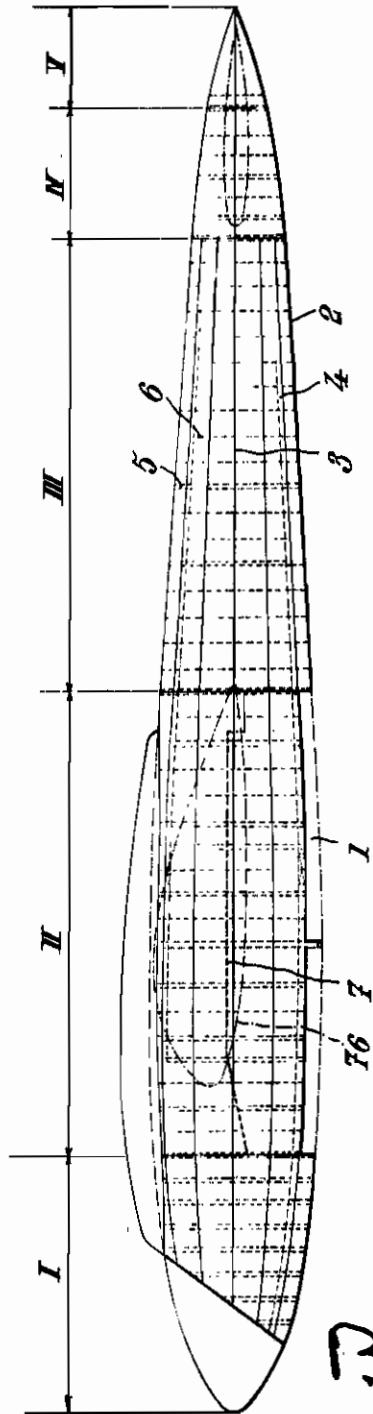


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CONSTRUCTION OF FUSELAGES  
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Serial No.  
288,683  
20 Sheets—Sheet 1

*Fig. 1.*



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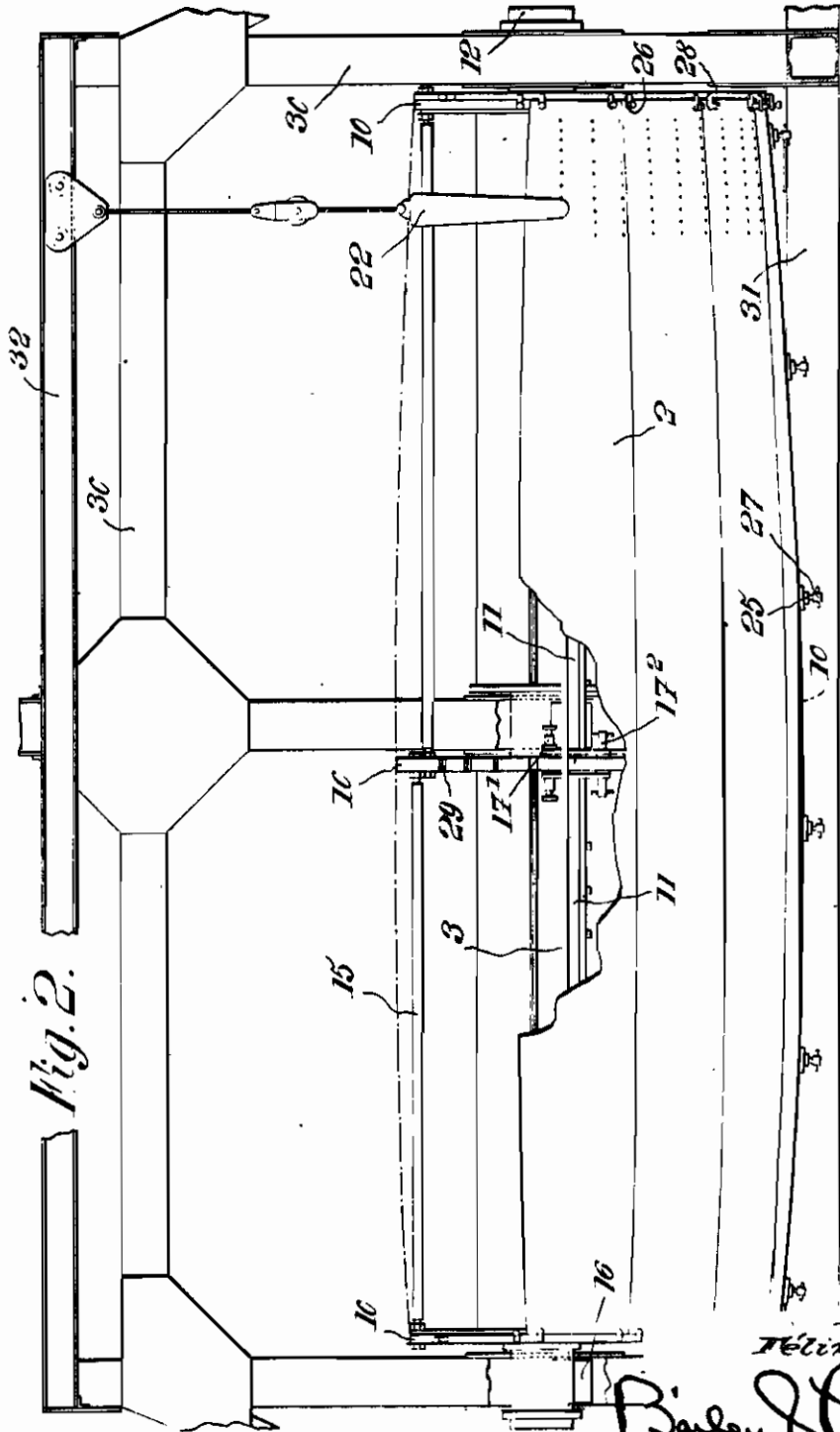


Fig. 2.

Inventor:  
Félix Amiot,

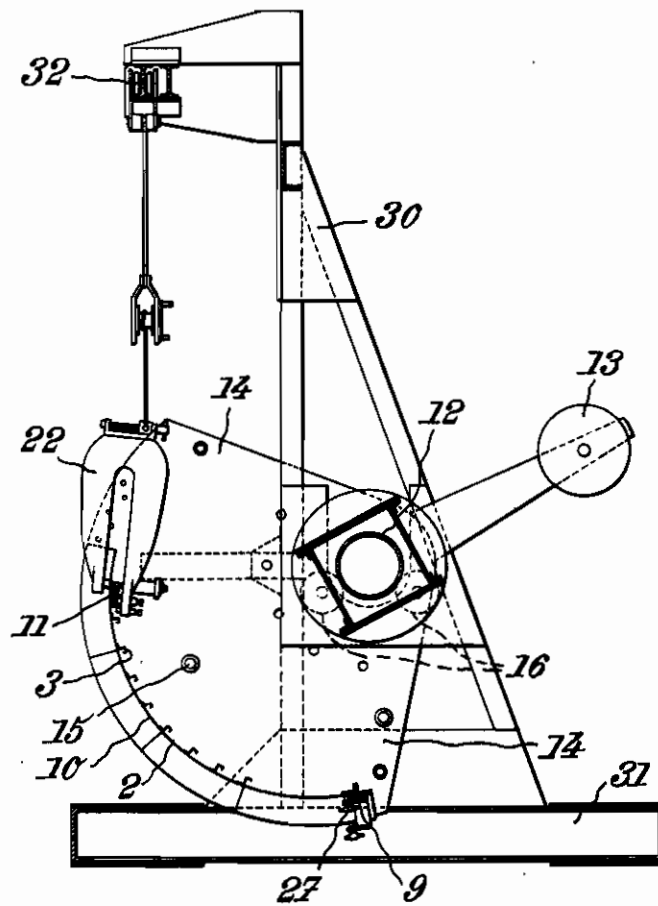
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*Fig. 3*



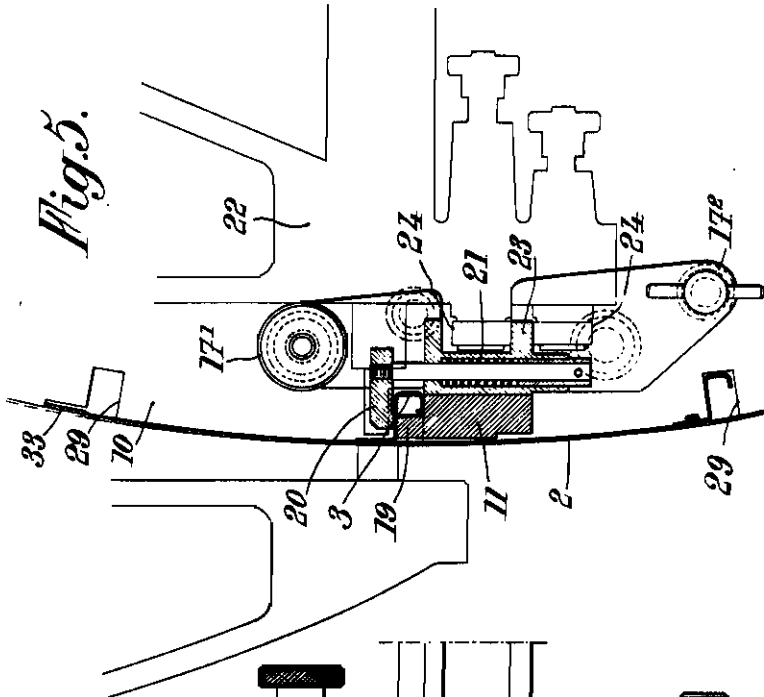
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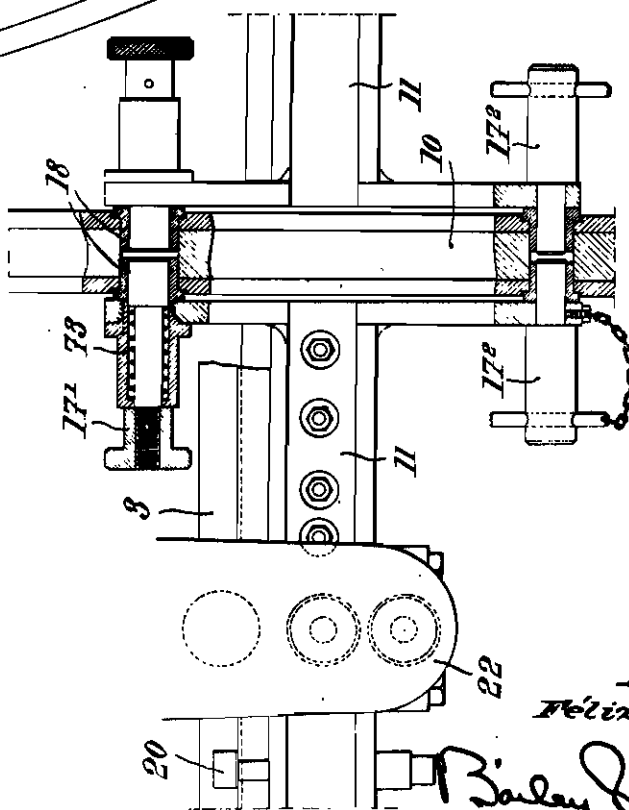
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288,683  
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*Fig. 5.*



*Fig. 7.*

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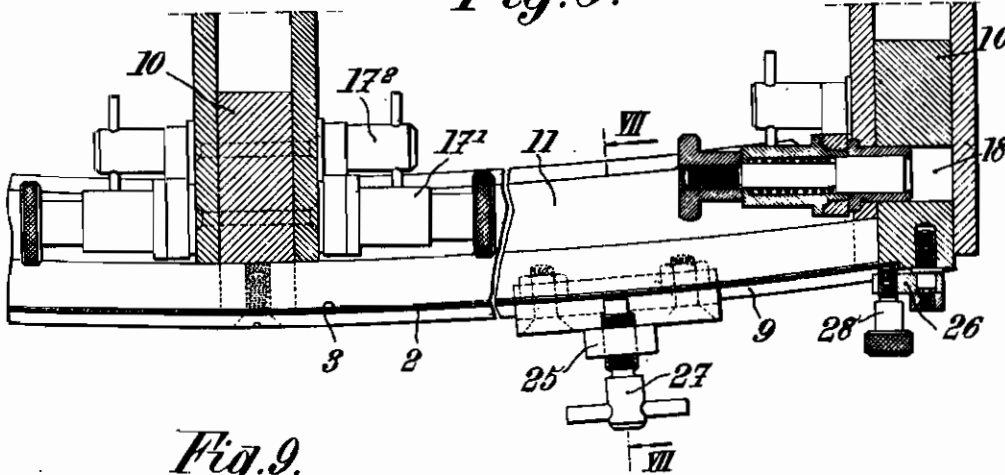
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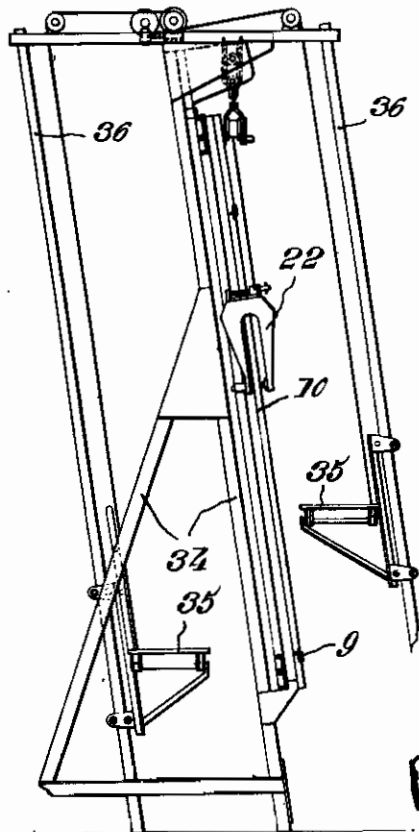
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*Fig. 6.*



*Fig. 9.*



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Fig. 10.

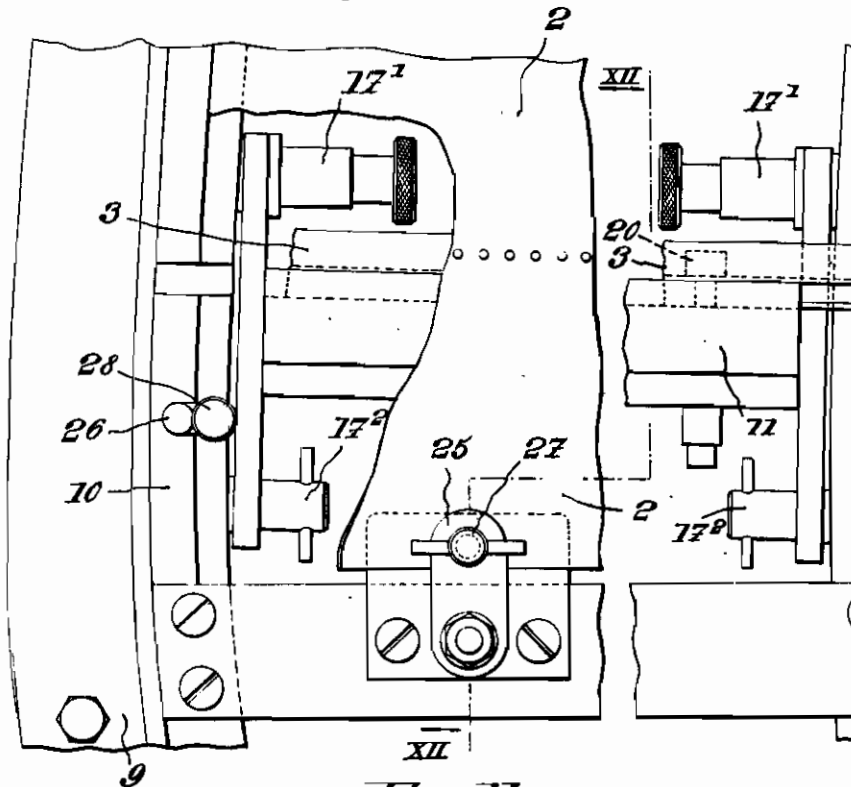
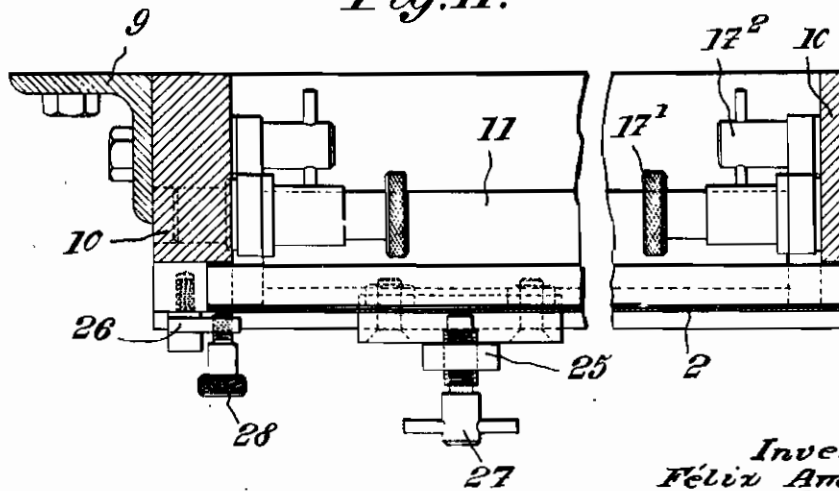


Fig. 11.



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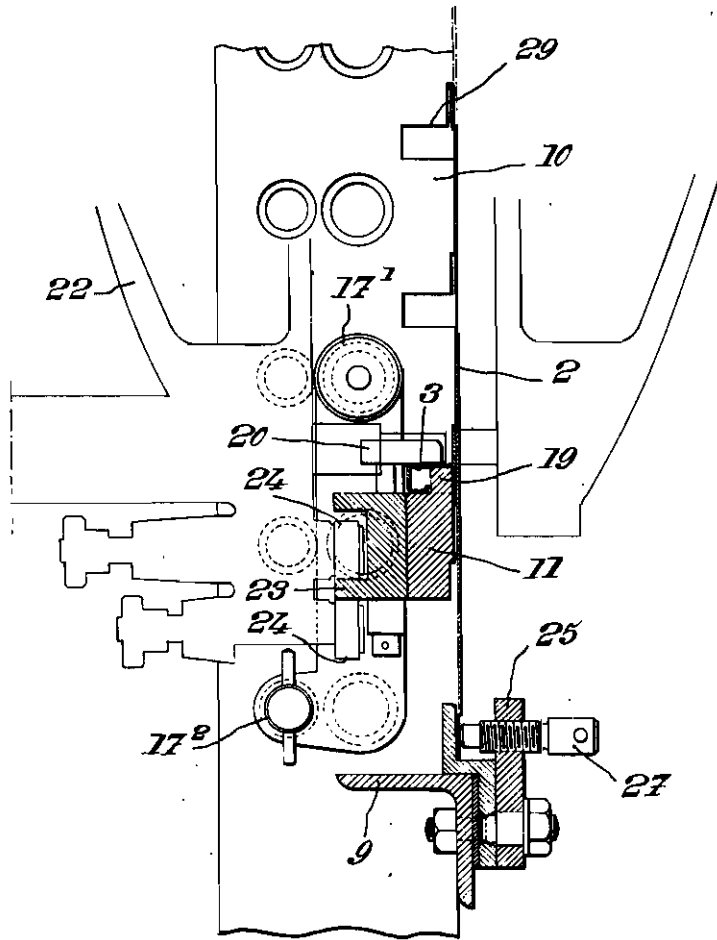
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*Fig. 12.*



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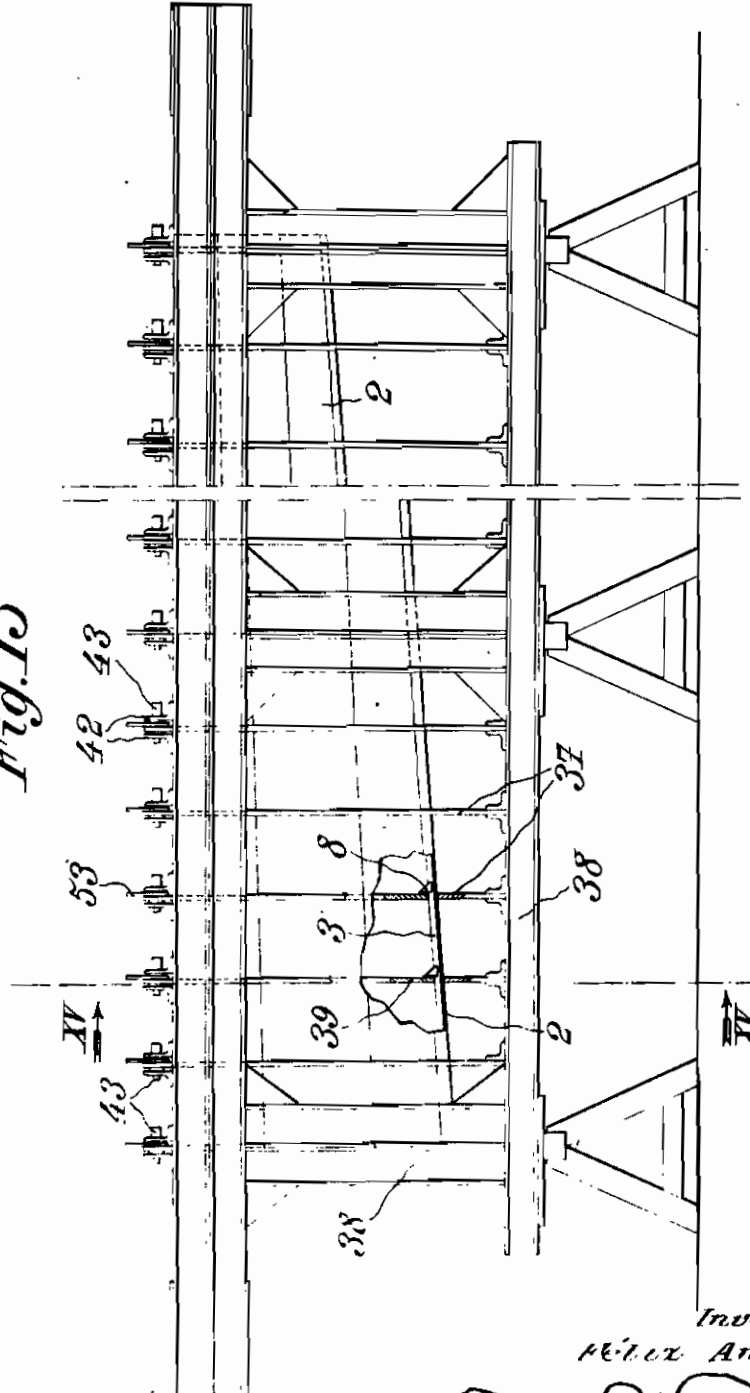


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*Fig. 13*



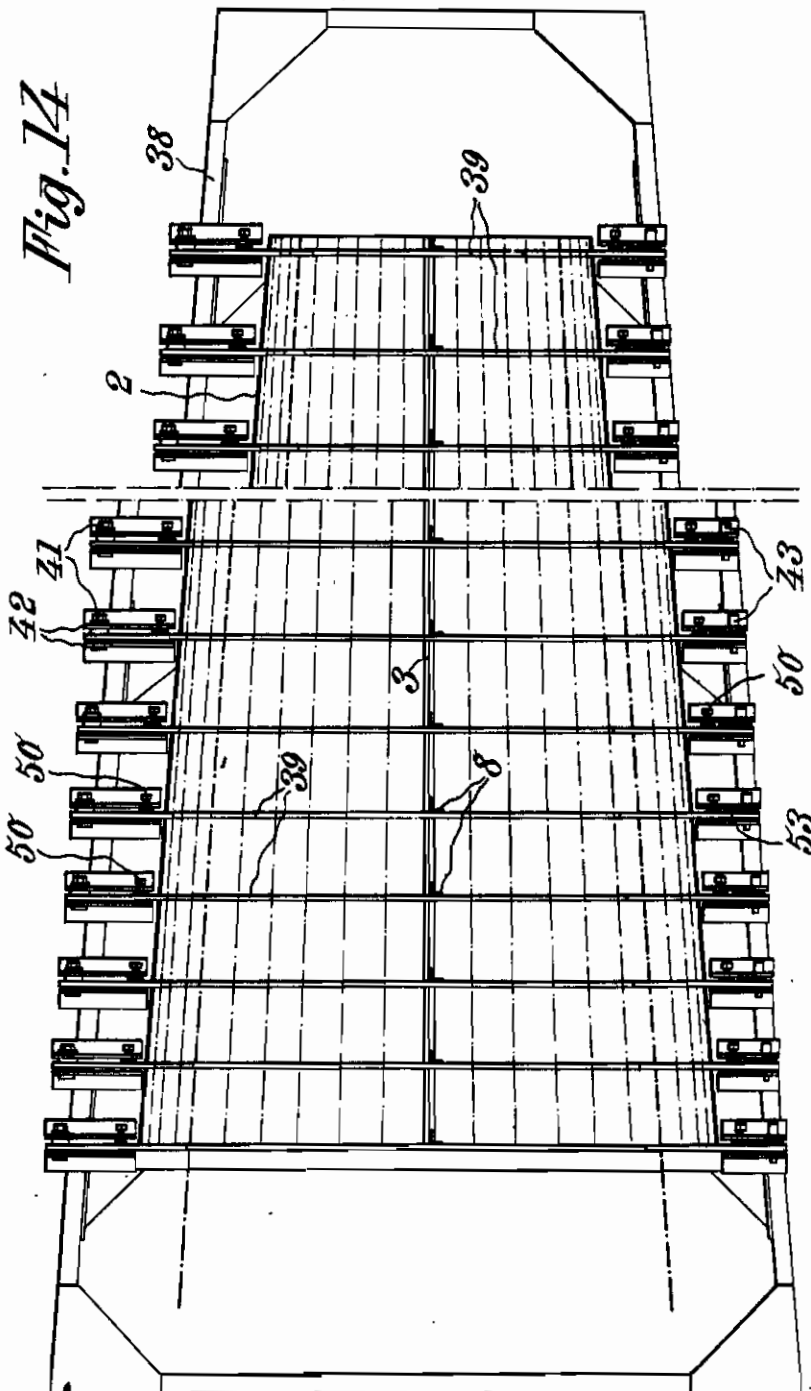
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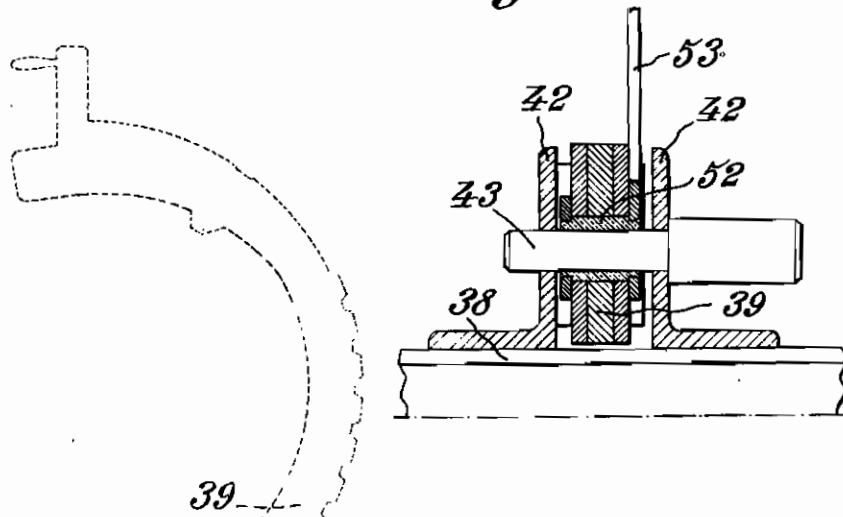
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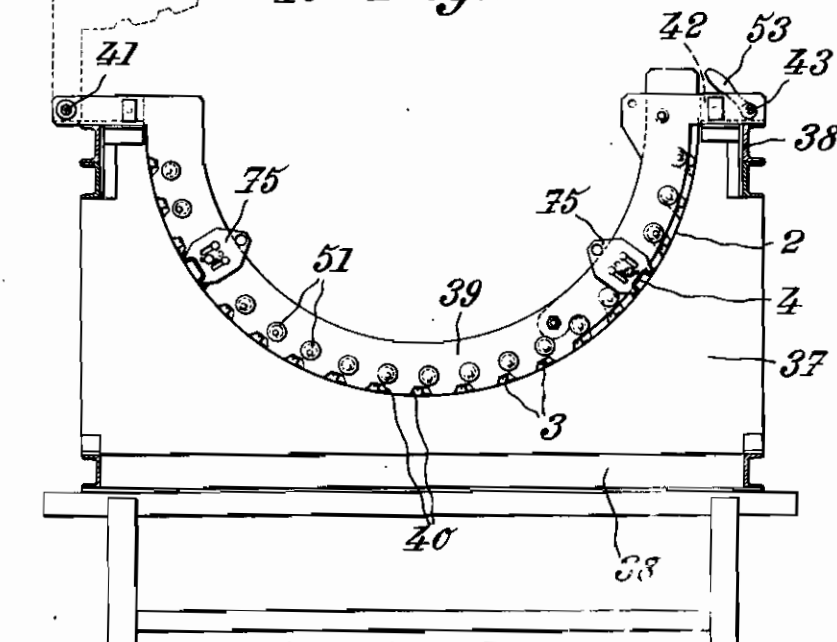
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*Fig. 15 a*



*Fig. 15*



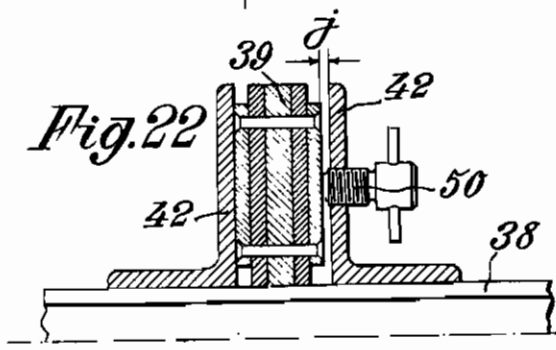
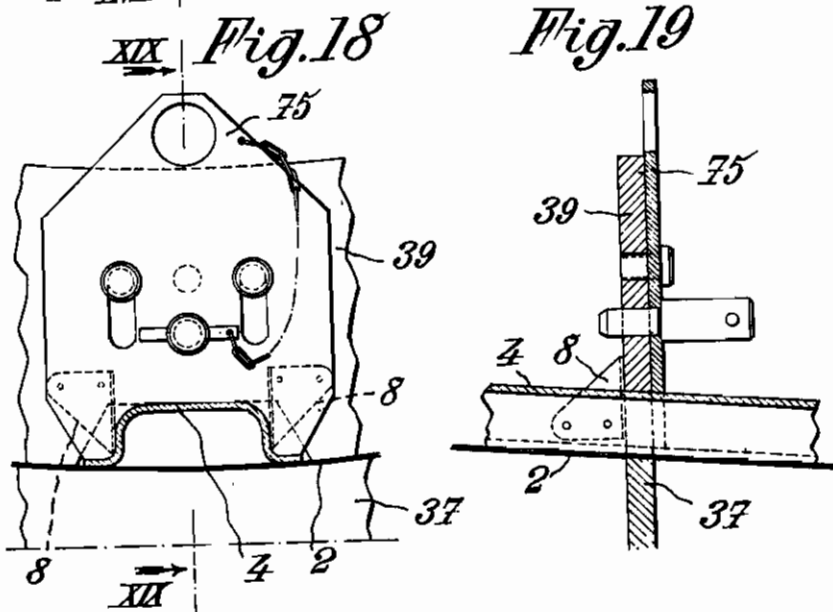
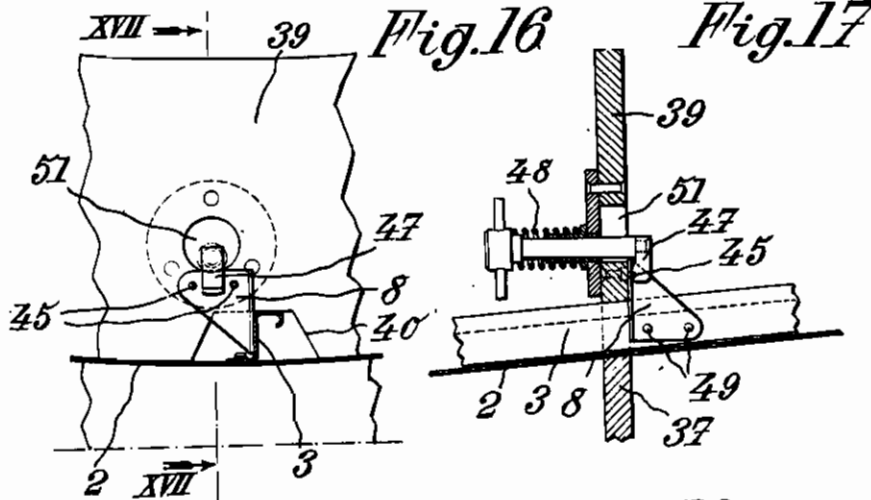
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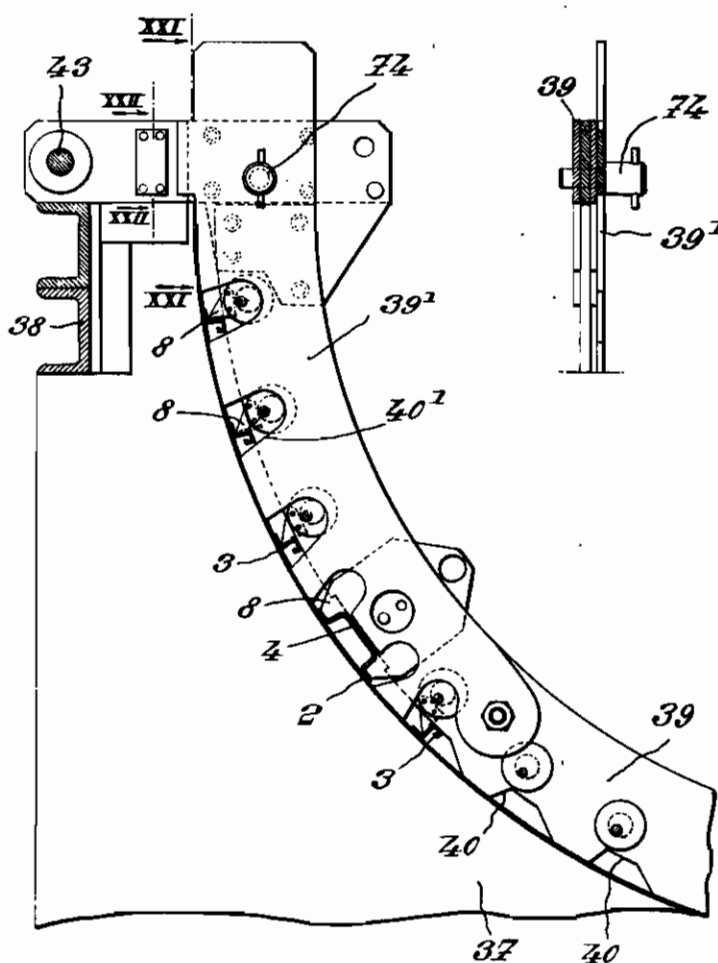
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Fig. 20.

Fig. 21.



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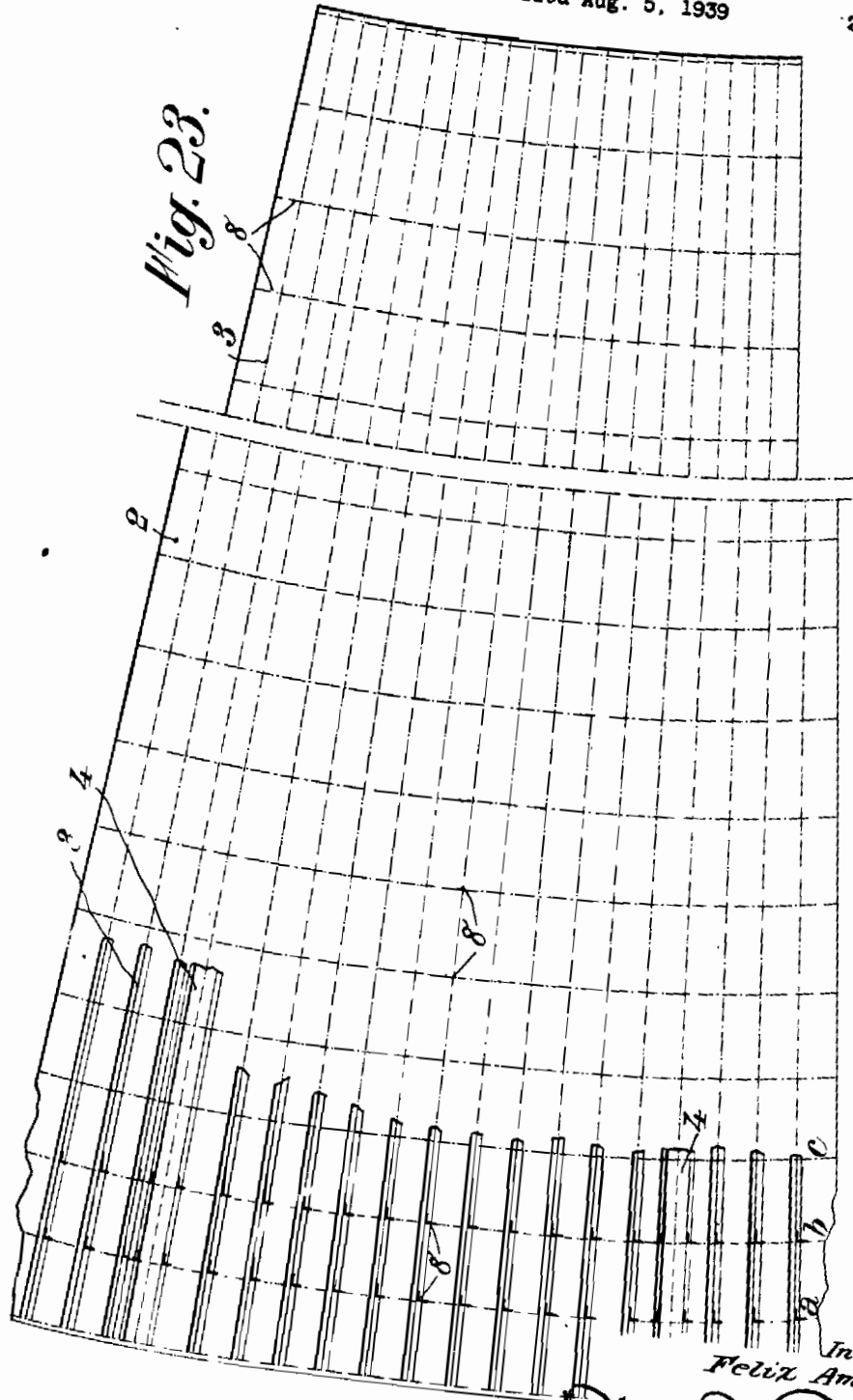
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Fig. 23.



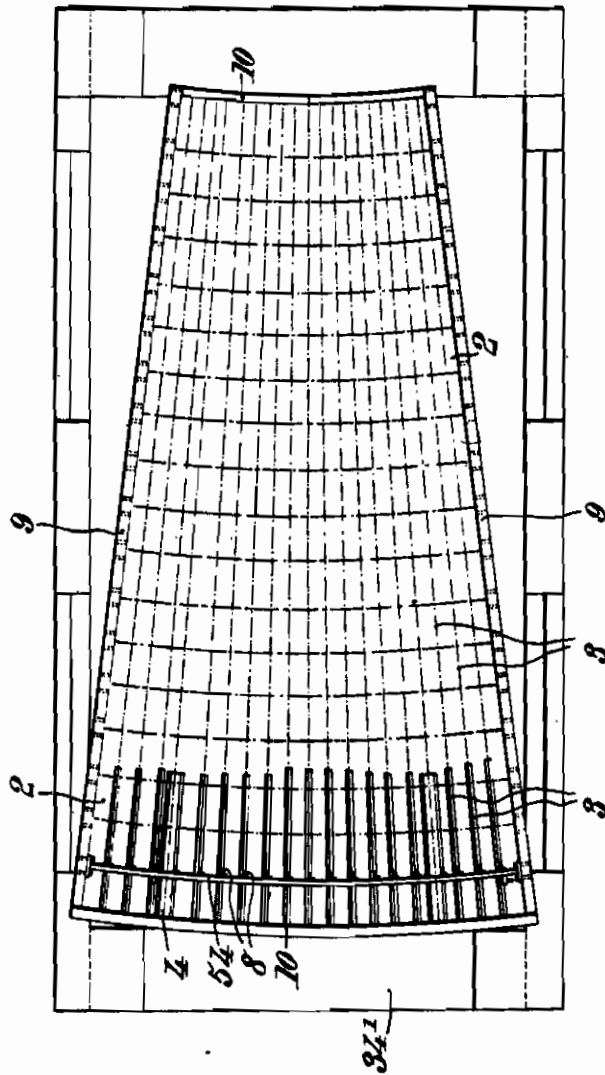
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Fig. 24.



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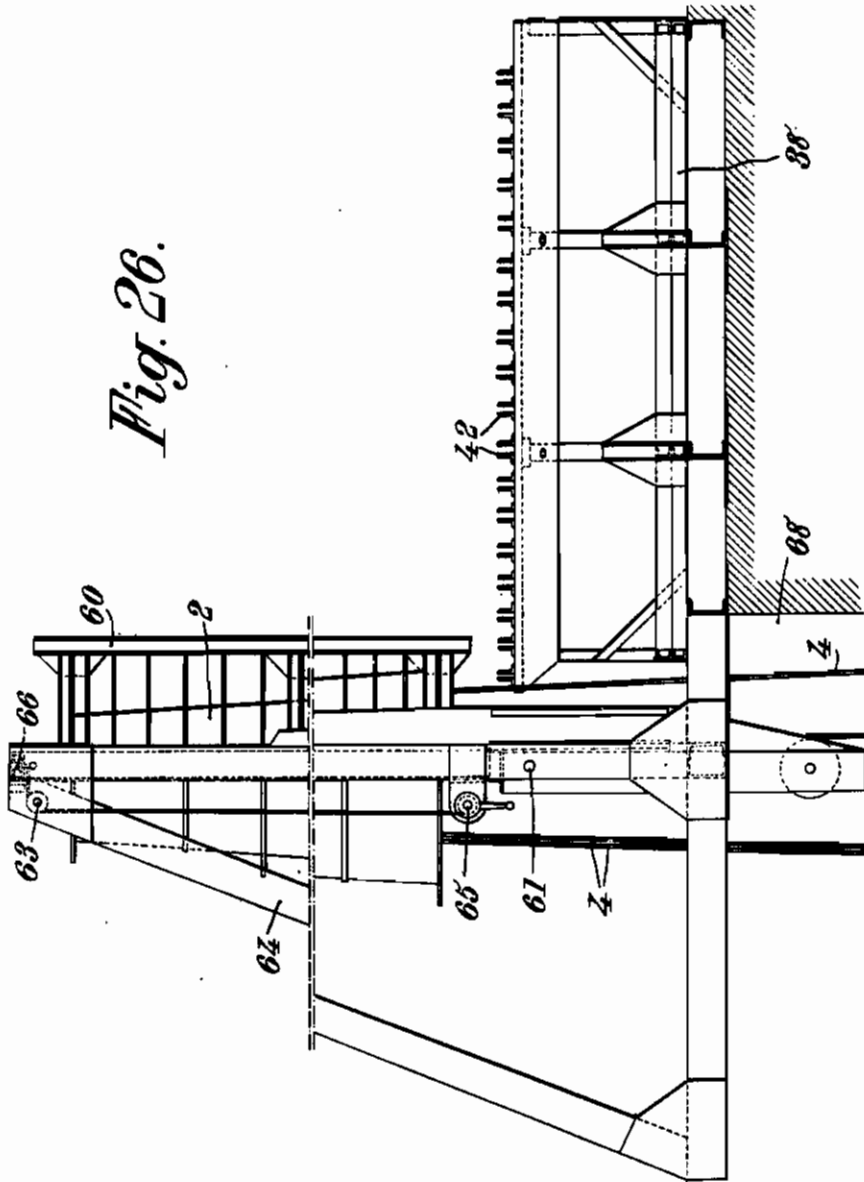
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*Fig. 26.*



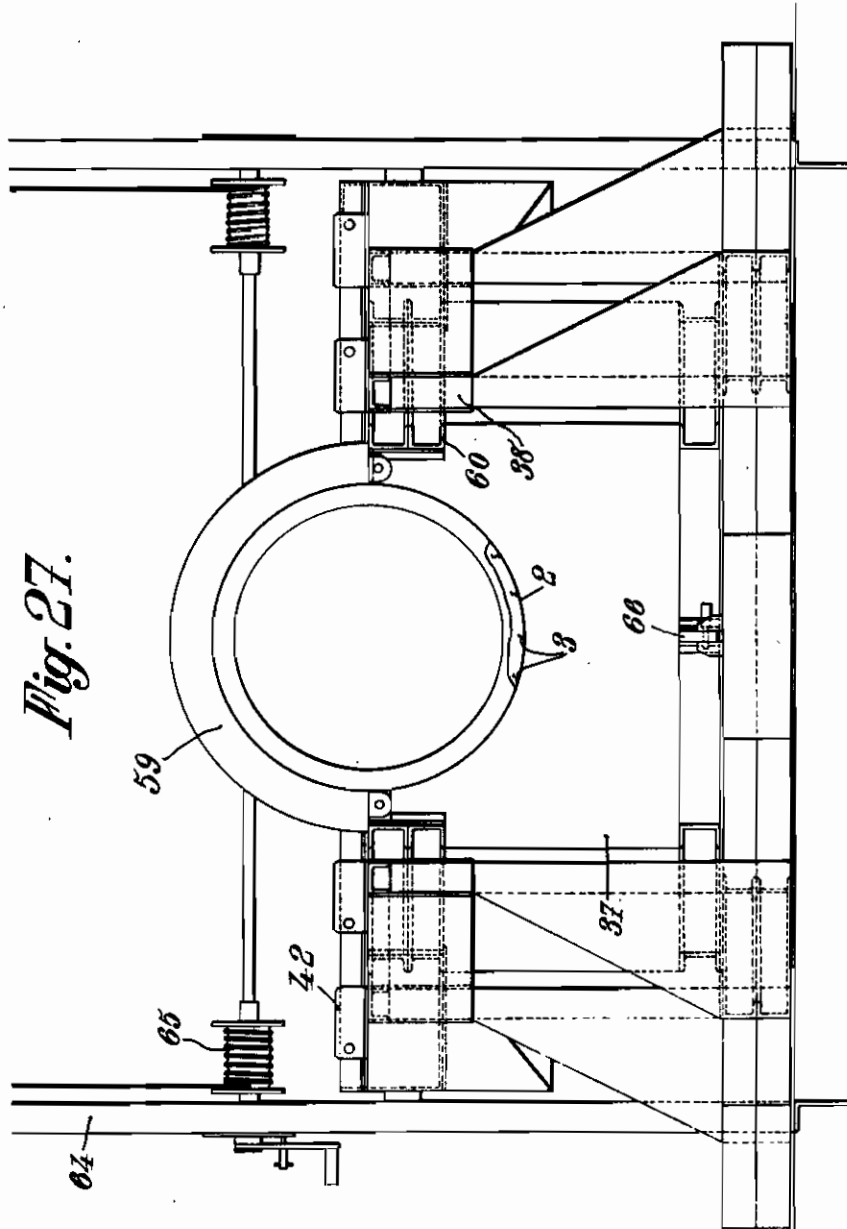
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*Fig. 27.*

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Fig. 28.

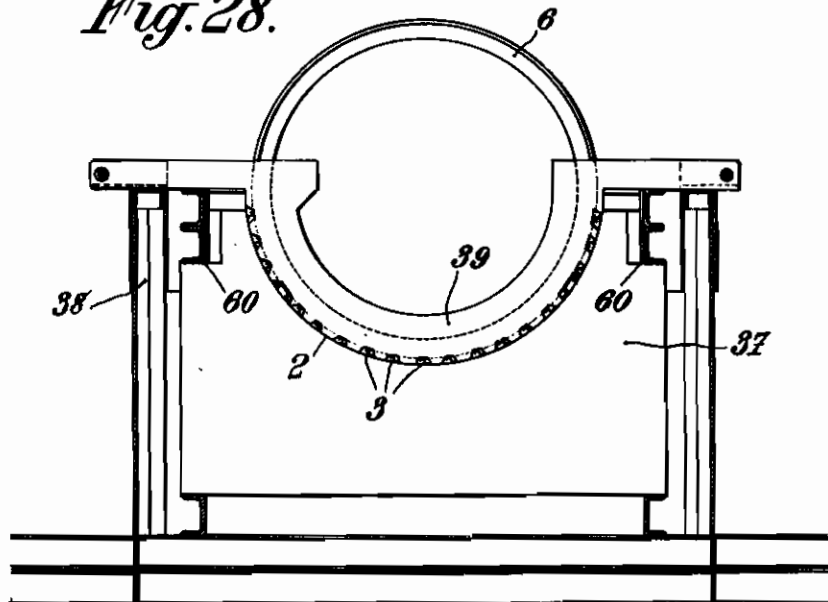


Fig. 29.

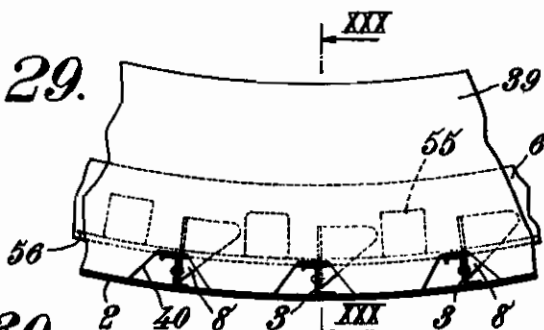


Fig. 30.

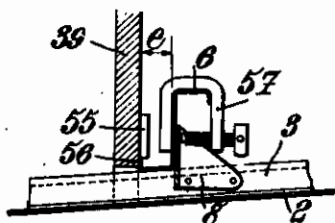
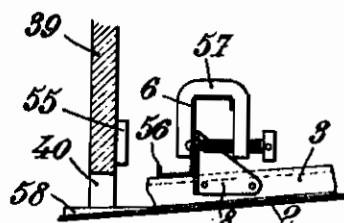


Fig. 31.



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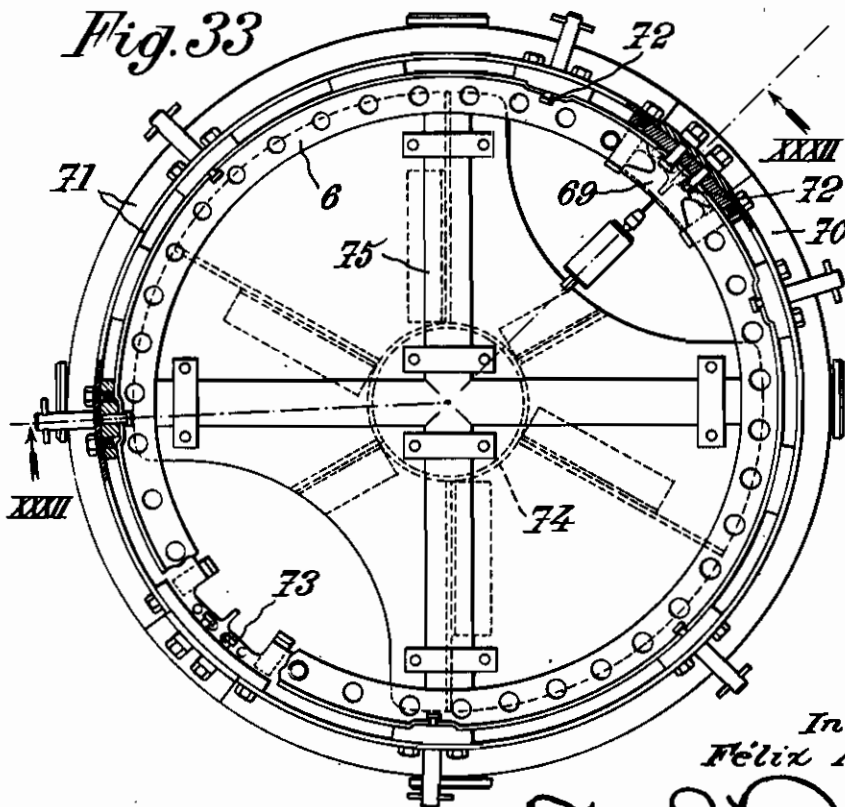
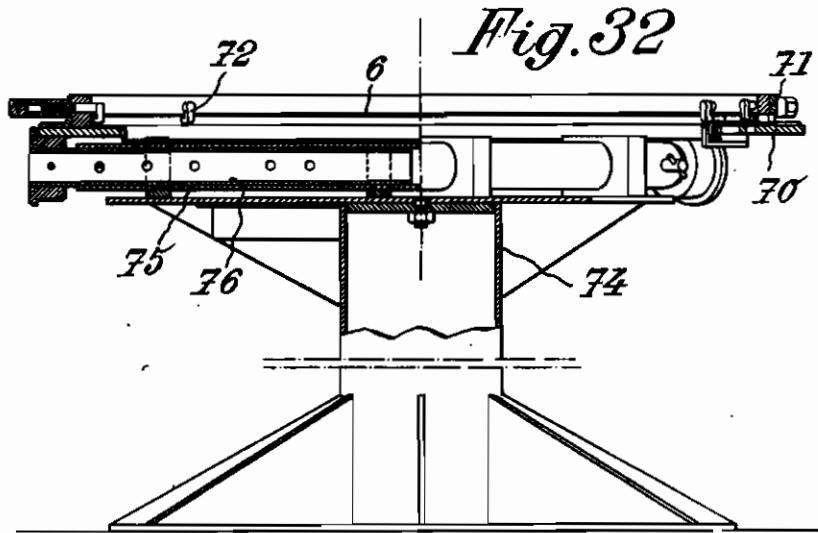
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# ALIEN PROPERTY CUSTODIAN

## CONSTRUCTION OF FUSELAGES

Felix Amiot, Neuilly-sur-Seine, France; vested in  
the Alien Property Custodian

Application filed August 5, 1939

The present invention relates to aerodynamic structures or surfaces, especially for aerial navigation machines, and it is more especially, although not exclusively, concerned, among these structures, with those of the stressed skin type, in which the skin or covering proper must be intimately assembled to a carcass or skeleton including longitudinal elements (stringers, longitudinal bars, etc.) and transverse elements (frames, formers, etc.). It should be well understood that these structures may consist either of fuselages, nacelles and the like, or of wings and the like.

The chief object of the present invention is to permit of forming these structures in a more methodic and rational manner than it was done up to this time, thus reducing the time and cost of manufacture, while increasing the resistance and safety rate owing to the perfection obtained in the assembly of the constituting elements.

According to an essential feature of the present invention, the assembling operations are performed by means of positioning devices capable, both of supporting, at least temporarily, the various elements to be assembled together, and of fixing in an accurate manner, through a predetermined marking, the relative positions that these elements are intended to occupy in the assembly, these devices being also eventually adapted to act as supports for the riveting or welding apparatus.

According to another feature of the present invention, in order to make structures of the type above described including a skin or covering, stringers, and transverse frames or formers or the like, I separately prepare, on the one hand the skin and the stringers assembled therewith, and, on the other hand, the transverse frames or formers (eventually with the internal structure elements to be fixed thereto) and then I adapt the stringer and covering assemblies around said transverse elements, after which the whole is assembled together.

According to still another feature of the present invention, in order to perform the assembling operations involved, in particular, by the fixation of the skin or covering on longitudinal parts such as the stringers, the pieces are supported, while the mounting takes place, by a carcass adapted to the shape which is to be given to the covering in the finished structure, said carcass being itself mounted pivotally about a longitudinal axis, the whole being advantageously such that, owing to the displacements of the carcass, the succes-

sive operations of assembly of the various parts can take place substantially at the same height.

According to still another feature of the present invention, concerning the case in which the structure includes developable surfaces, the mounting of the stringers, and eventually also of the means (gussets, angle plates, etc.) capable of ensuring the fixation of the transverse elements (frames, formers, etc.) on a plane surface, by starting from developed metal sheet elements, the whole being subsequently formed in such manner as to obtain the developable surface to be included in the final structure.

Still another feature of the present invention relates to the method of assembling the carcass or skeleton of the structure with the covering or skin and/or the stringers, and it consists in bringing and maintaining said skin or covering, for the assembly, exactly in the form it must have in the finished structure, for instance by engagement against a berth of corresponding shape.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a diagrammatic elevation of an airplane the fuselage of which is made of several portions or sections which may be made according to the present invention;

Figs. 2 and 3 are, respectively, an elevation and a cross section of a device for mounting the covering or skin and the stringers, in particular those of section II of Fig. 1, according to the invention;

Figs. 4 and 5 separately show, on an enlarged scale, respectively in elevation (with parts cut away) and in transverse section, some elements of the mounting system in question, and in particular a plate or band for the positioning of the stringers, according to the invention;

Figs. 6 and 7 separately show, also on an enlarged scale, respectively in plane view, with parts in section and in section on the line VII—VII of Fig. 6, some of the other elements of said system;

Figs. 8 and 9 show, respectively in elevation and in section, another system of the same kind, for the mounting of developable sections, in particular section III of Fig. 1, according to the invention;

Figs. 10 to 12 show, separately and on an enlarged scale, respectively in elevation, in horizontal section and in section by the line XII—XII

of Fig. 10, certain elements of said system, made according to the invention;

Figs. 13 to 15 show, respectively in elevation, in plan view and in transverse section, a mounting system according to the invention;

Fig. 15a shows, separately on an enlarged scale, a tightening device for use in said system, according to the invention;

Figs. 16 and 17 show, on an enlarged scale, respectively in elevation and in section on the line XVII—XVII of Fig. 16, devices for the positioning of fixation angle plates;

Figs. 18 and 19 show, in a similar manner, devices of the same kind, for the mounting of longitudinal bars included in the covering;

Figs. 20 to 22 show, separately and on an enlarged scale, certain other elements of the system of Figs. 13 to 15;

Fig. 23 diagrammatically shows, in developed plan view, the whole of a covering, stringers and angle plates, the whole being assembled as shown by the preceding Figs.;

Fig. 24 shows, in diagrammatic section, another device for the mounting of the angle plates on a developed skin or covering, made according to a modification of the invention;

Figs. 25 to 27 show, the two first in elevation, partly in section, in two different positions, the third in end view on an enlarged scale, a system for assembling on transverse frames and formers, systems including the covering, stringers and angle plates, for instance for section III of Fig. 1;

Fig. 28 shows, in section a part of said system, during the setting in position of the transverse frames and formers;

Figs. 29 to 31 are partial views, on an enlarged scale, respectively in elevation and in section on the line XXX—XXX in two different positions, devices for positioning the formers, according to the present invention;

Figs. 32 and 33 show, respectively in elevation and in transverse section, and in plan view, the whole of a former and the means for making it, such an assembly being made according to a prior application and being advantageously used in connection with the present invention.

According to the invention, as exemplified by the embodiments illustrated by the drawings, it is desired to make an airplane fuselage constituted by several sections adapted to be made separately, as set forth in some of my prior applications, and in particular the French patent application Ser. No. 441,519 of Feb. 4, 1939. For instance, there are five sections, I, II, III, IV, V (Fig. 1) the first of which is located ahead of wing 76, the second (generally of curved longitudinal section) at the level of the wing, provided, for instance, at its lower part with an aperture for a baggage, parachute, bomb or other compartment, the third, preferably of conical shape, between the preceding one and the tail unit, the fourth carrying this tail unit, and finally the fifth forming the rear end of the fuselage. The whole is preferably of circular cross section.

These various sections of the fuselage are constituted by the combination of a skin or covering 2 (Figs. 1 and 3) and of a carcass or skeleton capable of working in cooperation with said skin and including, on the one hand, a plurality of longitudinal elements which will be preferably fixed, over at least a portion of their length, on the metal sheets 2 of the skin, these elements being represented on the drawings by sectional irons or stringers 3 (Figs. 1 and 3) advantageously of S-shaped, Z-shaped or similar section, and

also, at least for some sections, by longitudinal bars 4 which reinforce the whole and which may further serve to rigidify the assembly between two successive sections (such as II and III in particular).

Furthermore, there are transverse elements, such as transverse frames or formers, intended to be fixed on both the stringers and the skin (frames 5 of Fig. 1) or only on the stringers (formers 6 of Figs. 1 and 28 to 31).

These frames and formers can be made in many ways, including for instance a sectional iron of the same section as the stringers, and they may extend over 360° (as in the case of section III) or on the contrary, they may be interrupted at certain places where there are apertures in the fuselage (as in section II). They may further be fixed on the side of the inside of the fuselage, with any complementary structures. For instance, in section II, they are assembled with a floor 7 (Fig. 1 in dotted lines) intended, as indicated in a prior patent application Ser. No. 441,856, filed Feb. 11, 1939, to reestablish the continuity of the fuselage interrupted by door 1.

It will be supposed in the following description that the elements are assembled by riveting and are made for instance of duralumin, but of course the invention would apply also to the case of structures including parts of stainless steel and adapted to be assembled together by continuous or discontinuous welding.

As above stated, according to an important characteristic of the invention, positioning means are provided for both supporting the elements for the assembly and fitting them in the proper relative position. These positioning means may be employed at each of the steps of the manufacture, whatever be the order in which the parts are assembled together.

However, according to another feature of the invention, it is advantageous to proceed in such manner as to produce separately, on the one hand systems including the skin proper, together with its longitudinal elements and also, preferably, the means for effecting the assembly with the transverse frames or formers (said means including, for instance, gussets or angle plates 8 as shown by Figs. 13, 16 to 19, 29 to 31) and, on the other hand said transverse frames or formers eventually assembled together with auxiliary structures such as floor 7 and part or the whole of means of fixation with the skin and stringer unit, and these last mentioned units are brought around the frames or formers and fixed thereto.

It will be supposed, in the following description that this method is employed, and this leads to describe first the method for constructing the skin and assembling the stringers therewith, then the method for the fixation of the angle irons, and finally that for the mounting and assembly of the frames and formers.

Concerning the construction of the skin and stringer units, I make use of positioning means arranged in such manner as to permit the following possibilities:

a. Maintaining the elementary metal sheets 2 the juxtaposition of which constitutes the skin, these metal sheets being cut in advance in any suitable manner with, eventually (for instance in the case of section II) a shaping into the desired form (by stamping or otherwise) and also eventually with the driving of the rivet holes;

b. Maintaining also the stringers 3, either all

simultaneously or, preferably, successively as they are being fixed in position, these stringers having been previously provided with holes;

c. Advantageously, guiding the riveting apparatus (or the welding apparatus, as the case may be).

For instance, these positioning means are made as follows:

On the one hand, there is a frame 9, 10 (Figs. 2 and 5, or 8 to 12) on which metal sheets 2 can be successively adapted. On the other hand, there is at least one band or plate 11, adapted to be used as temporary support for at least one of the stringers, this band being therefore capable of occupying, with reference to said frame 9, 10, several relative positions which are accurately determined. Finally, means are provided for ensuring the temporary fixation of the metal sheets or stringers on their supports.

Preferably (but not exclusively, as it will result from the description of Figs. 8 to 12) the whole is given a shape corresponding to that to be given to the skin of the fuselage, which is of course necessary in the case of a section of the shape of section II.

In this latter case, it is advantageous to arrange the system above described in such manner that it can pivot about a longitudinal shaft 12, being if necessary balanced by a counterweight, such an arrangement permitting, among other advantages, of working on a band 11 which is always located substantially at the same level.

As shown by way of example by Figs. 2 to 7, this carcass includes an L-sectional iron 8, from which the work is started, and several transverse bent bars 10, for instance two at the respective ends and one at the middle, the whole being carried by a pivoting support including several transverse plates 14 mounted on shaft or hub 12, with bracing members 15 interconnecting them. This hub, supported by rollers 16 is advantageously eccentric with respect to the axis of revolution of the skin or covering (that is to say the axis coinciding with the centers of curved members 10) in such manner as to facilitate the work. Finally, it has been supposed that the bent members 10 extend over portions of circumferences smaller than 180°, which corresponds to portions of covering of section II. But, of course, they might extend over portions corresponding to 180°, for instance for the construction of section III.

It is along these curved member 10 that band 11 must be displaced. Preferably, this band 11 is divided into two distinct elements which are shown of curved or rounded shape, so as to correspond to the shape of section II. In order to determine the exact relative positions of these two elements, I make use, for instance, of spindles 17 carried by said bands 11 and adapted to engage in holes 18 provided in curved members 10.

The bands 11 are for instance provided, at each of their ends, with two spindles 17<sup>1</sup>, 17<sup>2</sup> at least one of which, to wit 17<sup>1</sup> is mounted against the action of spring 13. At the time of the mounting, the workmen can thus first engage spring spindles 17<sup>1</sup> into the corresponding holes 18 (Figs. 4 and 5) after which they cause the band 11 to pivot about the axis of said spindles. When it has been brought into its correct position against metal sheet 2, the other spindles or pins 17<sup>2</sup> are located opposite their holes and they must be driven thereinto. They act as locking means. These spindles or pins 17<sup>2</sup>, might themselves be spring mounted, with a bayonet device which

would permit of keeping them away from the band, prior to the locking.

Of course, the bands 11 are given a shape such, and they are fitted with means such, that they can support stringers 3 and permit the riveting work.

For this purpose, for instance, on the one hand, these bands 11 are provided with a groove 19 against which it is possible to apply in correct position stringers 3 (Figs. 4 and 5), in combination with compressing means, such as hooks 20, provided with springs 21.

On the other hand, in order to ensure the guiding of the riveting apparatus 22, I provide, for instance, rolling tracks along a ridge 23, against which rolling tracks run rollers 24 of the apparatus in question.

The pivoting carcass thus made is completed by means for holding metal sheets 2, on the one hand, against bent members 10 and, on the other hand, against bottom iron 9 (for the first metal sheet). These means consisting for instance of lugs 25, 26, with tightening bolts 27, 28 (Figs. 6 and 7). The bent members 11 are further provided with recesses 29 for the passage of the stringers (Fig. 5).

Finally, the pivoting carcass is supported by a fixed frame 30, 31, including at its upper part a roller track 32 for carrying the riveting apparatus.

I thus obtain a device which permits of carrying out the mounting and the assembly, both of the metal sheets together and of the stringers with the metal sheets, in the minimum of time and with an accuracy which had never been obtained up to this time.

The first sheet 2 being fixed on sectional iron 9 and on bent members 10, the riveting is effected successively along the various lines of rivets corresponding to the stringers, by making use of bands 11, which are displaced, for each operation. Then the next metal sheet is posed (the joint being of the overlapping type as visible at 33, Fig. 5), and so on. Eventually, the movements of displacement of the bands 11 might be conjugated with the displacements of rotation of the pivoting carcass.

I go without saying that the method above described might be applied to the driving of holes through the metal sheets and the stringers or to any other operation to be performed on these elements. I might also, instead of riveting on the said carcass, only effect a securing of the parts together (by means for instance of some screws and nuts), the riveting being performed on another machine.

I might also, instead of utilizing, as shown by the drawings, one or several manually operated riveting machines, apply the method just above specified to an automatic riveting machine such as above described in a prior patent application and including a stationary comb-like element intended to support the metal sheets and stringers, along which element can move one of several carriages provided with driving and riveting tools. According to said method, the function of the comb-like element might be performed by band 11, arranged in a suitable manner and which can then be fixed. With this fixed comb-like member, might coact a carcass 9, 10 which would be displaced relatively to said comb-like member every time a line of rivets would be finished, and which would thus permit of exactly positioning the metal sheet and stringer of the next line of rivets. This carcass might be piv-

oting as above or, on the contrary, displaceable with a translatory movement, if the work is carried out along a plane surface as it will now be explained.

In Figs. 8 to 12, I have shown as it is possible, in the case of developable surfaces, (for instance for section III, Fig. 1, if it is of conical shape) to carry out the method according to the invention in a plane surface.

In this application, carcass 9, 10 will be carried by a flat surface 34<sup>1</sup>, for instance hanging vertically, or even slightly obliquely, from a support 34. In this case, stringers 10 are arranged in the plane according to the lines of development of the bases or sections of one half of a cone (along 180° of profile). The same positioning members (band 11) fixation members and assembling members can be employed and in Figs. 8 to 12, they are designated by the same reference numbers as in Figs. 2 to 7.

If, as supposed in the case of Figs. 8 to 12, the carcass is stationary, supports or platforms 35, guided at 36, are provided for enabling the workmen to work along the lines of rivets. But it would also be possible to work at constant height by displacing carcass 9, 10 (it would also be possible to work horizontally instead of vertically).

Having thus obtained, in one way or another, portions of skin or covering 2, provided with their stringers 3 and eventually with longitudinal bars 4, and supposing that it is now desired to fix on the stringers and the longitudinal bars, angle plates 8, it will be advantageous to have recourse to the methods above described, that is to say employ positioning means capable of supporting the respective elements to be assembled and of ensuring relative positions of said elements which are perfectly determined, while making it possible to carry out, or at least to start, the riveting.

In this case also it will be possible to act either on a skin-stringer unit which has been given the form it must have in the structure, as shown by Figs. 13 to 22, or on a unit of this kind supposed to be developed, every time such a development is possible (Fig. 24).

I will first suppose that the first of these solutions is adopted. The above mentioned means are arranged in such manner that they permit of engaging the skin-stringers unit against a kind of cradle of suitable shape which acts as pattern.

For instance, according to the embodiment shown by Figs. 13 to 22, and supposing that the process is applied to conical section 3, (it being well understood that said method would apply as well to section II provided the curved section thereof in the longitudinal direction is taken into account for the forward fed of the cradle and the positioning means), the cradle is essentially constituted by a plurality of metallic sheets 37, cut away in corresponding relation with the outer profile of the fuselage, and arranged in such manner as to be preferably at the level of the transverse frames and formers, these plates being carried by a support 38.

As for the positioning means, they are constituted by curved members 39 adapted to come opposite the plates 37 of the cradle, these curved members including recesses at 40 for the passage of the stringers and of the longitudinal bars and being fitted with supports for receiving the angle plates and ensuring their mounting.

Advantageously, these curved members are mounted in a pivoting manner, being for in-

stance movable, at one of their ends, about spindles 41 passing through supports 42 and adapted to be secured, at their other ends, at 43, in similar supports. Finally these curved members may be provided, on the side of the ends opposed to those provided with pivoting axes, with a movable part 39<sup>1</sup>, pivoted at 44 and including recesses 40<sup>1</sup> analogous to recesses 40, this in order to ensure a perfect disengagement (Fig. 20). A device 74 (Fig. 1) permits of interconnecting, at the time of the mounting, parts 39 and 39<sup>1</sup>.

It will be readily understood that, when the whole is set in position, the skin or covering, together with its stringers, can be rigidly held between the metal sheets of the cradle, 37, and the ridges of curved members 39 extending between recesses 40 or 40<sup>1</sup>. It is then possible to effect, with a high accuracy, the positioning and assembly of the angle plates which will have previously been adapted to said supports of the curved members.

As for these supports they are advantageously arranged as follows:

They include lugs 45 adapted to penetrate into at least some of the holes 46 provided in the angle plates for the riveting thereof on the frames or formers (Figs. 16 and 17).

They must permit, once these angle plates are in position, of keeping them in said position, for instance by means of pivoting hooks 47 carried by the curved members and subjected to the action of springs 49.

Figs. 18 and 19 illustrate analogous arrangements for fitting in position angle plates on longitudinal bars 4, the whole being, preferably, carried by plates 75 displaceable with respect to curved members 39.

Such arrangements permit, not only of obtaining a high accuracy in the assemblies, but also of having easy reach to the riveting apparatus and the riveting holes shown at 46 in Fig. 17.

Of course, the whole is arranged in such manner as to permit, once the riveting operation is finished, of disengaging the curved members. This result is obtained, for instance, in the following manner:

On the one hand, these curved members are adapted to undergo some transverse displacements, being for instance mounted with a certain play *j* (at least equal to the length of lugs 45) in their supports 42 (Fig. 22), and tightening means 50 being provided for ensuring the positioning in assembly position (shown by Fig. 22) and for ensuring, after releasing, said lateral displacements.

And, on the other hand, concerning hooks 47, they are mounted in such manner that they can, in position of rest, be retracted into holes such as 51 (Figs. 16 and 17), in such manner that they do not project from the face of the curved members located on the side of the angle plates.

Finally, the device above described may be completed by means for facilitating the obtaining, in the course of the mounting and the riveting, of a good pressure of application of the curved members on the skin or covering and the cradle. These means may consist in the provision, on each curved member (or on several curved members if they are conjugated) of an eccentric 52 combined with pin 43 which, for instance extends therethrough, this eccentric being operated through a hand control member 53 (Fig. 15a).

I have thus obtained a mounting system which permits of effecting the mounting of the angle



plates on one half of the covering or skin of section III (or any other section, for instance a portion of section II obtained on the device of Figs. 2 to 7) and which would also permit of making the other half, although it is also possible, for the latter, to work in connection with the mounting device intended for the assembly of the frames and formers and which will be hereinafter described with reference to Figs. 25 to 32.

In the case of developable sections of the fuselage, it would of course be possible to adapt the method above set forth to the case of the work being carried out in a plan.

As a matter of fact, if the whole obtained after assembly by means of the device of Figs. 13 to 22 is developed, I obtain a figure such as 23, in which the angle plates are disposed along arcs *a*, *b*, etc. Of course, it will be possible, in order to effect the assembly of the angle plates in a plane, to position them by means of curved bands 54 replacing said curved members 39 and which may be provided with the same supports for the angle plates as them. The whole thus obtained can subsequently be very easily curved and transferred to the devices which will now be described. It should be noted that the arrangement of Fig. 24 might be combined with those of Figs. 8 to 12.

Concerning the assembly of the skin-stringers-angle plates units with the frames and formers, it is carried out by means such that these units in the final shape they are to occupy, always through positioning means analogous to those above described, the frames and formers being themselves maintained in the correct relative positions.

For this purpose, it is advantageous to have recourse to a device of the same kind as that of Figs. 13 to 22 but in which the curved members 39 are arranged in such manner as to be able to position the frames and formers, preferably after having also positioned the angle plates with respect to the portion of the skin or covering placed in the cradle (Figs. 25 to 31).

It suffices, for this purpose, to provide, for said curved members, a possibility of transverse displacement *j* in supports 42, of sufficient amplitude for taking into account, on the one hand, the stroke necessary for the disengagement of said lugs 43, and, on the other hand, the space *e* occupied by the frame or former, after its introduction between the angle plates 8 and the curved members 39 (Fig. 30).

I therefore proceed to the mounting of the gussets, as above indicated. Then, once this has been done, the curved members are suitably disengaged and the frames or formers 6 are set in position (Figs. 29 to 31). I then exert, by means of the curved members and means such as eccentrics 52, a new pressure toward cradle 37, said curved members being for instance provided, from place to place, with projections 55 intended to act as abutments against the wings 56 of the frames or formers (Fig. 30).

At this time, everything is in position for permitting the riveting of the frames or formers on the angle plates, which can be done immediately, if there is sufficient room for this. Notches may eventually be provided for this purpose in the curved members for the passage of the tools.

It is also possible, as shown, to effect a temporary fixation, by vices 57 or any other means; each curved member 39 is then moved backward so as to permit the approach of the riveting tools (Fig. 31). In this position, it is still possible to maintain the pressure exerted on the skin,

wedges 52 being interposed so as to make allowance for the conical shape of said skin.

I have thus riveted the frames or formers on one half (or in any kind a portion) of the whole constituted by the skin, the stringers and the angle plates. There remains to effect the assembly on the other half or part (for instance that established on the device of Figs. 13 to 22). For this purpose, this half is adapted above the elements 6 (Fig. 25) and it is very tightly held, eventually by making use of external curved members 59 (Figs. 25 and 27) which exert a pressure on the whole, which curved members can be removed after the squeezing operation.

Concerning the riveting of this second portion, it can be effected when the whole is in the horizontal position. But, on the other hand, this may be awkward. Therefore, it is sometimes interesting, according to another feature of the invention, to pivot the whole of the cradle and of the section of fuselage fixed thereto in such manner that said whole is disposed vertically, the workman or workmen being then able to work on a platform movable on the inside of the fuselage section.

For this purpose, the elements of cradle 37, instead of being carried by the fixed frame 38 are carried by a movable support 60 which can be mounted in a pivoting manner about an axis 61, the whole being operable by means of a cable 62 passing on a pulley 63 carried by a pillar 64 and ending on a winch 65, with the provision, of course, of locking means 68, 67.

At 66 (Figs. 25 and 26) I have shown a shaft or pit in which can move the portions of longitudinal bars 4 which may eventually project from section III (which portions are intended to come to assemble with the covering or skin of section II, and on the inside thereof).

Concerning the mounting of the frames and formers 5, 6 of this curved section II, it is possible either to proceed as above set forth, or of using floor 7 for positioning these elements 5, 6, which may previously have been assembled on this floor, for subsequently receiving the skin-stringers or skin-stringers-angle plates units. The whole can be carried out in line with a section III which has already been constructed, in such manner as to perform the assembly of section II on the extensions of the longitudinal bars 4 of section III.

I may further make use, for the assembly of the various sections, of connecting or coupling rims provided at the ends of said sections, according to the method set forth in the French patent application Ser. No. 441,519 above mentioned.

It should be noted that the assembly, in order to be absolutely accurate with the methods above set forth, calls for formers and frames 6, 5 of highly accurate outline, same as the elements of cradle 37.

For this purpose, it is advantageous to have recourse to arrangements already set forth in prior patent applications filed by me and according to which, starting for instance from two half-frames extending over 180° and of an outline well determined on a pattern (circular in the present case), and intending to assemble them together by means of fish-joints 69 (Figs. 32 and 33) in order to obtain a closed and perfectly circular frame or former, I proceed as follows: I effect the riveting of these joints on moulds or patterns 70, 71, of a shape corresponding exactly to that of the finished frame or former and

against which the halves of the element (frame or former) are fixed, by securing at 72, during the operation of riveting of the joint 68, which operation takes place through passage 73 and others provided in the pattern. The whole can be carried by a table 74 having expansible arms 75, 76, which can be adapted to a whole set of frames or formers of different diameters.

The chief advantages of the system according to the invention are the following:

The assemblies are effected with a high accuracy;

The structures can be caused to work under conditions of perfect homogeneity, which increases their resistance;

Quantity production is made easy.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition, and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

FELIX AMIOT.