to be in a class entirely by themselves. They are 785 feet long, 88 feet broad, and 60½ feet deep. Their gross tonnage will be about 33,000, and they will displace 45,000 tons. Their horse-power, as already stated, is 68,000, and will probably work up to between 75,000 and 80,000.

The contract speed of these ships is 25¼ knots an hour on trial, and they are to show an average of 24¾ knots for a whole trip across the Atlantic.

When the Acetylene Flame Begins to Flicker.

When the flame of an acetylene lamp begins to flicker, showing the presence of wet gas, the strainer should be examined to see whether it is clean and dry, and if not, renewed. Failing this, it is possible frequently to insert a piece of blotting paper between the carbide and the metallic disk which rests upon it, thus drying the gas as it leaves the base of the container. In generators which are fed from above to the top of the carbide, this method is, of course, out of the question.—Bicycling World.

THE SECOND ANNUAL EXHIBITION OF THE AERO CLUB OF AMERICA.

In connection with the seventh annual show of the Automobile Club of America, the sister Aero Club gave its second exhibit of aeronautical apparatus both historic and modern. The exhibit this year was characterized by the up-to-date and practical character of the articles displayed, rather than by their historic interest, as was the case with the exhibit last year. There were, however, several historic machines that were not displayed last year. As heretofore, the walls of the room were covered with interesting photos, enlargements of balloon ascensions and airship flights. Besides a number of enlarged photos of the Wright brothers' gliding experiments, there were prints of Santos Dumont making a flight in his motor-driven aeroplane, as well as enlargements of this machine and its motor. Several baskets of the club balloons, one of them being that of the "United States," in which Lieut. Lahm and Major Hershey won the Bennett trophy, were on exhibition. Hung from the ceiling were the nacelles of two of the most successful American dirigibles—the "California Arrow" of Capt. Baldwin, and the airship which Leo Stevens built for Major Miller, and which is the only one in which a woman has made a flight.

The former airship, which has a cigar-shaped envelope of 9,000 cubic feet capacity, holds a record for speed of about 17 miles an hour. This is remarkable considering the size of the engine, which is only a 2-cylinder, 7-horse-power V motor, similar to that shown on page 449. The propeller, which is about 8 feet in diameter, makes about 400 revolutions per minute. Another interesting exhibit that hung from the ceiling was a peculiar winged kite exhibited by Henry Rodmeyer. This gentleman also demonstrated a model of a flapping-wing machine on the roof of the building on one day during the show. Another crude model of a beating-wing machine was exhibited and demonstrated daily by Mr. A. V. Wilson, who was one of the first American aeronauts to make a balloon ascension and parachute jump. This gentleman claims to have made a flight of over 1,700 feet in a beating-wing machine two years ago, the *reductio ad absurdum* of his claim being found in the fact that the machine—a cumbersome wood affair—was propelled by himself alone. A full-size flapping-wing machine, invented and constructed by Amos Drew two years ago, was one of the historical exhibits. This machine, which weighs 600 pounds and has 350 square feet of supporting surface, is fitted with a 3-cylinder air-cooled motor that is ridiculously small for doing the heavy work of flapping the long, narrow wings of the machine. The Gillespie aeroplane (which we illustrated some time ago) was another historical exhibit. Mr. Gillespie also had on exhibition a new double-surface model made up of four sets of twin planes.

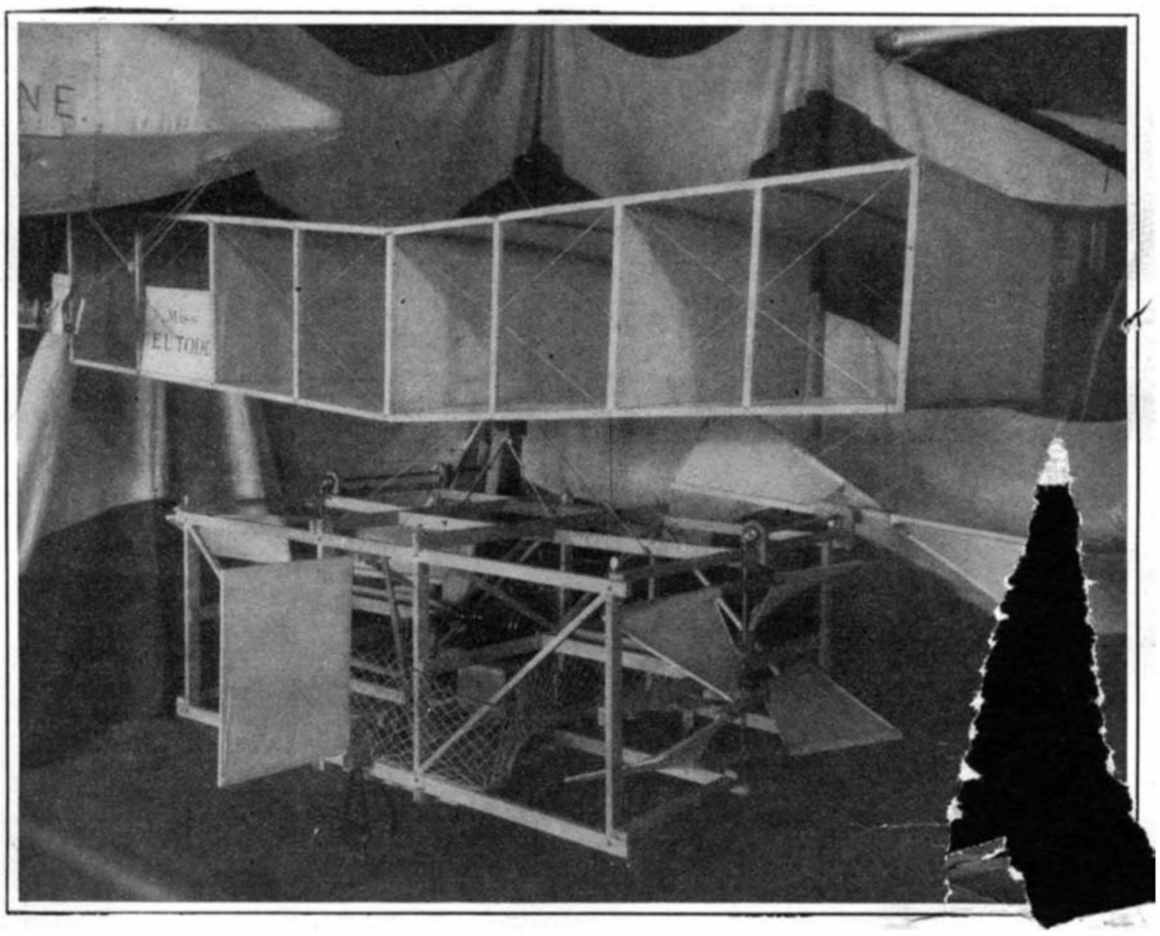
Passing now to the new apparatus, about the only thing in the aeroplane line was a large model built of wood and cloth by the inventor, Miss E. L. Todd, who has sought to obtain automatic stability of the aeroplane by suspending the framework below it in a novel manner, while she has also provided for a rigid connection of the planes and the car when necessary. A. Roy Knabenshue showed the framework and motor of his aeroplane, all of which looked too light to be very practical. There was also shown an experimental helicopter apparatus of Carl Dienstbach. The body framework of Gustave Whitehead's latest bat-like aeroplane was shown mounted on pneumatic-tired, ball-bearing wire wheels and containing a 3-cylinder, 2-cycle, air-cooled motor of 15 horse-power direct connected to a 6-foot propeller placed in front. This machine ran along the road at a speed of 25 miles an hour in tests made with it last summer. When held stationary, it produced a thrust of 75 pounds. The engine is a 4¼ x 4 of an improved type. Whitehead also exhibited the 2-cylinder steam engine which revolved the road wheels of his former bat machine, with which he made a number of short flights in 1901. He is at present engaged in building a 100-horse-power, 8-cylinder gasoline motor with which to propel his improved machine.

The main feature of the show this year was the display of light-weight aeronautical gasoline motors. The lightest of these for its horse-power was the 5-cylinder, water-cooled motor built by Prof. Langley in 1903 for use on his full-sized aeroplane. This engine, the cylinders of which are in the same vertical plane arranged radially around the crankshaft, weighs but 125 pounds and develops 52.4 horse-power. Its weight per horse-power is therefore but 2.3 pounds. With spark coil, batteries, 25 pounds of water, etc., the total weight is but 200 pounds, or 3.8 pounds per horse-power. As it is only within the last two years that any motor of such small weight per horse-power has been produced, it will be seen that Prof. Langley was ahead of his time in this line as in others.

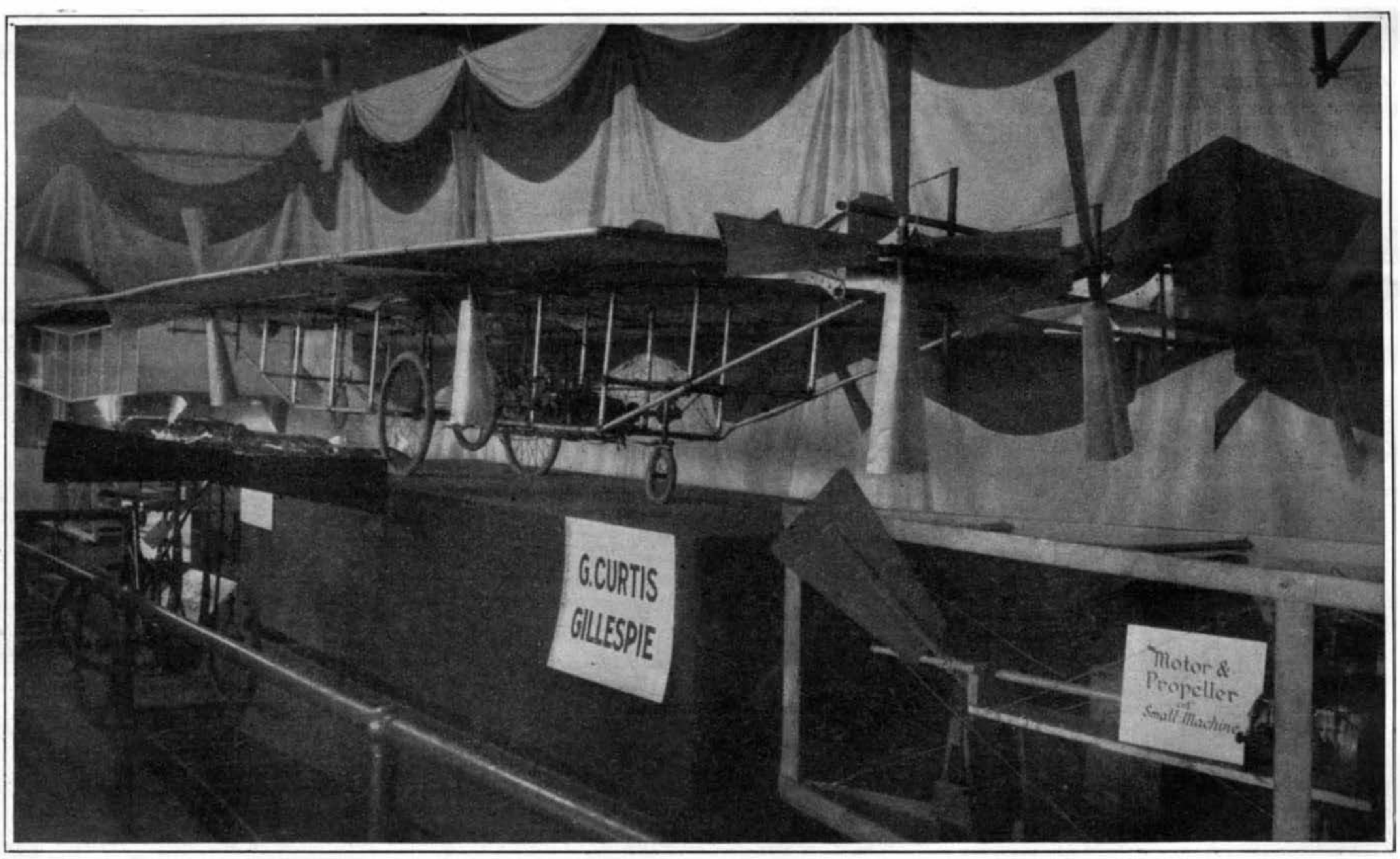
The next lightest motor per horse-power developed was a 4-cylinder, two-cycle, air-cooled engine, the invention of Mr. George J. Altham. This consists of two pairs of opposed cylinders placed side by side in adjacent vertical planes. One piston of each pair is connected to a crank in the usual way, while four straight rods (see cross-section) tie it to the piston in the opposite cylinder. These rods pass through brass bushings in a plate that closes the base of the second cylinder. A separate annular chamber of the same size as the crank case is provided for the initial compression of this second cylinder. In the diagram the piston of the second cylinder is at the top of its stroke, while that of the first cylinder is at the bottom. The charge of the latter is being transferred around the piston through transfer box, *T*, and is being deflected upward, as indicated by the arrows. The exhaust is at the same time taking place on the opposite side of the cylinder. The second piston has just uncovered the inlet port, *I*, and the vacuum made by the upward stroke of the piston is drawing a charge into the space below this piston for the initial compression. The motor, it will be seen, is of the three-port type, there being no valves whatever. The carbureter used with this motor has a float chamber, from which extends a vertical pipe, *P* (see diagram), containing three small holes for spraying the gasoline. A special cone-shaped aluminium valve, *V*, surrounds this pipe and is held down by a spring, *S*. In starting, or when the motor is running at low speed, the air is drawn in through the inlet pipe, *A*, and down around the bottom of the valve, as indicated by the arrows. The narrow passage around the pipe, *P*, makes a strong suction, and causes the gasoline to be drawn upward and to flow in a proper mixture with the air into the inlet pipes, *B B*. As the speed of the motor increases and the suction becomes stronger, the valve, *V*, is raised from its seat, and allows the air to pass directly by it to the inlet pipes of the motor. As the valve, *V*, is raised, it uncovers two more holes in the spray nozzle pipe, *P*, thus allowing more gasoline to be drawn and to mix with the air in a chamber provided in the top of the carbureter. Suction is, therefore, kept practically constant around the base of the spray nozzle pipe, and the amount of gasoline that is fed is controlled mechanically by the action of the valve, *V*. The carbureter is rather different from the usual automatic type. It was specially designed for use with a two-cycle motor.

The Curtis line of motors, which has been developed from the original two-cylinder V motor intended for use on a motor bicycle, was very complete, and ranged from a single-cylinder motor to one of the 8-cylinder V type. All of these motors are air-cooled. The method employed for cooling most of them is the use as a flywheel of a large wire-spoked wheel carrying small fan blades. These blades create sufficient draft upon the exhaust chambers and heads of the motors to keep them cool. All of the engines have a standard-sized cylinder having a bore and stroke of 3¼ inches. They are one of the most practical air-cooled motors built in this country, and the 8-cylinder engine, which weighs 125 pounds and develops 30 horse-power at 1,800 R. P. M., is the very latest attempt at making a high-speed, light-weight, multiple-cylinder motor for aeronautical work. This engine has a hollow crankshaft of 1⅛ inches diameter. Its 5-pound flywheel carries twenty-three fan blades. The weight of this motor is slightly over 4 pounds to the horse-power. Although it is not so light in proportion to the power developed as is Langley's motor, still it has none of the complications made necessary by the water circulation system of the latter, and its cylinders are so small that it should be able to run without much difficulty from overheating.

The most interesting motor on exhibition was the new 4-cylinder, four-cycle, water-cooled engine built by Messrs. Orville and Wilbur Wright, of Dayton, Ohio, and intended for use on their new aeroplane. The cylinders of this engine are of cast iron and have a bore of 4¼ inches, while a 4-inch stroke is used. The engine weighs complete only 160 pounds. The cylinders are mounted upon an aluminium crank case, and are jacketed with sheet aluminium. The valves are located in the heads of the cylinders, the exhaust valve only being mechanically operated. The motor is fitted with make-and-break igniters operated by cams on a transverse shaft placed beside the heads of the cylinders, this shaft being driven by bevel gears from the cam shaft of the motor. The time of the spark can be changed by a small handle provided for this purpose. The connecting rods are made of hollow steel tubing. A solid flywheel of light weight is used. The engine looks



LARGE SIZE MODEL OF AN AEROPLANE HAVING BOTH LIFTING AND PROPELLING SCREWS.



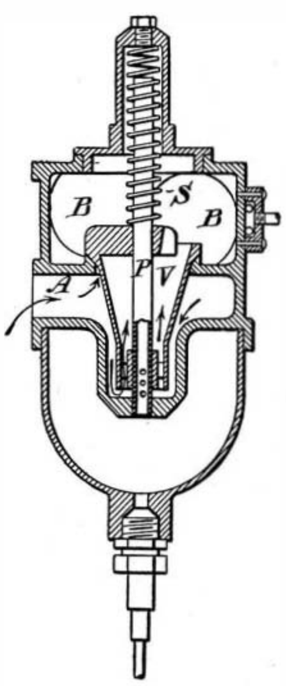
THE GILLESPIE AEROPLANE WITH MULTIPLE PROPELLERS.—AN INTERESTING HISTORICAL EXHIBIT.

Prof. Pickering's Wind Tricycle for testing propellers.

Rear End of Body Framework of Whitehead's Aeroplane. The motor and propeller seen belong to a smaller machine.

much heavier than it really is, and one can hardly realize that it weighs but slightly more than 5 pounds to the horse-power. The Wright brothers' original motor, with which they made a flight three years ago, was much heavier than the new one. Its weight complete being about 250 pounds. The valves were arranged in chambers upon the end of pipes that screwed into the cylinder heads. The valve chambers were not water-cooled, and it is probably due to this fact that there was a sudden loss of power after the motor had been run half a minute. The former motor developed but 16 horse-power. It was a 4-cylinder motor, water-cooled, and resembled the present motor in general contour. When used in the aeroplane, it is located in a horizontal position. The new motor is sufficiently powerful to drive an aeroplane carrying two men a distance of 200 miles at 45 miles an hour, or one man can be carried 500 miles at 50 miles an hour.

Another interesting motor was a 4-cylinder one designed by Harry E. Dey, of 309 Arlington Avenue, Jersey City, N. J. It has a bore and stroke of 2½ and 3 inches respectively, and is rated at 7½ horse-power at 1,500 R. P. M. It can be speeded up, however, to about 2,500 R. P. M. Its weight complete with flywheel is 86 pounds. This engine was designed and used for automobile work. For aerial work it could be made much lighter, especially in larger sizes. Mr. Dey states that he can design large sizes that will come between 2 and 3 pounds per horse-power. The cylinders are made of heavy seamless steel tubing, which have been rotated before a gang of cutters in a milling machine, cutting grooves about ¼ inch deep and 1-16 inch wide, leaving flanges about 1-32 inch thick between them, the remaining depth of the cylinder at the bottom of the grooves being 1-16 inch.



Cross-Section of Altham Carbureter.

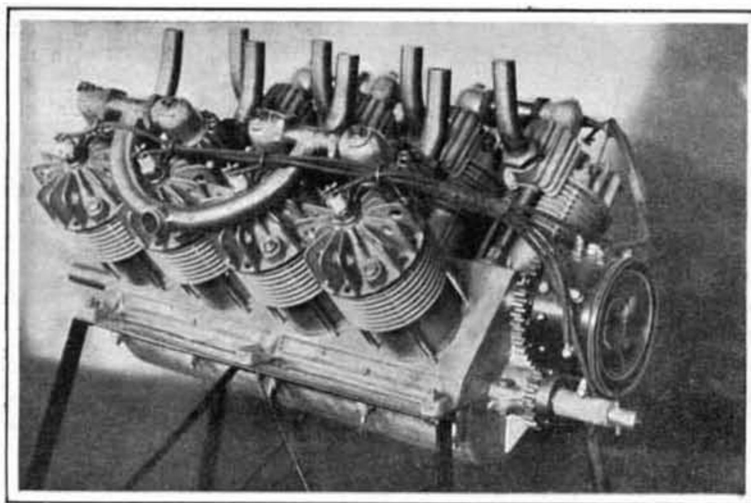
The heads, which are castings, are treated in the same manner, working from two centers, one being the center line of the valves. What the flanges lack in depth they more than make up for in numbers, so that the radiating surface is greater than that of a cast cylinder. The compression space is only 15 per cent of the total space, but the compression is not abnormally high, due to the unusually strong springs used upon the automatic type inlet valves.

This spring tension, however, may be lightened for emergency work by pressing upon the top of a counteracting spring placed above the main one. This is done by the four fingers attached to a horizontal rod above the valve chambers seen in the photograph. By this means the compression may be made abnormally high for emergency work of short periods. The crank case is a one-piece casting with the exception of the heads, which are bolted on by studs and nuts.

A small eccentric type pump placed on the end of the cam shaft and inclosed in the crank case pumps oil from a tank attached to the under side of the engine to the four crank compartments of the case, thus keeping up a constant level for the splash lubrication. Overflows to the tank are provided for taking care of the excess.

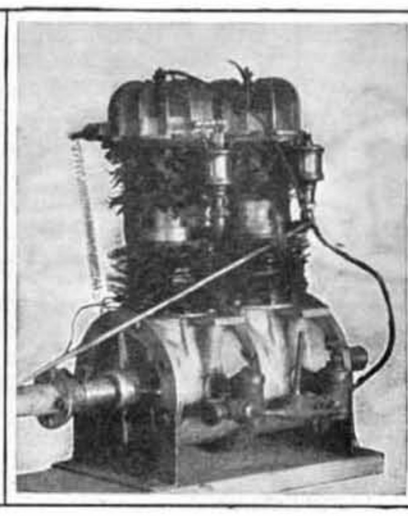
The connecting rods are made up of separate parts. The rod proper is made of rolled tool steel, while the bearing parts at each end are bronze castings riveted together. The design is such that it is next to impossible for them to come apart; the object sought being a very light strong rod for very high speed.

Ignition is by jump spark, a single coil with commutator being used. A ball governor automatically changes the spark lead to correspond with the speed. There were several other 4-cylinder air-cooled motors on exhibition, but the ones described were the most novel and well-built of all.



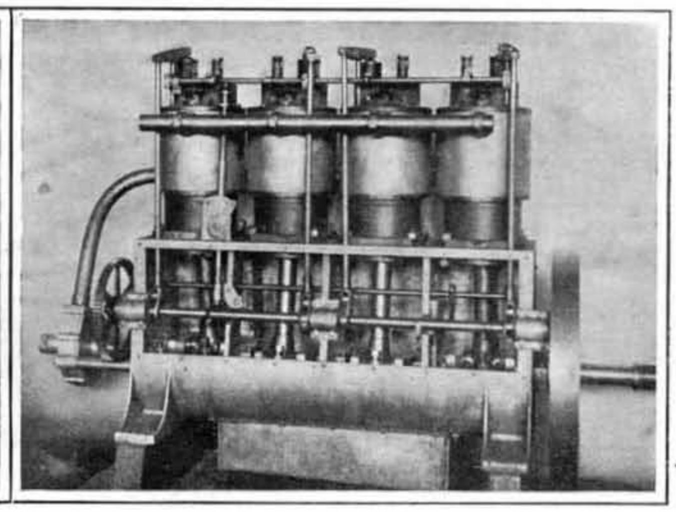
The Curtis 8-Cylinder, Air-Cooled, V-Motor, of 30 Horse-Power.

Weight, 125 pounds. Cylinders, 3¼ x 3¼. Speed, 1,800 R. P. M.



The Whitehead 2-Cycle Motor.

Weight, 35 pounds. Horse-power, 6. Speed, 1,000 R. P. M.

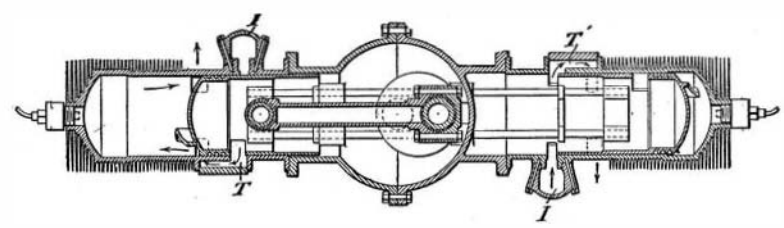


Wright Brothers' 28 to 30-Horse-Power Aeroplane Motor.

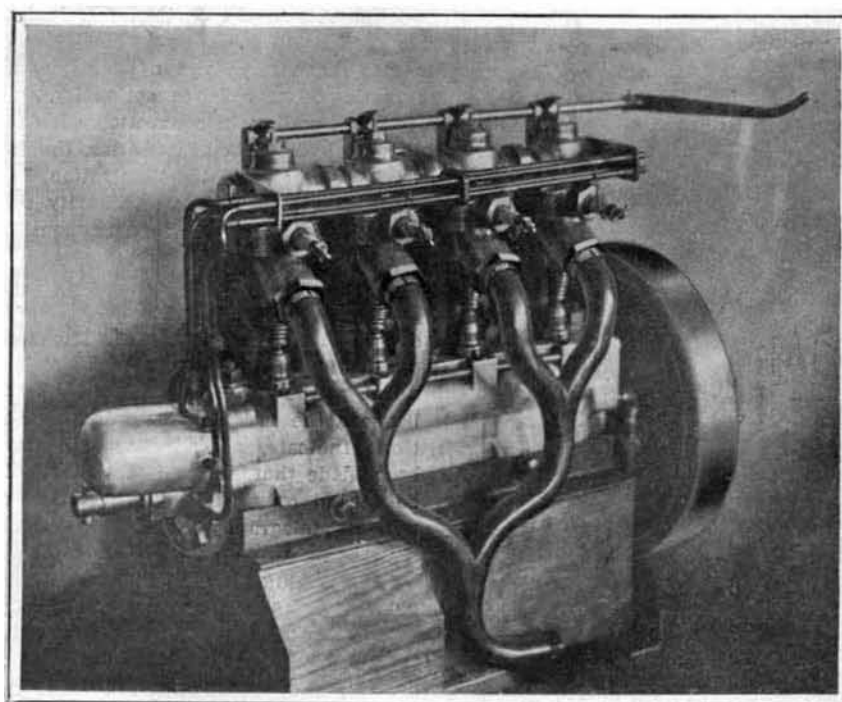
Weight, 160 pounds. Cylinders, 4¼ x 4. Speed, 1,200 R. P. M.

Official Meteorological Summary, New York, N. Y. November, 1906.

Atmospheric pressure: Highest, 30.43; date, 4th; lowest, 29.41; date, 15th; mean, 30.06. Temperature: Highest, 64; date, 18th; lowest, 27; date, 29th and 30th; mean of warmest day, 59; date, 19th; coldest day, 34; date, 29th; mean of maximum for the month, 50.8; mean of minimum, 39.0; absolute mean, 44.9; normal is 43.8; average daily excess compared with mean of 36 years, +1.1. Warmest mean temperature for November, 50 in 1902; coldest mean, 37 in 1873. Absolute maximum and minimum for this month for 36 years, 74 and 7. Precipitation: 1.28; greatest in 24 hours, 0.57; date, 15th and 16th; average for this month for 36 years, 3.46; deficiency, —2.18; greatest precipitation, 9.82, in 1889; least, 0.82, in 1890. Wind: Prevailing direction, N. W.; total movement, 9,919 miles; average hourly velocity, 13.8 miles; maximum velocity, 51 per hour. Weather: Clear days, 14; partly cloudy, 8; cloudy, 8. Snow: Trace, 13th; sleet, 15th; fog (dense), 22d; frost (killing), 2d. The temperature of September was 3.8, October 0.6, and November 1.1 in excess, making the autumn months of 1906 average 1.83 degrees above the normal. These months were each below the normal in rainfall except October, the total autumn deficiency being 2.61.

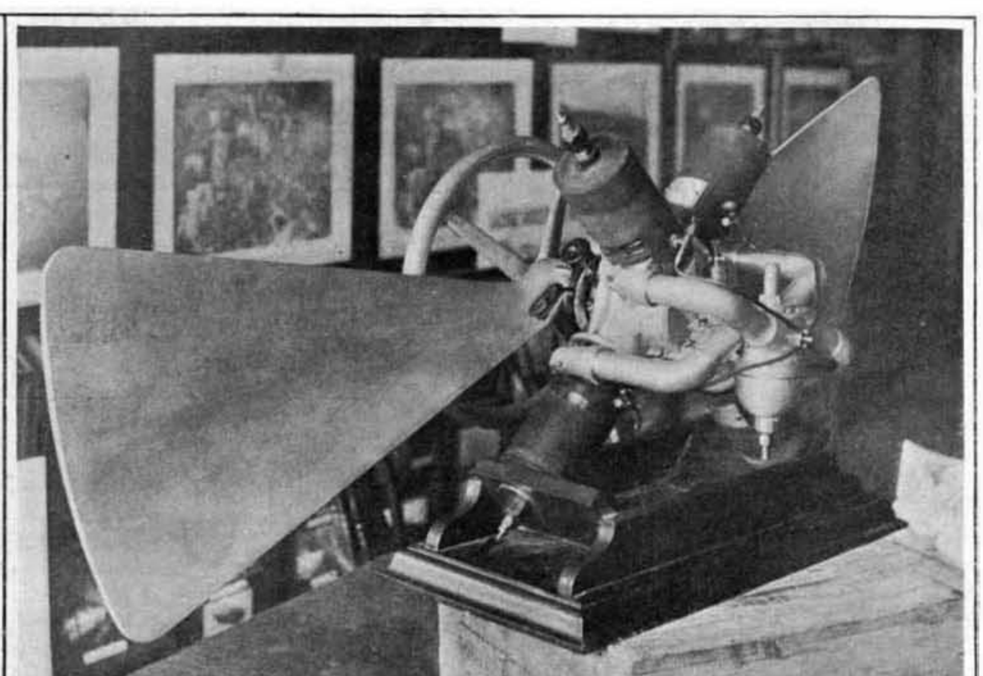


Cross-Section of Altham 2-Cycle Motor.



7½-Horse-Power Air-Cooled Motor Governed by Variable Compression.

Weight, 86 pounds. Cylinders, 2½ x 3. Speed, 1,500 R. P. M.



A New 9-Horse-Power, Air-Cooled, 4-Cylinder, 2-Cycle Aeronautical Motor.

Weight, 35 pounds. Cylinders, 2½ x 2½. Speed, 1,600 R. P. M.

LIGHT AERONAUTICAL GASOLINE MOTORS EXHIBITED AT THE AERO CLUB SHOW.