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J. E. F. GOBIN DIT DAUDÉ
RIVETED JOINTS
Filed Aug. 8, 1941

Serial No.
406,072
3 Sheets-Sheet 1

Fig. 1

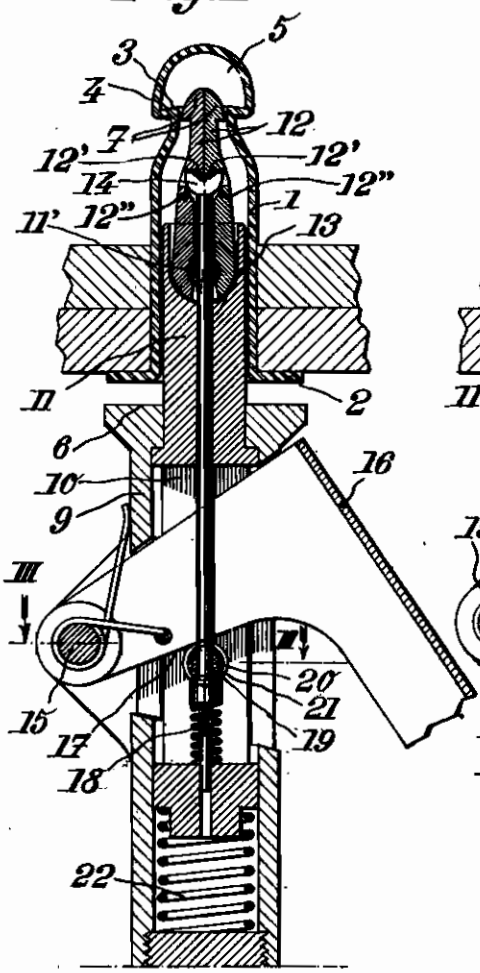

Fig. 2

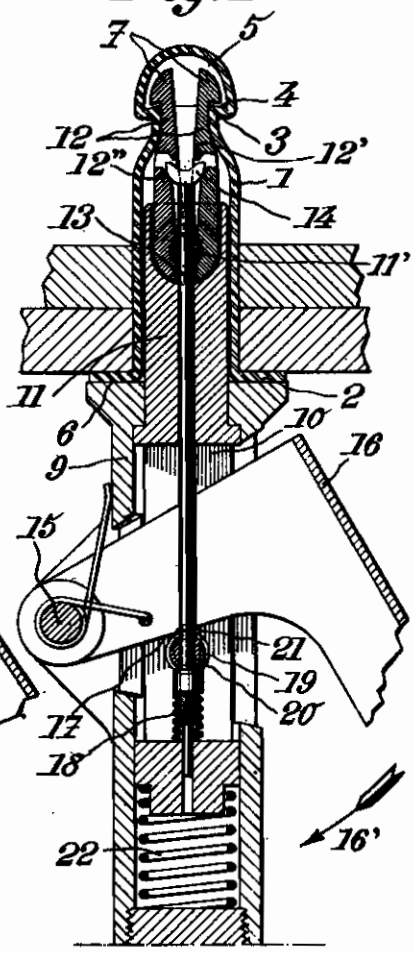

Fig. 3

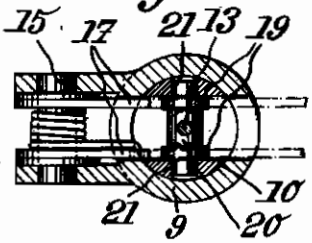

Fig. 4

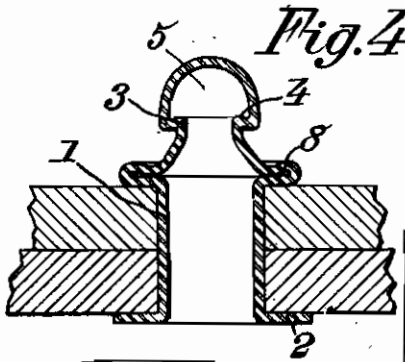

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Fig. 5

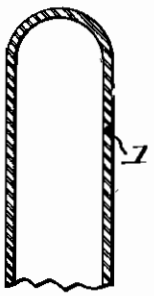

Fig. 6

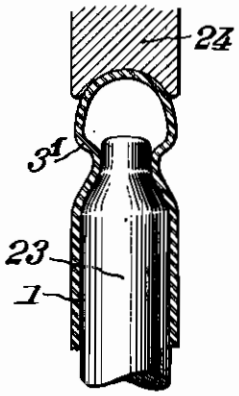

Fig. 7

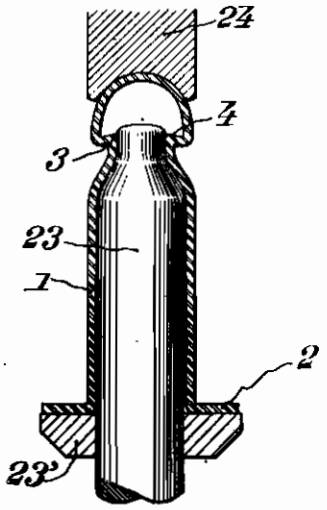

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Fig. 9

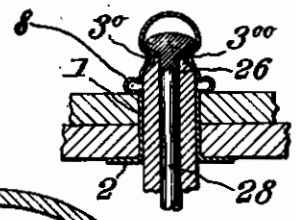


Fig. 11

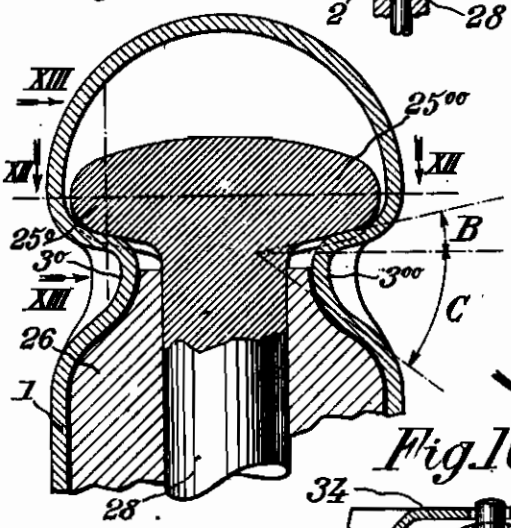


Fig. 12

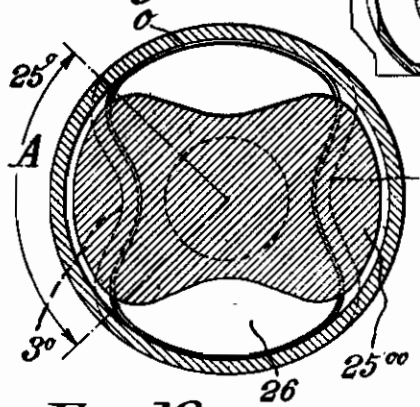


Fig. 13

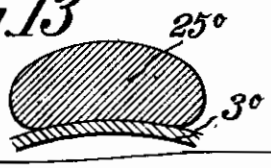


Fig. 8

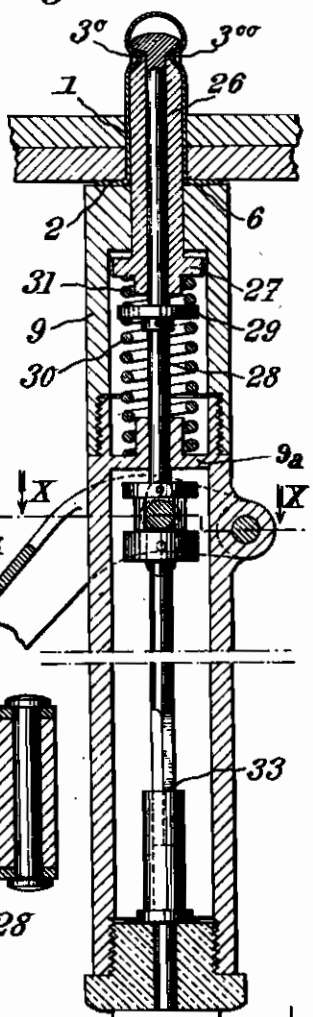
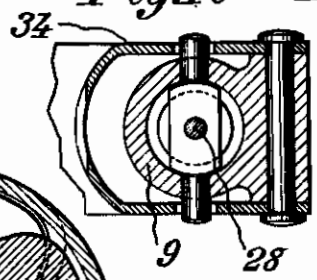
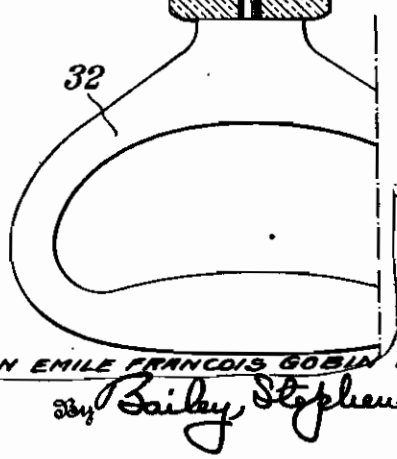


Fig. 10





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ALIEN PROPERTY CUSTODIAN

RIVETED JOINTS

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Application filed August 8, 1941

The present invention relates to riveted joints and more especially to those in which it is not possible to have access to one of the sides of the joint for riveting purposes.

The object of the present invention is to provide a riveting system which is better adapted to meet the requirements of practice than those used for the same purpose up to this time.

It has already been suggested, in the case of a riveted joint of the type above referred to, to make use of a hollow or tubular rivet provided, at one end (the outer or accessible end) with a flange adapted to bear against the corresponding face of the joint, and, at the other end (inner end located on the side of the joint which is not accessible) with anchoring means adapted to cooperate temporarily with a pulling tool engaged in the hollow rivet. Such a rivet was introduced, from the outer side (or front side) of the joint, into the holes provided in the parts of the joint, after which it was subjected, through any suitable means, to a combined compression exerted on the outer end and traction exerted on the inner end. The rivet was thus axially compressed and deformed so as to form a flange-like annular bulge against the rear face of the joint. The pulling member was then removed and the operation was finished.

According to an essential feature of the present invention, I provide a hollow rivet the inner end of which forms at least one inward projection adapted to cooperate with a corresponding portion of the pulling element of the riveting tool, said portion being adapted, in a relative position thereof, to be introduced through the hollow of the rivet past the restricted orifice left by the inward projection thereof, and, in another relative position, to bear against said projection so as to enable the pulling element of the riveting tool to crush the rivet in such manner as to form the desired annular bulge against the rear face of the joint.

According to another feature of the present invention, the riveting tool includes a mandrel adapted to fill with a slight play at least a part of the portion of the rivet that is to be deformed under the effect of the axial compression thereof, so as to avoid an inward deformation of this portion.

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 large scale axial section of a rivet, together with the riveting tool inserted therein, the whole being made according to a first embodiment of the invention;

Fig. 2 is a view, similar to Fig. 1, showing the parts in a position corresponding to a further step of the operation;

Fig. 3 is a section on the line III—III of Fig. 1;

Fig. 4 is a sectional view of the rivet, after fixation thereof;

Figs. 5, 6 and 7 are three sectional views illustrating three successive steps of the manufacture of a rivet of the kind shown by Figs. 1 and 2;

Fig. 8 is a view similar to Fig. 1, showing a riveting system made according to a second embodiment of the invention;

Fig. 9 is a partial view of the system of Fig. 8, showing another step of the riveting operation, to wit the end of this operation;

Fig. 10 is a sectional view on the line X—X of Fig. 8;

Fig. 11 shows, on an enlarged scale, the upper portion of Fig. 8;

Fig. 12 is a sectional view on the line XII—XII of Fig. 11;

Fig. 13 is a partial section on the line XIII—XIII of Fig. 11.

The rivet 1 used according to the invention is a blind tubular member, of general cylindrical or slightly conical shape. In the following description, it will be supposed that it is cylindrical, as shown by the drawings.

This member 1 is provided, at its outer (or front) end with a flange 2 through which the rivet bears against the front face of the joint.

Near its inner (or rear) end, member 1 is provided with an inward projection obtained by deformation of the metal thereof.

According to an embodiment of the invention (illustrated by Figs. 1 to 7), this inward projection forms an annular inner ridge 3. Advantageously, the portion 4 of this ridge which faces the inner end of the rivet is a frusto-conical surface of large apex angle (170° for instance) having its smaller base closer to the inner end of the rivet than its larger base.

This ridge 3 is positioned on the rivet shank at such a distance from the inner end thereof that a blind space 5 of a height approximating the diameter of said rivet is formed beyond said ridge.

The riveting tool to be used with a rivet of this kind includes the following chief elements:

a. A supporting element for the rivet, having

for instance the shape of a finger on which the rivet can be slipped;

b. An abutment **6** for flange **2**;

c. A pulling member including an expanding head with gripping means **7**, this head being capable, in the retracted position of said means **7**, of passing through the aperture left by projection **3**;

d. Means for causing said head to expand so that means **7** come into engagement with surface **4**; and

e. Means for causing the expanding head and abutment **6** to move toward each other, so as to obtain the axial compression of the shank and the formation of flange **8** (Fig. 4).

Of course, the specific construction of this riveting tool, the chief characteristic of which is the provision of the expanding head thereof, with its gripping means and the means for expanding and retraeting said gripping means, may correspond to many different embodiments.

The particular embodiment illustrated by Figs. 1 and 2 includes the following parts:

a. A stirrup **10** slidable in a body **9** and integral with a finger **11** adapted to aet as an inner support for the rivet;

b. Two small levers **12** pivoted to the free end of this finger **11** and each provided, at its end, with a hook **7**;

c. A pulling rod **13** slidable axially in said finger **11** and provided, at its upper end, with a cam **14** eapable, by coacting with parts **12** and **12'**, of expanding or retracting hooks **7** according as rod **13** is being pulled or, on the contrary, pushed, respectively; and

d. A lever **16**, pivoted about a spindle **15** carried by body **9**, and adapted, when pivoted downwardly, first to pull rod **13** downwardly, so as to expand hooks **7**, previously introduced into chamber **5**, and then to pull stirrup **10** downwardly, so as to compress the rivet shank and to form flange **8**.

For this purpose, inclined edges **17**, carried by lever **16**, are adapted first to push, against the actlon of a spring **18**, small rollers **19** mounted on a spindle **20** rigid with rod **13** and the ends of whieh are engaged in slots **21** provided in the wall of stirrup **10** (Figs. 1 to 3), so as to move said rollers downwardly. Of course, these slots are made of such a length that the relative displacement of rod **13** with respect to stirrup **10** is stopped when hooks **7** are moved apart the desired distance.

It will be readily understood that, once the play provided by slots **21** has been caught up, the movement of spindle **20** causes stlrrup **10** to be dlsplaeed downwardly against the action of spring **22**.

The displacement of lever **16** in the opposed direction causes, after the riveting operation has been performed, stirrup **10**, and therefore hooks **7**, to be moved upwardly, and said hooks to be brought close to each other into the relative position illustrated by Fig. 1, after which finger **11** can be removed from the inside of the rivet.

Of course, the rivets to be utilised for carrying out the invention as just above explained may be made in any suitable manner. However, I have found that it is advantageous to have recourse to the method illustrated by Figs. 5 to 7 inclusive.

According to this method, I start from a stamped blank the inner end of which is preferably semi-spherical (Fig. 5).

The shank is then deformed, at the proper level, so as to form an inward projection 3^1 of the shape shown by Fig. 6, which includes no undercut portion for the shaping tool.

I then introduced into the shank thus shaped a mandrel **23** of a diameter corresponding to that of said shank and capable of supporting the lower portion of inner ridge 3^1, as shown by Fig. 6.

Finally, I exert an axial thrust on the upper end of the shank by means of a concave punch **24**, while mandrel **23** is maintained in position. Under the effect of this thrust, the lower portion of inner ridge 3^1, which is supported by mandrel **23**, keeps its initial shape, but the upper portion of said ridge is deformed and given the inclination above described which is to be obtained for surface **4** (Fig. 7).

Of course, if necessary, I provide means for preventing deformation of said lower portion of ridge 3^1 when punch **24** is acting on the rivet shank, said means consisting, for instance, of an abutment **23'** rigid with mandrel **23** and against which the flange **2** of the rivet comes to bear.

I will now describe a second embodiment of my invention illustrated by Figs. 8 to 13.

In this case, I give the metal shank, otherwise made as above described, instead of the inner annular ridge **3**, at least one inward projection extending over only a portion of the periphery of said shank.

The riveting tool is provided with a head earrying, preferably in a fixed manner, at least one outward projection capable of passing, when suitably positioned, through the restrieted orifice left free by the inward projection of the shank. After it has thus been inserted past the inward projection of the shank, the outward projection of the tool can be brought, by suitably turning said tool about the axis of the shank, into a position such that these two projections engage each other when the tool is being pulled backward.

In the example illustrated by Figs. 8 to 13 inclusive, the elements above mentioned are made as follows:

The rivet shank includes two inward projections 3^0 and 3^{00}, diametrally opposed and symmetrical (Fig. 12), these projections extending each (in section by a plane at right angles to the axis of the rivet shank) over an angle A smaller than 180° and for instance equal to 90°.

Advantageously, these projections are given the shape clearly shown by Figs. 11 to 13, that is to say, in particular, a shape eomplying with the following conditions:

a. In section by the bi-sector plane of angle A (that is to say as shown by Fig. 11), the mean inclination B of that of the faees of the inward projection which faces the inner end of the rivet is relatively small, say 10°, while the mean inclination C of the other face of the inward projection may be much greater, in order to facilitate stamping; and

b. At least some of the sections of the projection of the shank by planes parallel to the axis of the rivet and perpendicular to the bi-seetor plane of angle A (such for instance as the section shown by Fig. 13) show, for the face of said inward projection which faces the inner end of the rivet, a convexity turned toward said inner end.

As for the riveting tool, it includes the following essential elements:

a. An element for supporting the rivet, this element consisting for instance of finger on which the rivet can be slipped;

b. An abutment **6** for flange **2**;

c. Pulling means including a head provided

with two opposed outward projections 25^0 and 25^{00} complying with the conditions above set forth and the active faces of which (adapted to come into contact with inward projections 3^0 and 3^{00} for exerting thereon the necessary thrust) have a concavity (Fig. 13) corresponding to the convexity of the corresponding faces of said inward projections; and

d. Means for exerting on said pulling means the effort necessary for deforming the rivet shank so as to form a flange thereon.

In the particular embodiment illustrated by Figs. 8 and 9, the rivet supporting member consists of a finger **26** adapted to slide in a body **9**, this finger being provided with a shoulder or abutment **27** adapted to slide in an enlarged portion of said body **9**.

The means for exerting the necessary pull consists of a rod **28** adapted to slide axially in finger **26**, this rod including a head, projecting from the free end of finger **26** and provided with the outward projections 25^0 and 25^{00}. Rod **23** is further provided with a collar **29**, slidable inside body **9**.

A spring **30** is interposed between this collar **29** and a partition **9***a* within body **9**, so as to push rod **28** upwardly.

Another spring, to wit **31**, is interposed between collar **29** and abutment **27**.

I provide, at the lower end of rod **28**, means for turning said rod about its axis, such means consisting, for instance, of a rotatable handle **32** provided with a socket **33** of square-shaped inner section in which the square end of rod **26** can slide.

Finally, a lever **34** is pivoted to body 9 and adapted to impart the necessary axial displacements to rod **28**.

With such a tool, it will readily be understood that, at rest, spring **30** pushes upwardly the free end of rod **28** and also, through spring **31**, the free end of finger **26**.

The rivet to be fitted can then be mounted on the riveting tool in the position shown by Figs. 8 and 11.

When, after having inserted said rivet in the holes of the plates to be assembled together by riveting, rod **28** is pulled downwardly by means of lever **34**, the rivet shank is crushed against the rear face of the inner plate, as a consequence of the thrust transmitted to the inward projections 3^0 and 3^{00} of the rivet shank by the outward projections 25^0 and 25^{00} of the head of rod **28**.

After the riveting has thus been performed, it suffices, after having released lever **34**, to turn handle **32** through 90° for bringing the respective projections of rod **28** and rivet **1** out of engagement with one another. The riveting tool can then be slipped out from the rivet.

The preceding description makes it unnecessary to enter into further explanations concerning the operation and advantages of the riveting system according to the invention.

According to still another feature of the invention, which may be used separately, the riveting tool is provided with a mandrel capable of filling with a slight play at least a part of the portion of the inside of the rivet which corresponds to the zone in which said rivet is liable to deform under the effect of the axial thrust to which it is subjected.

For instance, in the case of the riveting tool illustrated by Figs. 8 and 9, finger **26** is made of such shape that it fills substantially the whole of the inside of the rivet, from the outer end thereof to the level of the maximum depth of the inward projections 3^0, 3^{00} thereof.

Thus, the end of finger **26** is made of a shape corresponding to the axial section shown by Fig. 11 and the cross section shown by Fig. 12 (line **0** of this last mentioned Fig.), whereby said finger supports the portions of the wall of the rivet located between the inward projections 3^0 and 3^{00} thereof and prevents said portions from being moved toward each other under the effect of the axial thrust exerted on said projections 3^0 and 3^{00} and which tends of course, to force these projections away from each other.

With such an arrangement of finger **26**, it is advantageous to place collar **29** in a position such that, at rest, projections 25^0 and 25^{00} are very close to the terminal edge of finger **26** but can be moved away therefrom, against the action of spring **37**, to such a distance that, once the rivet has been fully engaged on finger **26**, it is possible, by turning handle **32** while the rivet is kept in position, to cause projections 25^0 and 25^{00} to slip over projections 3^0 and 3^{00} and into engagement therewith.

When rod **28** is being pulled downwardly, finger **26** practically follows the movement of said rod and its presence inside the rivet prevents any deformation thereof toward the inside and ensures the satisfactory formation of the fixation flange resulting from the deformation of the metal shank **1**.

Of course, the above features are not limitative and for instance the bearing faces of inward projections 3^0 and 3^{00} might be concave instead of convex as shown by Fig. 13, while the corresponding faces of outward projections 25^0 and 25^{00} would be convex instead of concave as shown by the same Fig.

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.

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