THE CONSTRUCTION OF THE WRIGHT AEROPLANE.

In view of the record-breaking flights made by the Wright brothers here and in France during the past few weeks prior to the accident to Orville Wright's machine, we believe that our readers will be interested in some of the constructional details of this, the simplest and, so far, the most successful aeroplane flying machine that has been built. In our issue of August 29 we gave a brief description of the Wright aeroplane, and in this issue we show some detailed photographs of its various parts.

The machine consists of two rectangular planes, rounded slightly at the rear corners and superposed, one above the other, at a distance of 6 feet apart. These planes are 40 feet long by 6½ feet wide, and have a supporting surface of about 500 square feet. They are made of unbleached muslin tightly stretched on rectangular frames provided with curved ribs extending across the frames and beyond their rear edges for about 18 inches. A wire is stretched tightly through the forked rear ends of the ribs, and to this wire the cloth is attached, while it also passes around the front edge of the rectangular frame and back under the ribs, completely covering them. The two frames are fastened together by sixteen tapered up-

the other. This has a steadying effect upon the steering of the machine. The vertical rudder is also a twin affair. It is mounted upon two horizontal sticks that project back of the machine at its center point, and is operated by one of the two levers (the vertical one) seen projecting upward close together in Fig. 5. The manner in which this is connected to the operating lever is shown in Diagram 3, Fig. 4, where *F* is the rudder and *B* the main planes. The third lever (the other one of the two just mentioned) has connected to it two wires in a similar manner to those which operate the vertical rudder. These wires run through pulleys at the rear of the lower main plane, and extend to the top of the outermost rear connecting post, as shown in 1, Fig. 4. The lower ends of the lower plane are connected together by a wire passing upward through pulleys and downward again, as is also shown in this diagram. When the lever is pulled, as shown, it draws down the upper rear edge of the uppermost plane. The lower plane, being connected to it by the upright, is also forced downward, exerting a pull upon the wire attached to it, thus raising its opposite end, which also forces upward the corresponding end of the upper plane. The ends of the planes are warped in this manner, and thus

In stopping the motor, he was obliged to take his hand off the twin levers that warped the surfaces and worked the vertical tail, and it is possible that during this moment the machine may have tipped too much to one side, and that the aviator was unable to correct this tipping during its downward plunge.

Experts believe that after the motor was stopped the machine, which had already lost speed on the end having the broken propeller, quickly lost its momentum, and that although Mr. Wright was able to regain his equilibrium momentarily, its final downward plunge was due to the loss of speed and the forward location of the center of gravity. The height of the machine above the ground was not sufficient for it to descend properly in gliding flight, as a machine of this size and type, if dropped from a height, must plunge downward 50 or 60 feet before it can obtain sufficient speed to glide successfully in a more or less horizontal position. The instability of this type of aeroplane was demonstrated by the accident, and it seems certain that some type of machine which has more inherent stability, both in a longitudinal and a transverse direction, will have to be devised.

Regarding the mechanical features of the aeroplane, its 4-cylinder, vertical, water-cooled motor and

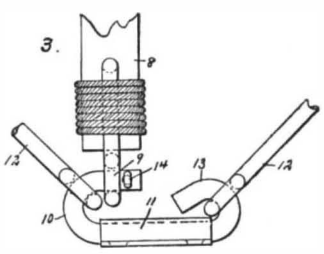


Fig. 3.—Joint Used in Connecting Uprights to Planes.

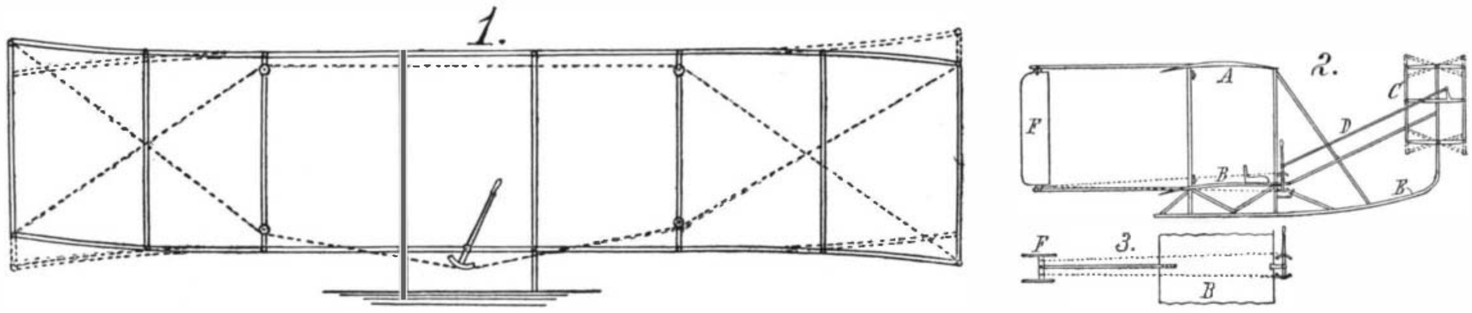


Fig. 4.—Diagrams Showing How the Surfaces Are Warped and How the Rudders Are Operated.

1. Diagram showing connections for warping the planes. 2. Side view showing connection, *D*, for operating horizontal rudder, *C*, which is carried on an upward projection of runners, *E*. 3. Plan view showing connections for operating vertical rudder *F*.

Figs. 11 and 12.—Through the Breaking of a Propeller While the Aeroplane Was Traveling at a Height of 75 Feet, with Orville Wright and Lieutenant Selfridge on Board, the Machine Became Unmanageable and Plunged to the Ground, With the Result That Lieutenant Selfridge Was Killed and Mr. Wright Seriously Injured.

THE CONSTRUCTION OF THE WRIGHT AEROPLANE.

rights, properly spaced apart along their front and rear edges. Four of these uprights on each end are secured to the frames of the planes by the hook-and-eye connection shown in Fig. 3, which makes a flexible joint. The aeroplane is mounted upon runners, which are secured beneath its center part and which extend forward and curve upward to support the horizontal rudder. This is formed of two superposed surfaces very similar to the main planes. These surfaces pivot upon a rod that runs through each of them lengthwise, a little forward of their center point. The uprights (Fig. 6) also carry a rod about half way between the two planes, and on this rod, at suitable intervals, are fastened horizontal crosspieces, which connect with vertical tie-strips that unite the upper and lower planes. A lever projects upward from one end of the rod, and is connected by means of a wooden rod to the operating lever on the front edge of the aeroplane, and which is shown projecting forward in Fig. 5. On the base of this lever is a drum with a friction band which holds the lever, and, consequently, the rudder in the position in which it is set by the aviator, and thus relieves his hand of much of the strain. In the middle of the horizontal rudder there is a semicircular vertical surface, which is allowed to flap a short distance from one side to

when a greater angle of incidence is obtained at one end, the angle is correspondingly lessened at the other. As the device is constructed, there are additional wires running from the tops and bottoms of the posts next to the end ones, and joining the wires just before they pass through the pulleys. This feature of the Wright aeroplane is patented, and is the one to which they lay the success of the machine; for by twisting the planes they are able to tip the machine readily and make sharp turns, and also to quickly counteract the effect of wind gusts. They expect to warp the surfaces and control the rudders automatically in the future, but for the present they depend upon manual control, which, of course, does not eliminate the personal equation. It may be due to this that their aeroplane made its fatal downward plunge, as a similar accident occurred during their practice flights in North Carolina last spring, when Wilbur Wright very likely would have been killed had it not been for the fact that the machine landed in the soft sand. He made a false move of the lever which operates the horizontal rudder and, instead of rising and passing over a sand dune, the machine dove suddenly downward into it. In the recent acc dent, however, Orville Wright stopped his motor, ana he should have been able to glide safely to the ground.

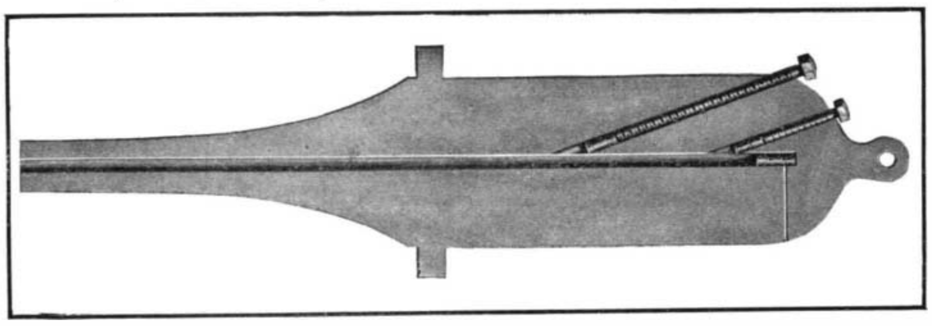
the method of driving the propellers are illustrated in Fig. 1. This engine was designed by the Wright brothers and, like the machine itself, is of great simplicity. Its total weight is 170 pounds. It is mounted in a fore-and-aft direction in the aeroplane, a little to the right of the center line of the machine as one sits in it and faces forward. The four cylinders are bolted to an aluminium crankcase; they are fitted with aluminium water jackets and the valves are located in their heads. The inlet valves are automatic, and are connected together by a suitable inlet pipe. Gasoline is pumped into this inlet pipe by a small pump in the crankcase, which is driven from the crankshaft. There is also an oil circulating pump which raises the oil from a reservoir attached to the under side of the crankcase, and distributes it to the bearings of the crankshaft. The motor is oiled chiefly by splash lubrication. The water-circulating pump is on the outside of the motor at its forward end, and is distinctly visible in the photograph, as is also the large gear of the camshaft. The flywheel is to be seen at the rear end of the motor. The cooling water is pumped through four rows of vertical radiating tubes, each consisting of six flattened brass pipes, which make a light form of radiator having considerable surface and but little air resistance. The ignition is of the make-and-break type, the igniters being operated from a horizontal camshaft running across the top of the motor, and driven by bevel gears from a vertical shaft extending into the crankcase. A magneto, driven off the flywheel, supplies current. The switch is visible in the photograph at the lower front edge of the motor. The chains which drive the propellers pass through tubular guides on their way from the sprockets on the motor crankshaft to the sprockets on the propeller shafts. One of the latter of these is visible at the left-hand upper edge of Fig. 1. The crossed tubes carrying the chain of the other propeller are also distinctly visible in this illustration. The method of reversing the direction of rotation of the propeller by crossing the chain does not seem to be an extra good one, despite the statement of Mr. Orville Wright that he has never had any trouble with this arrangement. Whether this had anything to do with the breaking of the propeller, or not, will probably never be known. The propellers which were used on the day of the accident were new ones about 9 feet in diameter and of a somewhat less pitch. The propellers which were used previously, and which were about 8½ feet in diameter and of the same pitch, are those illustrated in our photographs. They ran at a speed of about 400 revolutions a minute. Mr. Wright had hoped to increase the speed of the aeroplane by the use of new propellers, as their flatter pitch should enable the motor to obtain a higher speed and develop somewhat more power. Ordinarily, the motor developed about 25 horse-power, which was sufficient to drive the machine over 40 miles an hour. The specifications put out by the government required a speed of 40 miles an hour with two men on board, and Mr. Wright hoped to surpass that considerably. As far as endurance was concerned, he had already, on September 12, made a flight of 1 hour, 14 minutes, 24 seconds, which was practically a quarter of an hour longer than was required by the specifications. These required that he should carry a passenger, however, and it was in a second effort to see what he could do in this direction that he took Lieut. Selfridge with him on the 17th instant.

In one of our illustrations, Fig. 8, the aeroplane is seen upon an army wagon. This photograph shows it as it is being transported from the shed where it was put together to the tent where it was housed during the first few days of its stay at the Fort Myer parade ground. In this picture the vertical rudder is shown folded up against the rear of the plane, and the runners are also folded back against the front edge. When it is desired to take the machine apart, the outer quarters of the main planes can be folded back upon the central halves, and the whole machine can be quickly disassembled. Great ingenuity was displayed by the Wright brothers in constructing their aeroplane so that it would fulfill the condition of being readily dismounted and packed upon an army wagon, but the great simplicity of the entire machine is the most striking point about it, and the one which most strongly evidences a real stroke of genius. The result of the accident will be a greater striving of inventors to produce a machine having automatic stability, and which will only require sufficient attention on the part of the aviator to steer it sidewise and up and down, and to keep the motor running. It would also seem that a new impetus should be given to Langley's idea of experimenting over water where, if a machine took a sudden plunge, the aviator would at least have a chance of escaping. The accident to the Langley machine some years ago, when it plunged into the Potomac while Mr. C. M. Manly acted as aviator, illustrates this point; for, although the machine was injured, and Mr. Manly had a very narrow escape, nevertheless he is alive to-day and is one of our most enthusiastic aviators.

In the Electrical World C. E. Lord describes a method of ventilating a high-speed machine so that the noise is reduced to a minimum. The air which cools the rotor does not pass directly to the stator, but follows a restricted path through the stationary member. The ventilating passageways in the stator are arranged concentrically about the axis of the rotor, and means are provided for cutting off direct communication between the ventilating passageways and the air gap of the machine.

AN EARLY ARMOR-PIERCING GUN.

The following sketch and description of an early and decidedly novel design for an armor-piercing gun have been furnished us by Mr. W. B. Williamson, of Ames, Okla., who was on special service in Washington from 1862 to 1865, and was in a favorable position to observe the construction and test of the gun. The drawing, it should be understood, is only approximately correct, the sketch on which it is based having been made from memory after a lapse of forty years. The gun was cast at the Washington navy yard and placed in the experimental water battery (then used for drill and practice). Its length was about 11 feet, and its bore only 2⅛ inches. Its weight was about equal to that of a 32-pounder iron Dahlgren. From the trunnions to the muzzle the taper was abrupt; from the trunnions to the neck ring the piece had all the ear-marks of a 68-pounder smoothbore. The projectiles, which were forged from tool steel and turned down to caliber, were about 12 inches long. The gun was rifled, and soft metal rims were swaged on the projectile to enable it to take the rifling. The first powder charge and the projectile were loaded from the muzzle. On the right side of the breech were two holes bored at acute angles to the longitudinal axis of the gun, the first entering the bore a little ahead of the projectile, the second farther ahead, nearer the trunnions, in the position shown in the engraving. Each hole was fitted with a long, coarse-threaded breech-pin. A charge of powder, somewhat smaller than the main charge, was inserted in each chamber, and the breech-pin screwed home. Each of these auxiliary chambers was of about 2 inches bore. The gun easily pierced a 9-inch iron plate at 500 yards, and it required a 12-inch plate to stop the projectile.



Length, 11 feet. Bore, 2⅛ inches. Penetrated a 9-inch iron plate. The gun had three powder chambers in which the charges were ignited successively as the projectile passed down the bore.

AN EARLY BREECHLOADING GUN.

It will be seen that, in a certain sense, the designer of this gun anticipated the theories of our modern smokeless powder; for the charge was burned progressively, part of it at the breech, and two other portions at succeeding intervals during the travel of the projectile down the bore.

President Lincoln, visiting the yard one day in 1862, requested to have the gun loaded, sighted the piece, and fired, making a center. Thereupon the piece was dubbed "Abe Lincoln's pocket piece."

Shows Manner in Which Defective Fender Allowed Body to Pass and Be Mangled.

CAR FENDER TESTS BY THE PUBLIC SERVICE COMMISSION.

According to a contemporary, there is manufactured in Holland a substance called liconite. It is similar to rubber in appearance and in many of its qualities. It is a compound of bitumen and various oils, has neither rubber nor gutta-percha in its composition, is elastic and tough, and is said to be non-hygroscopic, unaffected by water, dilute acids, or alkalis, and capable of withstanding all ordinary temperatures without flowing or cracking.

CAR FENDER TESTS BY THE PUBLIC SERVICE COMMISSION

The Public Service Commission of the city of New York never inaugurated a more commendable movement than when it arranged for a series of public competitive trials of street-car fenders, with a view to selecting the most efficient type for use on the street railways in this city. It has been moved to take this step as the result of the statistics of street-railway accidents which have been gathered under its administration. These were of such an appalling character, both in number of fatalities and the shocking character of the injuries, that the Commission at once took steps to institute the present inquiry and select a really effective car fender. The tests are to be carried out partly at Schenectady and partly at Pittsburg; the first on tracks provided by the General Electric Company, and the later series on tracks near the works of the Westinghouse Company. Neither of these concerns has the least financial interest in the competition; they merely place the excellent facilities of their respective plants at the service of the Commission. The tests, of which we present several illustrations, were held upon a stretch of track running along the banks of the Erie Canal in the presence of the Commissioners and their engineering staff, eminent traction engineers from various parts of the country, and several members of the General Electric Company's own engineering force.

The first series of tests took place on Wednesday, September 16, and evidence that the competition will be of the most widespread character was shown by the fact that up to noon of the previous day, 112 men had registered for competition at the office of the Commission. The character of the tests and the conditions of the competition were given in full detail in our issue of September 19. The first fender tried was of the projecting automatic type, and was manufactured by John O'Leary, 25 Congress Street, Cohoes, N. Y. It consists of a square section of metallic latticework which, when in use, extends in front of the car close to the track, and, when not in use, can be raised and tied up to the dash board. One of these fenders was attached to a trolley car weighing 25 tons, provided by the General Electric Company. Dummies representing boys weighing 50 to 60 pounds and others representing women weighing 120 pounds were placed upon the track in various attitudes, and run into by this car with the fender in position. The tests were made with the car going 15 miles an hour and also at a speed of 6 miles an hour. There were two series of tests, one on cobblestone pavement and the other on asphalt pavement, this being done to reproduce as nearly as possible street conditions in New York city.

The dummies were placed on the track standing up, lying on their side, or stretched along the rail, and the effect of the contact with the fender in all such positions was noted. In most instances the fender made a clean pick-up of the dummy and carried it, as if in a basket, until the car was brought to a standstill by the brakes. In some instances the dummy was scarcely injured by the impact; in others it was deprived of one or two legs; and in cases where the fender failed to pick it up, it was rolled along over the roadbed and badly mangled. The credit marks used in each test to keep the official record were as follows: A counted 4 points for a complete pick-up or removal from the track; B counted 3 points for a partial pick-up or removal from the track, with any part of dummy remaining under fender; C counted 2 points for a partial pick-up or removal from the track, but with the dummy for the most part under the fender; D counted 1 point where no pick-up is made and when the dummy is entirely under the fender, but dragged sufficiently to prevent its going under the car. In the first series of runs made on cobblestones at 15 miles an hour, the O'Leary fender received four A's, one C, and one D. In the same series on cobblestones at 6 miles an hour it received three A's, one B, and two D's.

The dummies, as will be seen from our photographs, were constructed so as to closely approximate the forms of living persons; and the distributing of the weight, center of gravity (most important point), etc., were carefully considered. It will be noticed