Feb. 27, 1934. L. M. BUTLER 1,949,007

ALIGNMENT JIG

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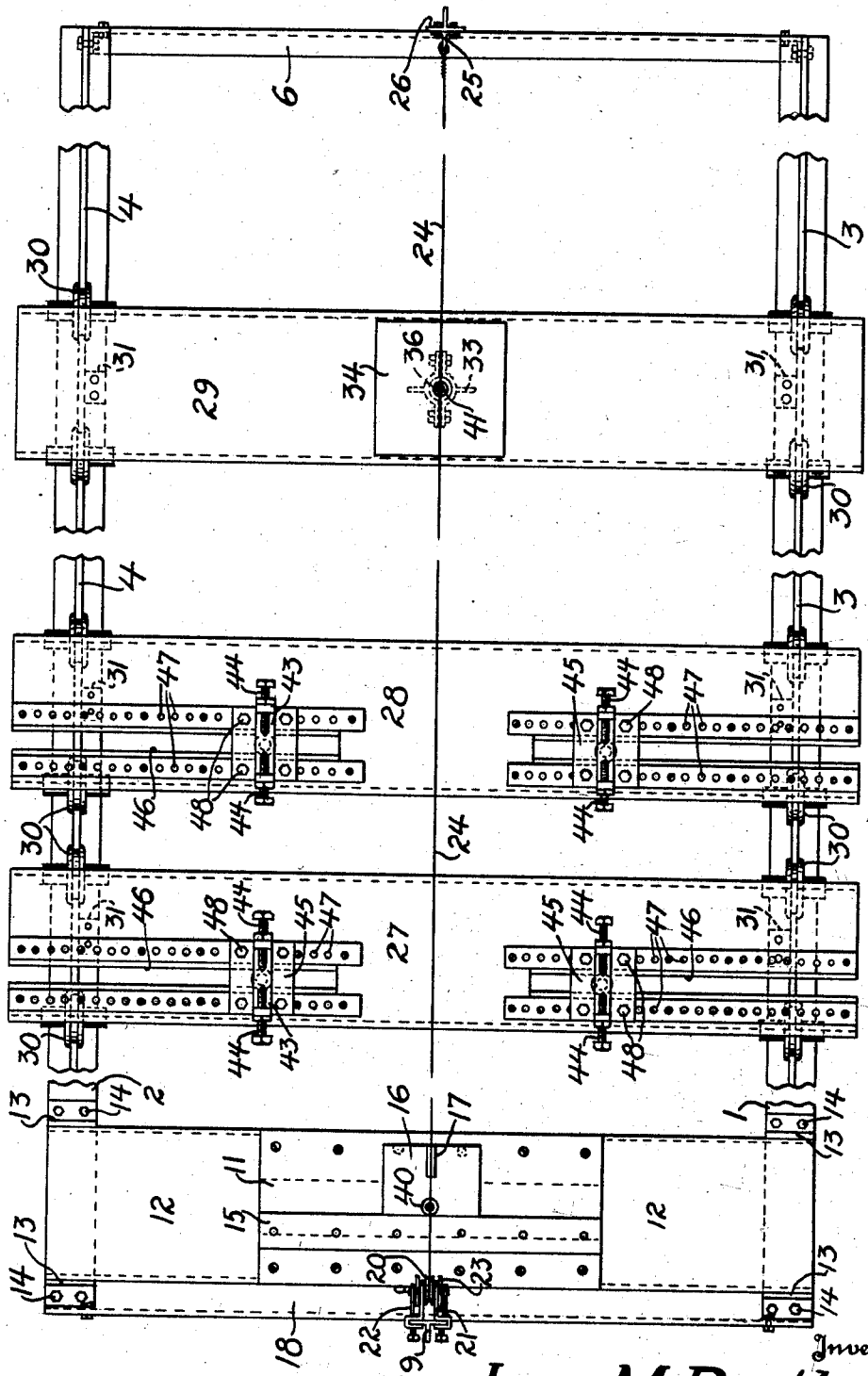


FIG. 1

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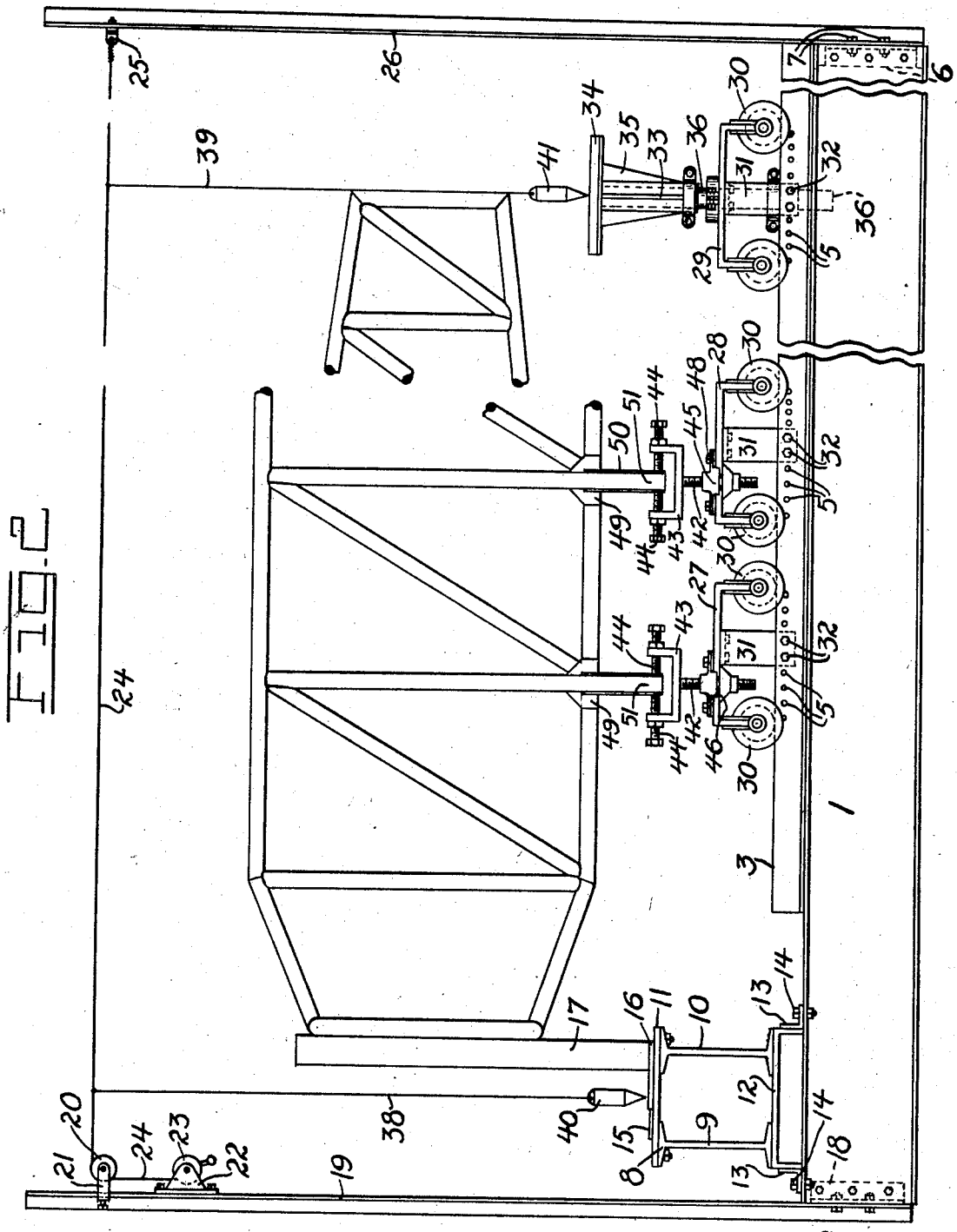


FIG. 2

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UNITED STATES PATENT OFFICE

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ALIGNMENT JIG

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16 Claims. (Cl. 33—174)

My invention pertains to improvements in apparatus in the form of a jig adapted for use in the construction of airplanes.

In the construction of airplane fuselages, it is important that perfect symmetry obtain for the structural members of the fuselage about its longitudinal axis, and since the present day fuselages are of bolted or welded tubular construction, the preliminary assembly thereof results in more or less twisting or misaligning of the structure as a whole.

The principal object of my invention is to provide means whereby an assembled fuselage may be accurately checked and its misalignment noted, as a result of which correction can be readily and conveniently made.

These and other objects will appear from a study of the accompanying drawings and this specification, and from the claims which more particularly define the novel parts and arrangement of my invention.

In the accompanying drawings Figure 1 is a plan view of my improved form of jig.

Figure 2 is a side elevation of Figure 1.

As a foundation for the jig, I may employ a pair of parallel beams 1 and 2 on the upper edge of which are mounted tracks 3 and 4. The beams 1 and 2 are securely held in spaced relation by beams 6 and 18.

Rigidly mounted upon one end of the foundation and at right angles to the center line of the jig is a guide plate 15. This guide plate is supported by a table which may consist of a plate 11, I beams 9 and 10, and a channel 12. The entire table assembly is securely attached to the foundation members 1 and 2.

Supported upon the table 11, and movable thereover, is a gauge by which transverse alignment of parts intended to be perpendicular to the center line of the fuselage (such as the engine ring or bearers) can be checked. As shown, this comprises a vertical straight edge 17, held by a base plate 16 which rests upon the table 11, and is guided for rectilinear movement by the guide plate 15.

Upon the other end of the foundation is adjustably mounted a plate 34. This plate is supported by a post 36 and braced by brackets 35, the post 36 being vertically adjustable upon a carriage 29 which supports it. Plate 34 is also adjustable along a horizontal line by means of the carriage 29 which is equipped with grooved wheels 30 which engage tracks 3 and 4. Said carriage 28 is provided with a depending arm 31 which is supplied with holes through which bolts 32 fit into corresponding holes 5 in the rails 3 and 4, thereby securely holding the plate 34 in any predetermined position.

The plates 15 and 34 are provided with lines or markings upon their faces designating the center-line of the jig.

Gauging points may be made up of brackets 43 into which are threadedly fitted conically tipped centering pins 44. These brackets are adjustable vertically by means of threaded posts 42 and are also adjustable transversely with respect to a longitudinal line of the jig by means of slots in the carriage 27 or 28 which support them, and may be locked in this position along the slots by pins 48, or other suitable means. The carriages 27 and 28 are adjustable longitudinally by means of grooved wheels 30 which engage tracks 3 and 4. These carriages 27 and 28 may be locked at any position in their path by means of a depending arm 31, bolts 32 passing through holes in said arm and through corresponding holes 5 in rails 3 and 4. Thus the gauging points may be exactly positioned in accordance with the engineer's designs.

In the center of the cross beams 6 and 18, vertical arms 19 and 26 are secured. Near the top of 26 is provided a fastening 25, to which a wire may be attached. Near the top of 19 is provided a grooved pulley 20 supported by a bracket 21. Below the pulley, and also secured to the arm 19, may be provided a reel 23, upon which is wound a wire 24 which passes over the grooved pulley 20, and is secured to the fastening 25 on the arm 26. This wire 24 is tightly stretched across the top of the jig, and from it are suspending plumb-lines 38 and 39 which carry plumb-bobs 40 and 41 respectively, which maintain a position directly above the center line on the plates 15 and 34.

Airplane fuselages are usually provided with four or more fittings 50 and 51 for landing gear or wing stubs such as are shown in Figure 2 secured to the fuselage at 49. Whether these stubs extend downward, as is the case where they are intended for landing gears, or whether they stand outward and are intended for wing stubs, the conically tipped centering pins 44 may be easily adjusted to receive them. These fittings may be used as bases of reference from which all other points of the fuselage may be aligned.

To align a fuselage with my improved form of jig, the fuselage is so placed that the fittings 50 and 51 come between the conically tipped pins 44, which have previously been exactly positioned in accordance with the engineer's design, and are here firmly gripped. The plumb-line 39 is then

moved up along the wire 24 until it comes against the tail post of the fuselage. If the tail post is out of alignment the error is quickly noted.

The plumb-line 38 at the front end of the fuselage is, at all times, in a fixed relation to the plate 15 directly above its center line marking. The engine ring or bearer on the front end of the fuselage is then brought in contact with the vertical arm 17, which is a plumb straight edge and which can be moved across the face of the engine ring or bearers so as to check any misalignment thereof.

With the fuselage in place and securely clamped between the points of the centering pins 44, any misalignment in the axis of the fuselage may be noted by sighting from one plumb-line to the other. Such misalignment may be corrected while the fuselage is held in the jig by adjusting the brace wires (not shown) in the various panels of the fuselage until absolute symmetry is obtained along its longitudinal center-line. In the course of quantity production, a fuselage may be placed upon the jig, quickly checked, corrected and removed, the entire operation requiring but a short time.

This jig may also be employed to check over the fuselage of an airplane which has been wrecked or damaged, to bring it once more into its original alignment, so that it may be safely flown. Further, being adjustable in every way, the jig may be quickly adjusted to any repair job or where several different sizes of planes are being built in one factory and a quick change is necessary, this jig will save much time.

What I do claim as my invention is:

1. An apparatus of the class described comprising a frame of parallelogram formation, carriages movably mounted on said frame, means adjustably mounted with respect to said carriages for supporting an airplane fuselage, another carriage also movable on the frame and provided with marks indicating the center line of said frame, said last mentioned carriage being in movable parallelism with a fixed center line of the apparatus.

2. An apparatus of the class described comprising a bed with sides arranged parallel with respect to each other, wheeled carriages mounted for longitudinal movement on said bed and means for locking said carriages in various positions with respect to each other and with respect to the ends of said bed, one of said carriages having a center line marked therein, airplane fuselage supporting means adjustably mounted on other of said carriages, a wire positioned above said bed to mark the longitudinal center line, plumb-lines with plumb-bobs depending from said wire and adapted to register with the center line indicating mark on the marked one of said carriages, and there being a fixed centerline marking on the bed.

3. An alignment jig for airplane fuselages comprising a center line wire longitudinally supported above the fuselage, means disposed oppositely on each side of the center line wire for engaging the forward landing gear fittings at each side of the fuselage, and like means independent of the first for engaging the rear landing gear fittings at each side of the fuselage, thereby supporting the same and fixing it in position symmetrical to the center line wire, and gauge means disposed in a vertical plane containing the center line wire and depending from said wire, and applicable respectively to the engine mount and the tail post of the fuselage.

4. An alignment jig for airplane fuselages comprising a center line wire longitudinally supported above the fuselage, means disposed oppositely on each side of the center line wire for engaging the forward landing gear fittings at each side of the fuselage, and like means independent of the first for engaging the rear landing gear fittings at each side of the fuselage, thereby supporting the same and fixing it in position symmetrical to the center line wire, gauge means disposed in a vertical plane containing the center line wire and depending from said wire, and applicable respectively to the engine mount and the tail post of the fuselage, and means for lateral adjustment of the several landing gear support means.

5. An alignment jig for airplane fuselages comprising a center line wire longitudinally supported above the fuselage, means disposed oppositely on each side of the center line wire for engaging the forward landing gear fittings at each side of the fuselage, and like means independent of the first for engaging the rear landing gear fittings at each side of the fuselage, thereby supporting the same and fixing it in position symmetrical to the center line wire, gauge means disposed in a vertical plane containing the center line wire and depending from said wire, and applicable respectively to the engine mount and the tail post of the fuselage, and means to adjust vertically the several landing gear support means.

6. An alignment jig for airplane fuselages comprising a center line wire longitudinally supported above the fuselage, means disposed oppositely on each side of the center line for engaging the forward landing gear fittings at each side of the fuselage, and like means independent of the first for engaging the rear landing gear fittings at each side of the fuselage, thereby suporting the same and fixing it in position symmetrical to the center line wire, gauge means disposed in a vertical plane containing the center line wire and depending from said wire, and applicable respectively to the engine mount and the tail post of the fuselage, and means for longitudinal adjustment of either pair of the landing gear support means relative to the other pair, and each relative to the nose and tail gauge means.

7. An alignment jig for airplane fuselages comprising a center line wire longitudinally supported above the fuselage, means disposed oppositely on each side of the center line for engaging the forward landing gear fittings at each side of the fuselage, and like means independent of the first for engaging the rear landing gear fittings at each side of the fuselage, thereby supporting the same and fixing it in position symmetrical to the center line wire, gauge means disposed in a vertical plane containing the center line wire and depending from said wire, and applicable respectively to the engine mount and the tail post of the fuselage, and means supporting each landing gear support for universal adjustment.

8. An apparatus of the class described comprising a frame of parallelogram formation in plan, means supported thereon to support an airplane fuselage, comprising a plurality of units, each unit being mounted for universal adjustment relative to the frame, and a carriage movably mounted on said frame provided with means indicating the center line of the frame, and movable in parallelism with such center line.

9. An alignment jig for airplane fuselages comprising a main frame, means supported from said frame disposed above and below the position

of the fuselage, and cooperating as a center line gauge to define a given vertical plane, supports mounted on said frame engageable with fixed points of reference on the fuselage to support the fuselage, a gauge means fixed on said frame disposed in such given vertical plane for application to the engine mount, and gauge means supported from said frame and adjustable in such vertical plane towards and from the fixed gauge, and similarly disposed for application to the tail post, to align said engine mount and tail post with respect to said center line gauge, and means permitting the said supports to be adjusted laterally with respect to such vertical plane.

10. An alignment jig for airplane fuselages, comprising a plurality of gauging members adjustable to define a desired geometrical space reference diagram, positioning means, and means which are themselves fixed relative to such space reference diagram, for guiding said positioning means for movement into a predetermined relation with respect to such space reference diagram, said positioning means being adapted to position an airplane fuselage in fixed relation to such reference diagram by engagement with fixed points of reference on the fuselage, said gauging members being disposed, when the fuselage is thus positioned, adjacent selected elements of the fuselage, whereby the agreement of reference indices on the fuselage with the geometrical space reference diagram is immediately apparent.

11. An alignment jig for airplane fuselages comprising two longitudinal members disposed in parallel relation, means adjustably mounted on said members adapted for engagement with fixed points of reference on the fuselage to position the same, two means disposed in spaced relation in a vertical plane midway between said longitudinal members adapted for application, one to the fuselage frame member at the nose, and the other to the frame member at the tail, and adjustable one towards the other in such vertical plane, whereby when the fuselage has been positioned by said first means, upon such application of said latter means to the fuselage its agreement with both of said latter means is immediately apparent.

12. An alignment jig for airplane fuselages comprising two gauging members disposed in a vertical reference plane, positioning means, means supporting said members and said positioning means and guiding the latter for disposition in a predetermined symmetrical relation with respect to said vertical reference plane, said positioning means being adapted to position an airplane fuselage in fixed relation to such reference plane by engagement with fixed points of reference on the fuselage, said gauging members being disposed, when the fuselage is thus positioned, one adjacent the fuselage frame member at the nose and the other adjacent the frame member at the tail, whereby the agreement of the fuselage center line with the reference plane including said two gauging members is immediately apparent.

13. The combination of claim 12, and a straight-edge member mounted on said supporting means for application to an engine mount of said fuselage to check any misalignment thereof.

14. The combination of claim 12, and means guiding the gauging members for adjustment towards or away from each other in such reference plane.

15. The combination of claim 12, the positioning means being adjustable both laterally with respect to such vertical plane and longitudinally with respect to the two gauging members.

16. The combination of claim 12, the supporting means guiding the positioning means for adjustment both laterally with respect to such vertical plane and longitudinally with respect to the two gauging members, and means to fix the positioning means in a given lateral and longitudinal position.

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