BULLETINS

OF THE

Aerial Experiment Association

Bulletin No. ~~VI~~ Issued ~~MONDAY, AUG. 17,~~ 1908

MR. McCURDY'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association.

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Beinn Bhreagh, Near Baddeck, Nova Scotia.

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AERODROME NO.1, SELFRIDGE'S RED WING: by F. W. Baldwin.

(A paper presented to the Aerial Experiment Association May 17, 1908, revised for this bulletin).

The first motor driven aeroplane built by the A.E.A., which was known as the Red Wing had double superposed surfaces and would come under the class generally known as the Chanute type. There were two distinctive features in this design. The first was in the general principle and arrangement of the truss which supported the two surfaces and the second in the shape of the surfaces themselves.

The frame of the usual double decker, is the simple Pratt Truss, with parallel upper and lower chords and panels of consequently constant depth. The vertical posts in this form of truss are held at two points only (at the top and bottom). (See page 2).

In the Red Wing Truss (page 2) the upper and lower chords were made converging toward their extremities, giving the panels greater height in the center where the bending moments are at a maximum, and gradually decreasing in height towards the outside panels where the bending moments approach zero. In this way the height of the truss was proportional to the bending moments; and, as the stresses due to bending are by far the greatest ones to be considered, the structural advantage in having the chords bowed is obvious at a glance.

Another equally, if not more important advantage, is in the lateral support afforded to the vertical posts of the

truss by attaching them to a bow-string wire extending from tip to tip of the upper and lower chords. This fixes the uprights against lateral deflection at four points instead of two and theoretically increases their efficiency about fourfold.

Th great advantage in this is that besides lending itself naturally to lighter construction, it permits the use of struts very narrow in cross-section, materially reducing the head resistance offered by the framework.

All the exposed members of the main planes, tail, and bow-control, which were substantially at right angles to the line of flight were made of fish-shaped cross-section giving a form of least resistance according to experiments made by Prof. Zahm and conforming fairly well to stream-line theory. A number of different sizes of spruce sticks were made for this purpose. They were of four to one, and three to one dimensions, the largest size being 4" x 1" and the smallest 1 1/2" x 1/2" (see page 4).

The other feature of the Red Wing which distinguishes it from the usual type of double-deck machine lies in the shape of the supporting surfaces. These are very much like a birds wing in plan, (see page 5), tapering towards the tips and at the same time decreasing in curvature.

Experiments published by W. R. Turnbull suggested the advisability of using aero-surfaces concave below in the forward position and convex in the after position.

The double curvature of the surfaces was obtained by the use of curved ribs made up of four laminations of wood

each 1/8" thick. The two outside strips were of ash to give them the required stiffness and the inner ones of spruce. These strips were laid up on a form and after being carefully glued together, retained their shape admirably without any apparent warping.

The spread of the wings from tip to tip was 43 ft. 4 inches. The depth of the surfaces at the center was 6 feet 3 inches, and the distance apart 6 feet, 6 inches at the center, and 4 feet at the outside panel. This gave a surface of 385.5 sq. ft. of silk.

The seat for the operator was arranged just above the lower surface in the central panel. His body was shielded by a rectangular spindle-shaped nose which was covered with silk and came to a point seven feet in front of the main planes. This nose was made of four bamboo poles with internal bracing and supported the bow-control which was a flat surface 8 feet across and 2 feet deep. It was balanced about a point one third back from its front edge and pivoted at the point of the nose (7 feet in front of the main planes). Yoke-ropes connected the bow-control to a steering drum just in front of the operator on his left hand side, and was manipulated either by turning the drum itself or a small spoke attached to it.

Fore and aft stability was also sought by the use of a fixed small surface tail. It was 14 feet 10 inches across, and 3 feet deep giving a surface of 44.5 sq. ft. This surface was placed horizontally 10 feet back of the rear edge of the main planes and was attached by bamboo poles guyed with piano wire.

Right and left steering was effected by a square rudder 4 feet X 4 feet which pivoted about a vertical axis above the tail and was controlled by steering ropes which led to a lever just in front of the operator on his right hand side.

While there were no fixed vertical planes in the Red Wing, the fish-shaped uprights of the main truss offered a vertical surface calculated as 19 sq. ft., and undoubtedly contributed to the stability of the machine.

As the experiments with this machine were to be conducted over the ice it was mounted on runners. Two main runners with a tread of 2 feet 6 inches were placed below the center panel and supported nearly the entire load of the machine. A light runner was fixed under the tail and subsequently taken off as the machine retained its balance on the front runner alone. Two light runners were also placed under the second panels from the center in case the machine should come down sidewise in landing.

The main planes were given an angle of incidence of 7 1/2 degrees. The engine used was a 40 horse-power, eight cylinder Curtiss, air-cooled motor. The bare engine weighed 148 pounds, but with the oil-tank, batteries, shafting, coil, etc., it weighed about 185 pounds.

The propeller was made of steel, had two blades, a diameter of 6 feet 2 inches, and a pitch of about 4 feet. It weighed 15 pounds and was driven direct, the engine and shafting being mounted horizontally. The fundamental idea in the design of the Red Wing was to produce an aeroplane with head resistance reduced to a minimum and power enough to ensure its getting into the air.


Plan

AERODROME NO.2, BALDWIN'S WHITE WING, SHOWING HOW IT DIFFERS FROM NO.1: by F.W. Baldwin.

(A paper presented to the Aerial Experiment Association May 17, 1908, revised for this bulletin).

The second motor driven aeroplane which has just been completed is as nearly as possible a reproduction of the Red Wing in general design. It is built of heavier material throughout and with slightly larger surfaces. The improvements are nearly all in the details of its construction.

In this machine, it was deemed advisable to get some positive method of controlling the lateral stability. The tips at the extremities of the wings are hinged about their fore edges and by a system of steering gear the angles of incidence can be changed by the operator. By this arrangement if the machine inclines to one side the man by leaning to the high side operates a tiller which is connected by steering ropes and increases the angle of incidence of the tips at the lower side and decreases the angle of incidence of the tips on the high side. This gives a righting couple which should keep the machine on an even keel, the idea being that the man will instinctively lean to the high side.

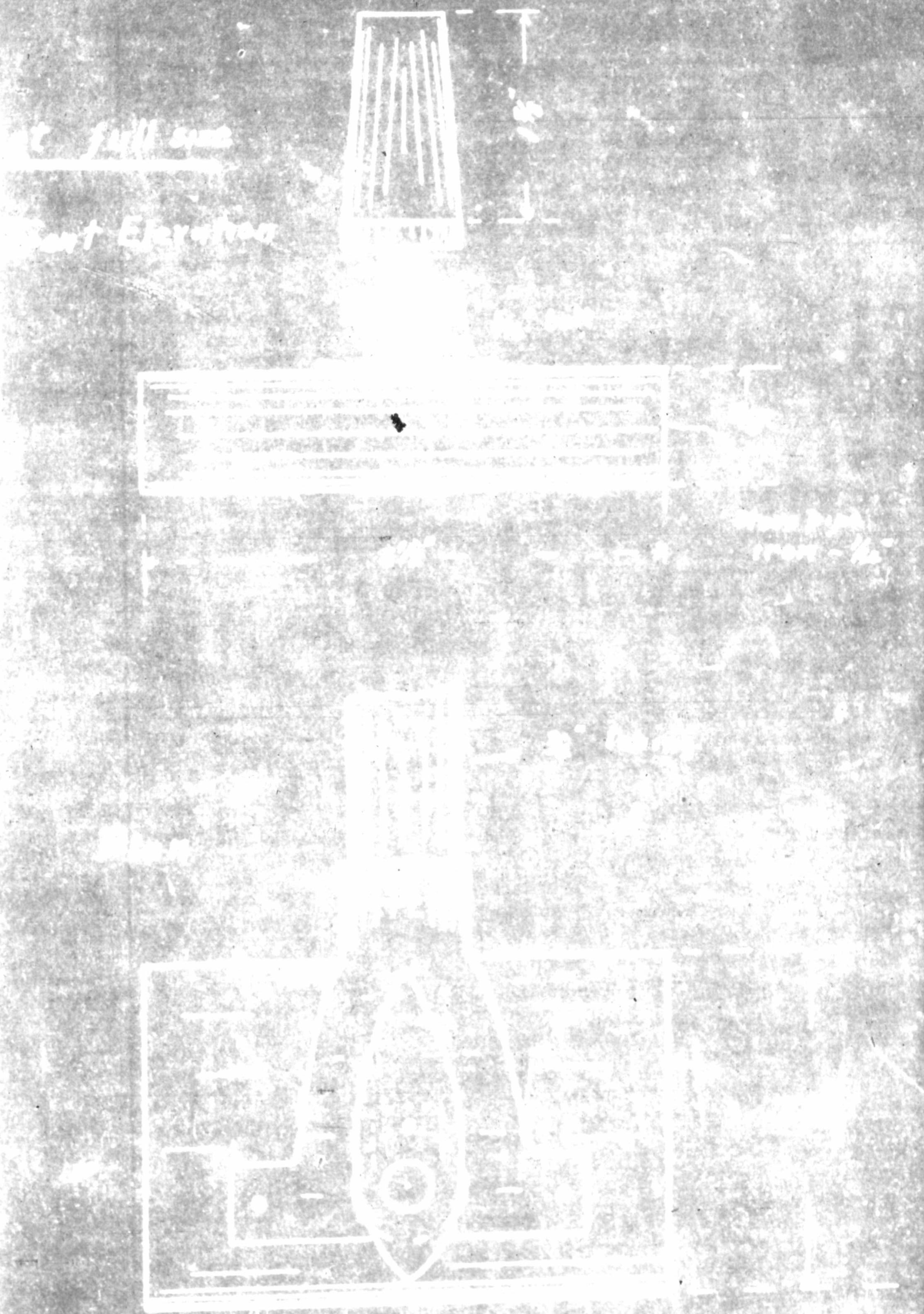
The bow-control has been placed a foot farther in advance of the main plane, and is 9 feet across and 2.5 feet deep. This control is operated by a lever connected directly to the steering post, and not by yoke ropes as in the Red Wing.

Right and left steering is provided for by a triangular rudder which swings about a vertical axis behind the after central strut of the tail. The steering ropes from this rudder lead to the steering wheel in front of the operator which works like the steering wheel of a motor car, turning to the right putting the rudder over to the right and turning to the left putting the rudder over to the left.

The tail is composed of two superposed surfaces giving about the same surface as in the Red Wing and is placed 10 feet (the same distance) behind the main plane. This was done to remedy the weakness shown by the faulty construction of the single surface tail first used on the Red Wing. The box which constitutes the tail is given a slight angle with the engine bed (1 in 27 or 2°20'). In this it differes from the Red Wing in which the tail was parallel with the engine bed. The justification for this, by no means important, departure is that theoretically, it would seem that the machine when perfectly balanced should have all its surfaces, including controls, at the most efficient angle. That is, the angle at which the ratio of lift to drift is greatest.

In the new machine, all members of the truss outside of the center panel fit into sockets and are thus more easily repaired than in the old construction with its through members. The uprights are fitted with a set-screw in the socket so that they may be lengthened out or shortened, thus doing away with the necessity for turn-buckles on the diagonal wires. (see accompanying drawing page 11).

The upper and lower chords of the White Wing are not true curves as was the case of the Red Wing, but the members are straight between each panel. Another change from the old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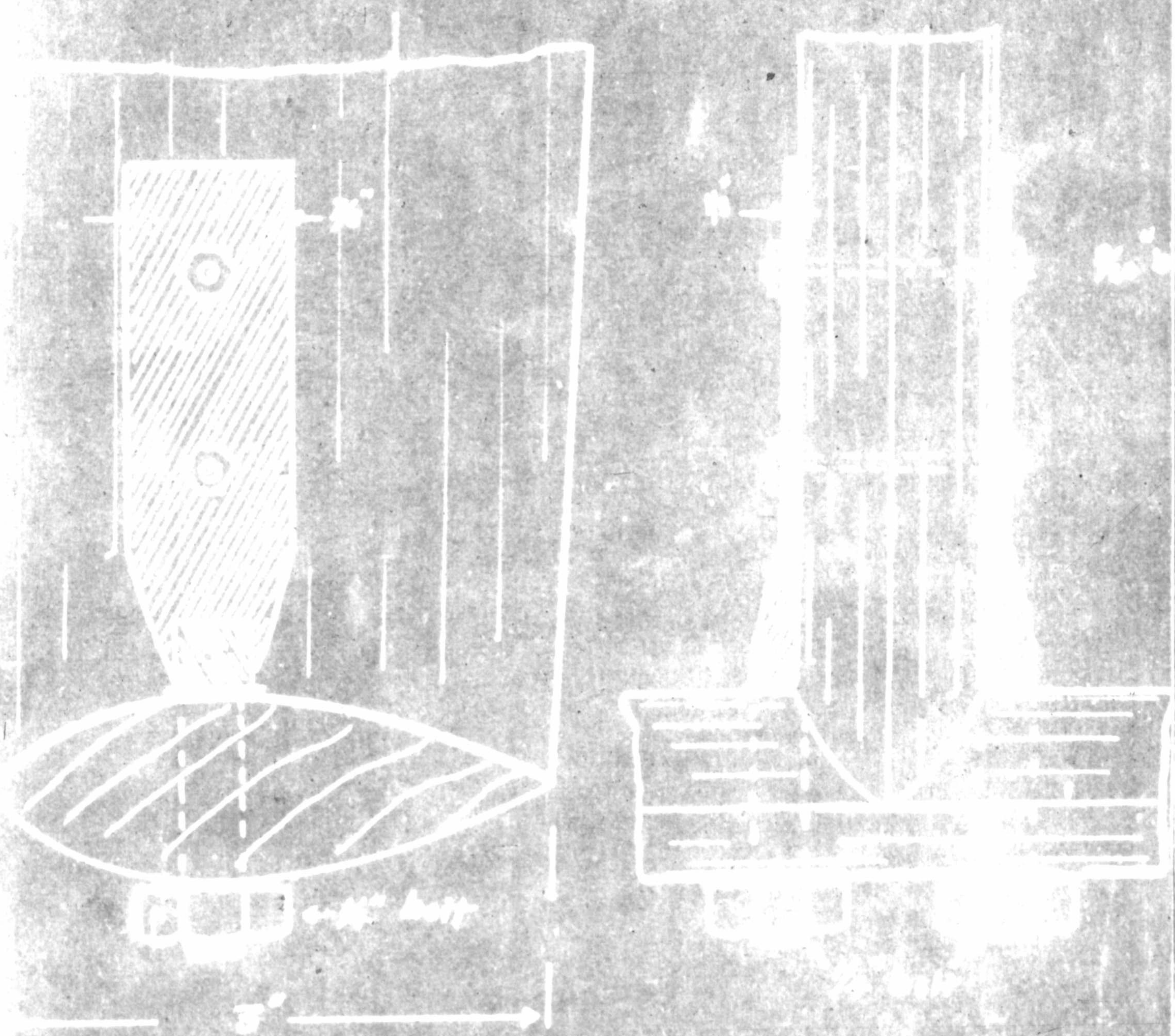
Elevation



Connection device for member of central panel
Scale — Full Size

design is in the joints of the center panel. Mr. Bedwin devised a scheme for bolting the uprights through the upper and lower chords which is very much neater, stronger and lighter than the old way of straps and knees (see accompanying illustration page 12).

A wooden propeller is used on this machine with the same engine as before. The diameter is 6 feet, the pitch is slightly greater than the diameter. The weight of this propeller is only about 8 pounds and it should prove more efficient in every way.

The new machine is 43 feet 6 inches from tip to tip; the planes are 6 feet 6 inches deep at the center, and 4 feet deep at the outside panel, which gives a total supporting surface of 408.5 sq. feet. The weight of the main planes with the engine bed is 133 lbs. as against 119 lbs. in the case of the Red Wing. The nose weighs 27 lbs., the tail including a light wheel weighs 30.5 lbs. The wheels and the spring frames which support them weigh 47 lbs. The engine, accessories and propeller weigh 192 lbs. So the total weight taking the man at 175 lbs. will be about 606 lbs. This gives a flying weight of about 1 1/2 lbs. to the sq. ft. compared to 1 1/4 in the Red Wing.

The cloth used throughout (except for the tail which is silk) is of a quality of nainsook which weighs 70 grms. per square meter. Altogether the new machine is a great improvement over the old one in the matter of construction. While its struts are larger, more of its members are enclosed and it should not offer much more head resistance than the Red Wing.

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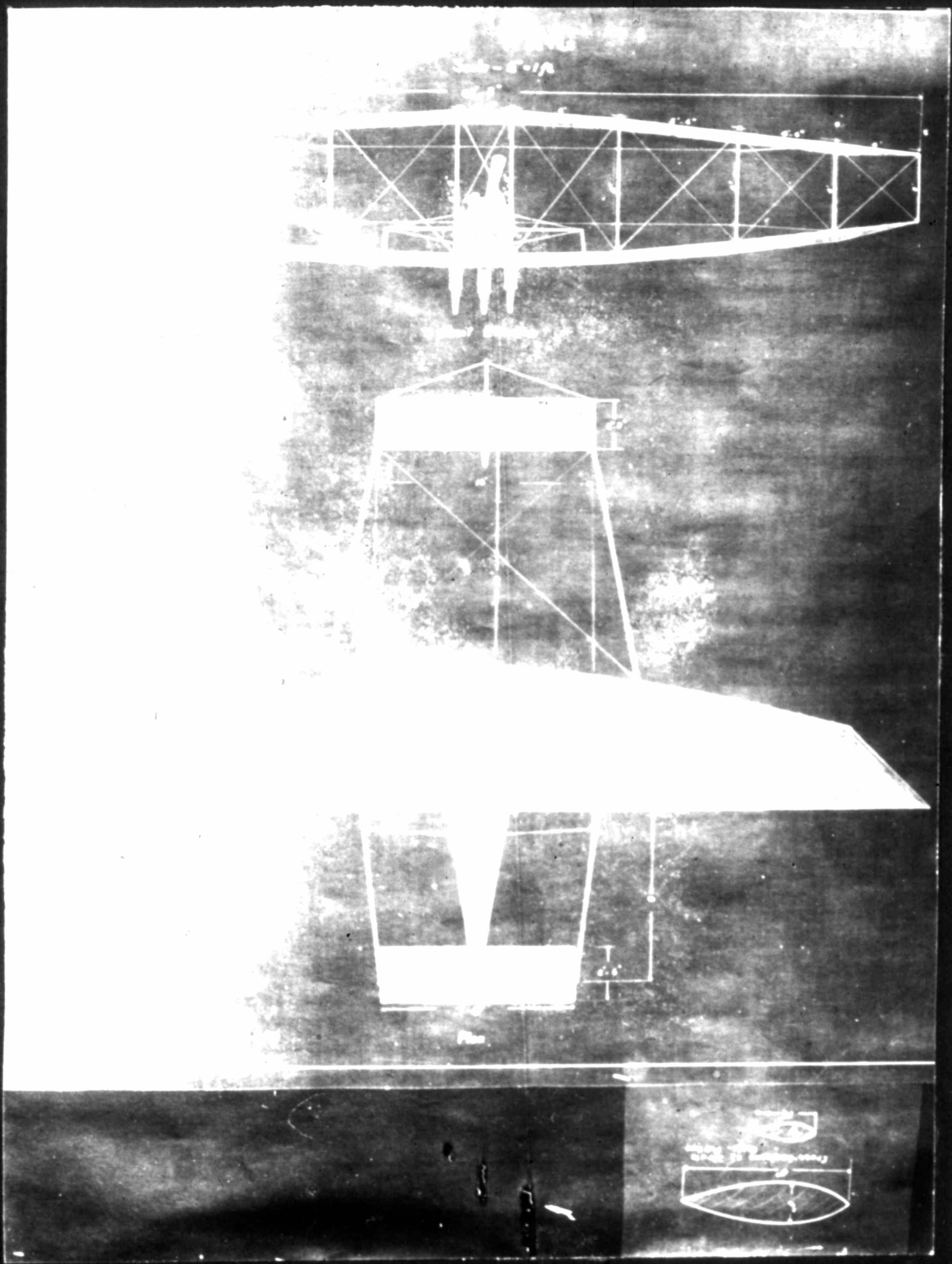


AERODROME NO.3, CURTISS'S JUNE BUG, SHOWING HOW IT DIFFERS FROM NO.2: by G. H. Curtiss.

(A letter to Dr. Bell).

Hammondsport, N.Y., July 13, 1908:- The following is an enumeration of the differences between Aerodromes No. 2 & No. 3:-

In No. 3 the wing tips were so set that when not in use, they were at a neutral angle while those in No. 2 when not working as controls were parallel to the surfaces. The gearing of the wing tips was simplified by the new arrangement of wiring necessitated by the operator's seat being moved farther to the front.

The main weights are separated by a greater distance in No. 3 than in No. 2. The engine was set five inches farther back and the man two feet farther to the front. The front control was also moved farther out and the front edge of it now 10 feet 10 1/8 inches in front of the front edge of the main planes thus making the machine 27 1/2 feet long. Five square feet have been added to the area of the front control, its total spread being now 13 feet 10 inches as compared with 11 feet 8 inches of No. 2. The nose is now wedge shaped instead of pointed and has been left uncovered.

The running gear consists of three wheels as before, but the wheel base has been extended two feet. It has also been greatly strengthened by two large wooden members running fore and aft which are to be used as skids in case the wheels break down.

The wings have been made so that they can be easily removed from the engine bed section and their surfaces have been varnished with a mixture of gasoline, yellow ochre, paraffine and turpentine in order to make them air-tight. The yellow ochre was used for photographic purposes. The working surfaces of the machine have been reduced from 408 to 370 sq. feet. Switch and spark controls have been placed on the front steering wheel.

The lower plane has been greatly strengthened by eight guy wires fastening it to the hubs of the wheels and bottom of the skids.

The engine section has been made up of lighter material, the struts being only 3/4 of an inch thick at their widest part and 2 1/4 inches long instead of one inch thick at their widest part and 4 inches long as was used in No. 2. Additional guy wires have been added to this section and it is now more rigid than before.

The propeller has been cut down from 6 feet 2 inches to 5 feet 11 inches, and is now turning up to about 1200 rpm. instead of 1050.

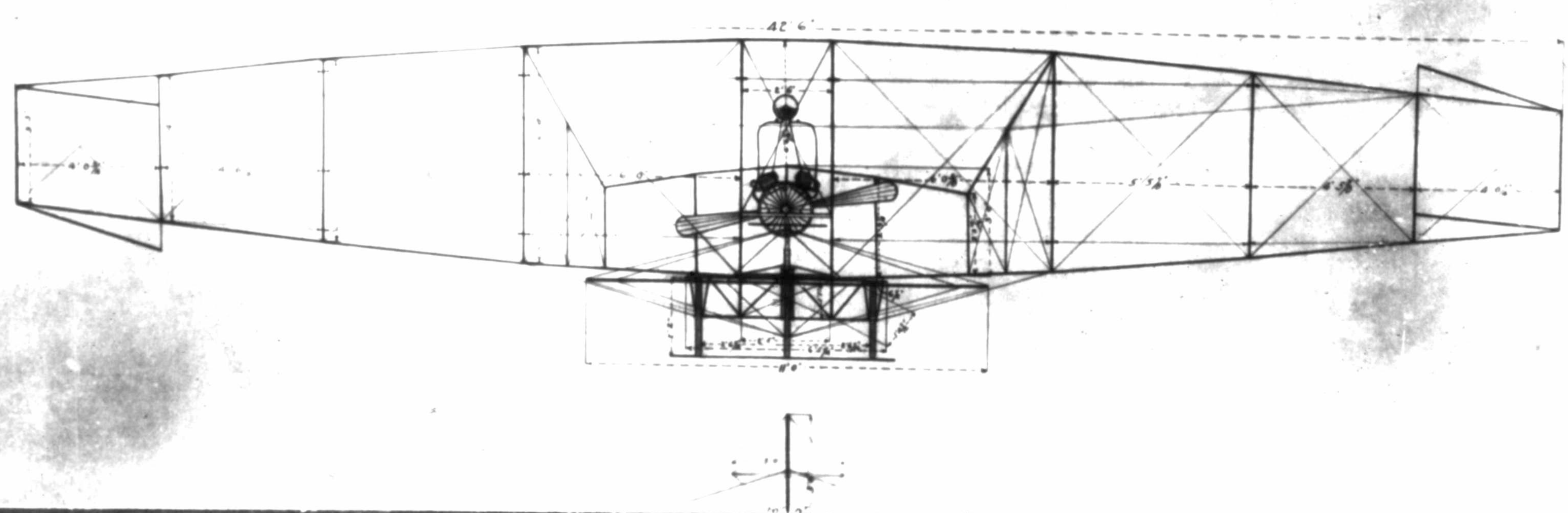
The tail has been made spar-shaped from side to side so as to conform to the general shape of the main surfaces. The vertical surfaces of the tail have been removed and the area of the vertical rudder increased from 27 inches square to 36 inches square.

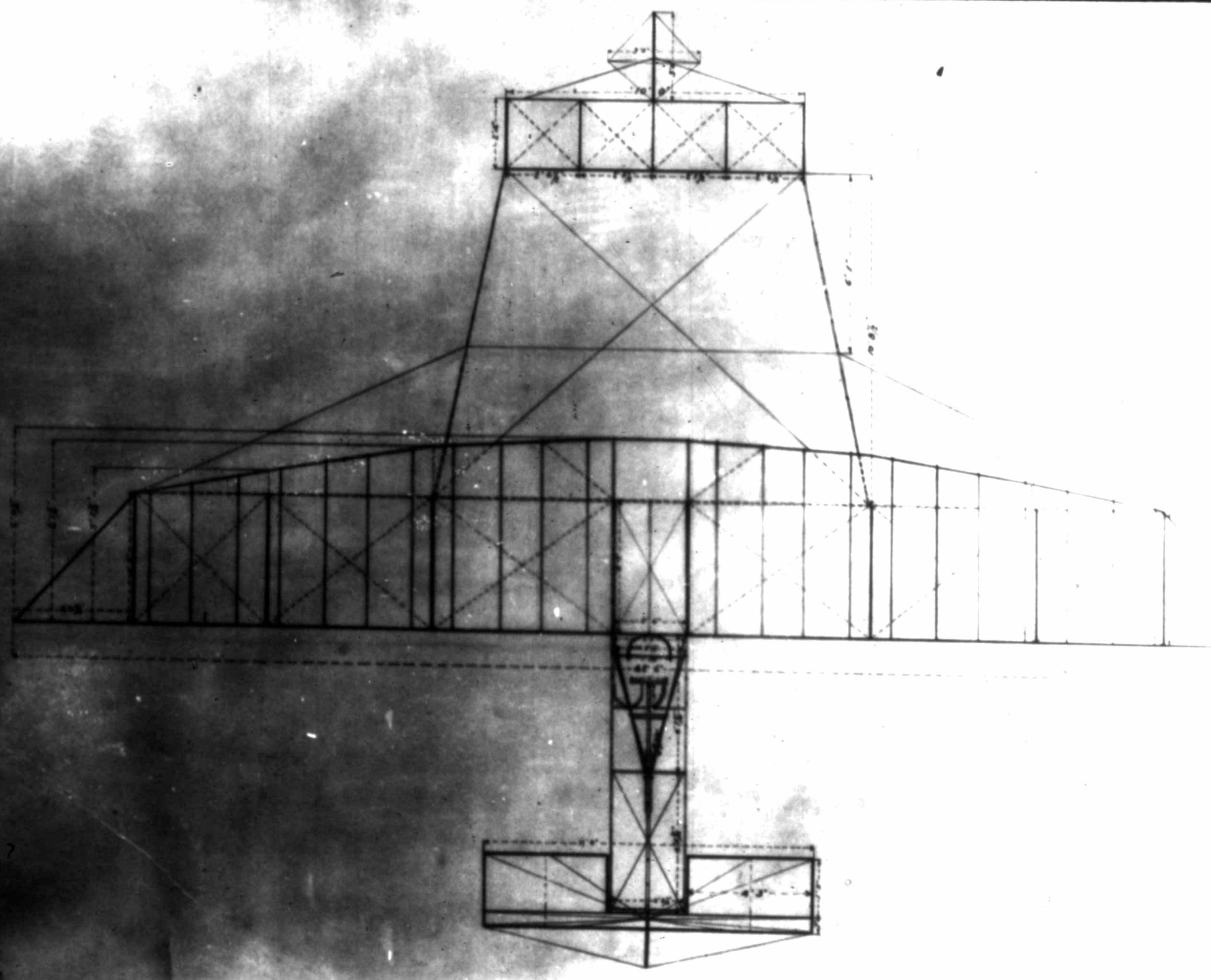
It has also been decided to do away with the screw sockets for the vertical posts and to put turn-buckles on each socket. We are also to use balloon rubber silk for the surfaces. These last changes have not yet been made however. The distance between the center of gravity of the operator and the center of gravity of the engine is now 6 feet.

JUNE BUG

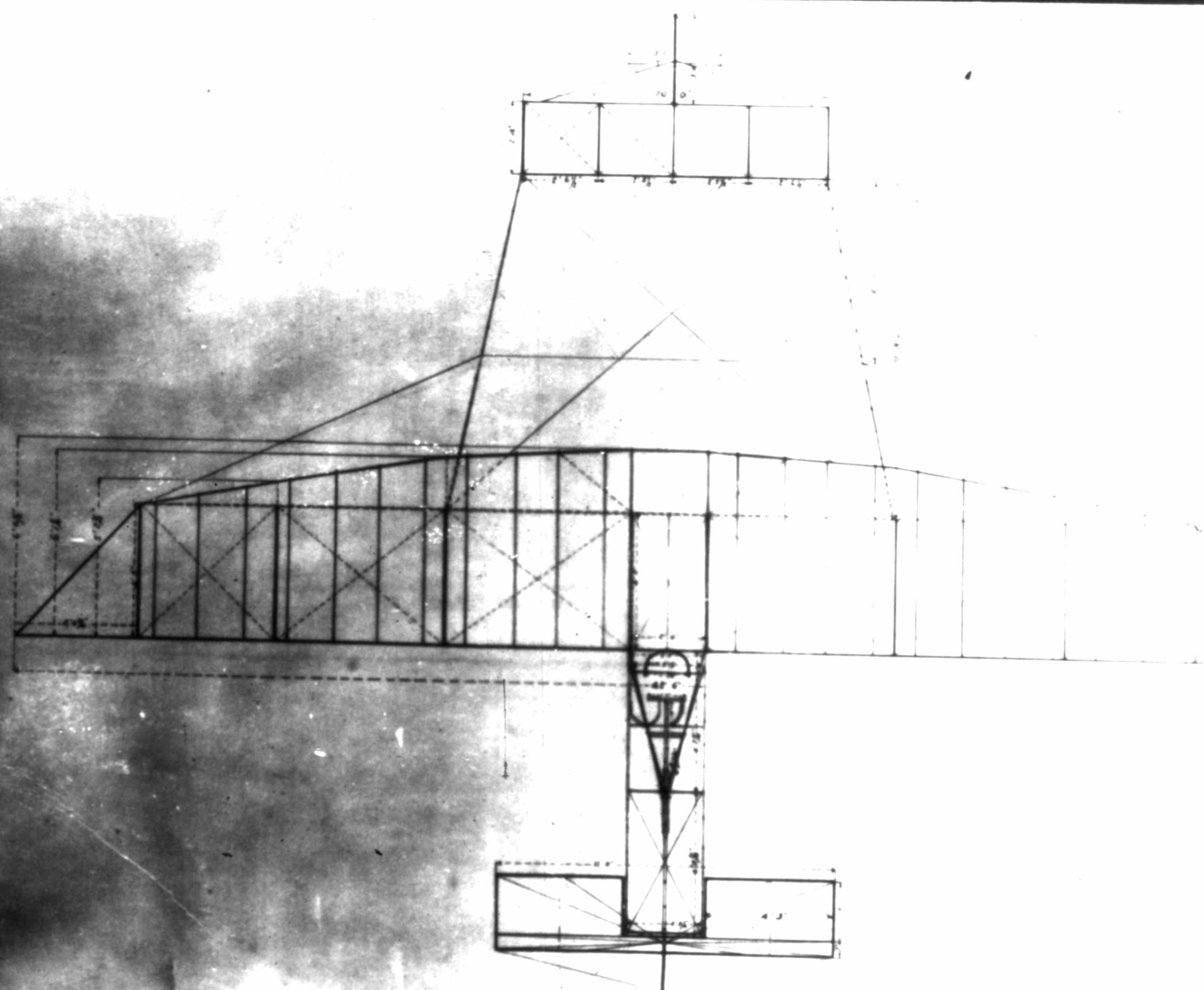
Scale – [illegible] inch = 1 ft

Front Elevation





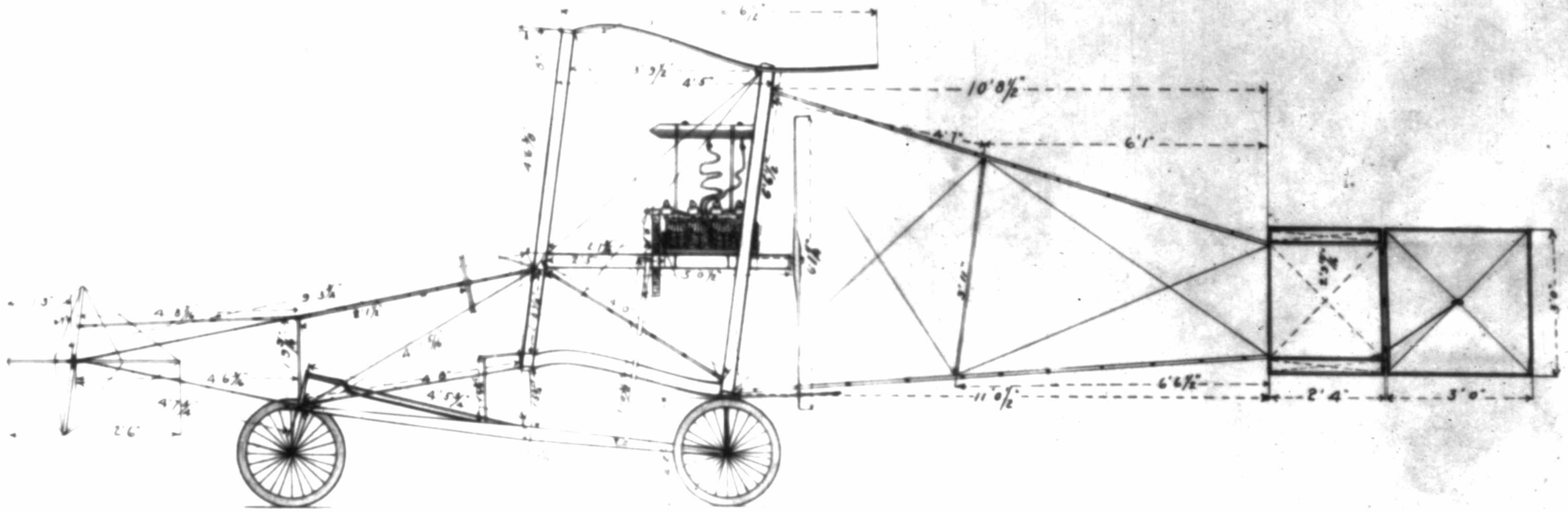
Plan.



Plan

JUNE BUG

Scale – ½ inch = 1 ft



Side Elevation