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JUNE 1, 1943.
BY A. P. C.

F. VON OPEL
FASTENING DEVICES
Filed June 18, 1942

Serial No.
447,499
3 Sheets-Sheet 1

Fig. 1.

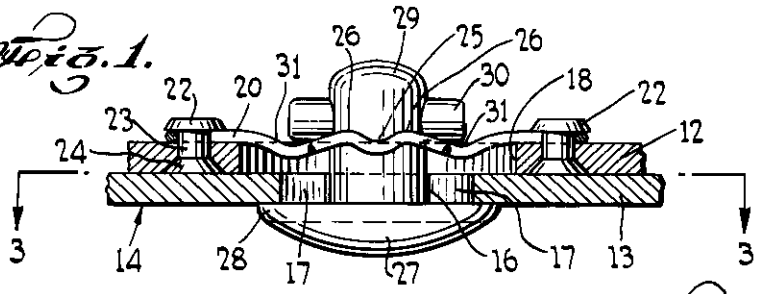

Fig. 2.

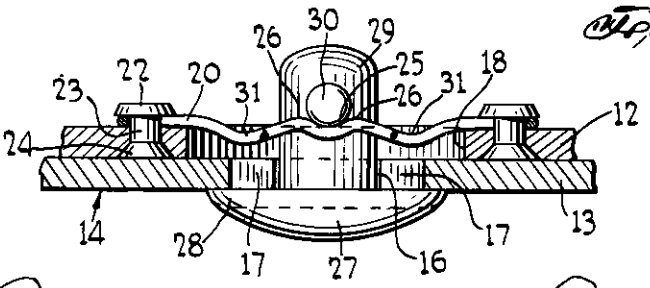

Fig. 3.

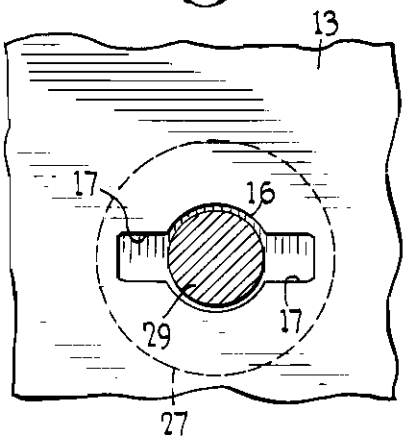

Fig. 4.

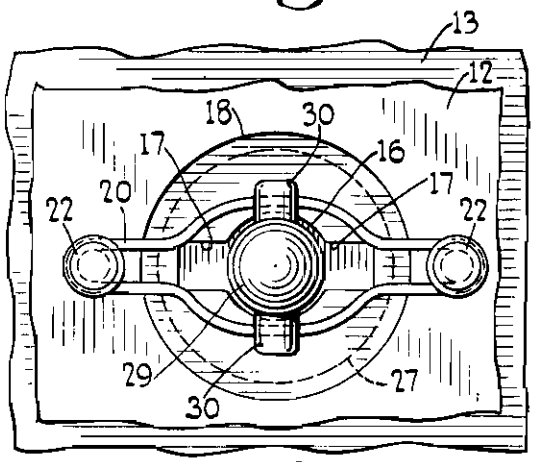

Fig. 5.

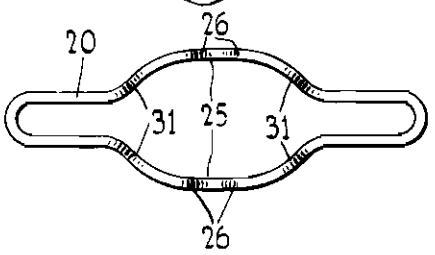

Fig. 6.

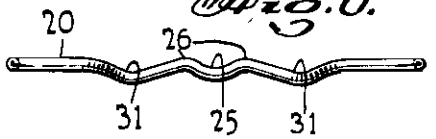

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Fig. 7.

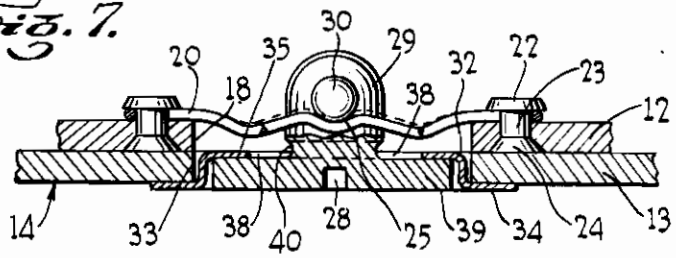


Fig. 9.

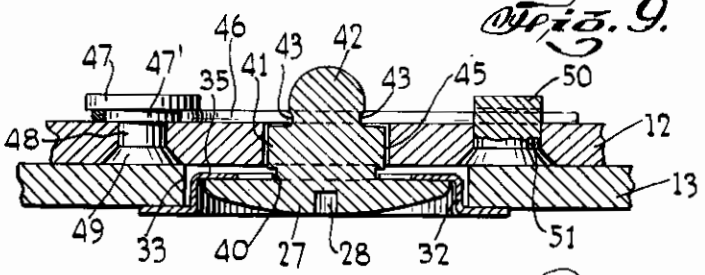


Fig. 8.

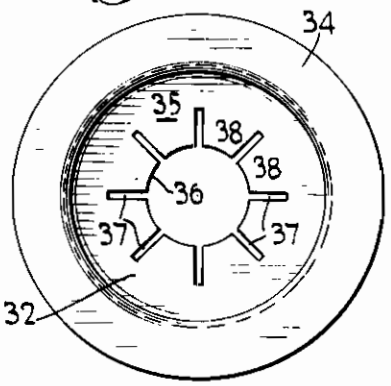
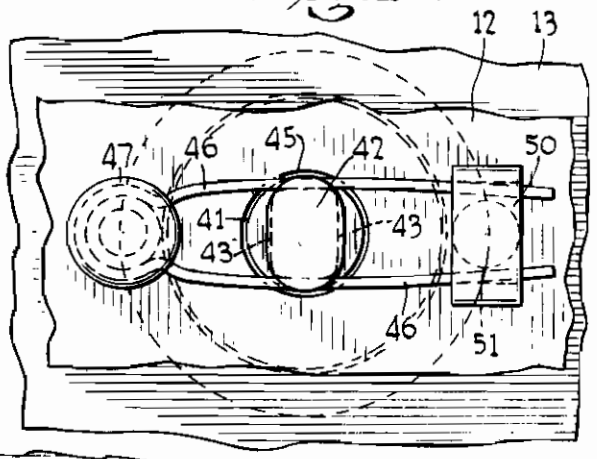


Fig. 10.



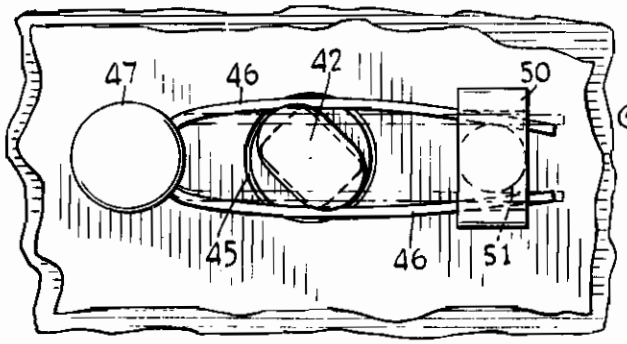


Fig. 11.

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Fig. 12a.

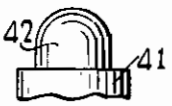


Fig. 12.

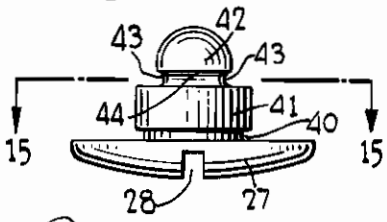


Fig. 13.

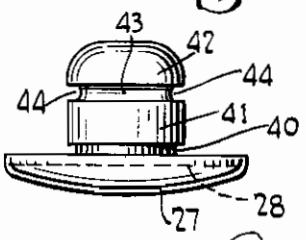


Fig. 14.

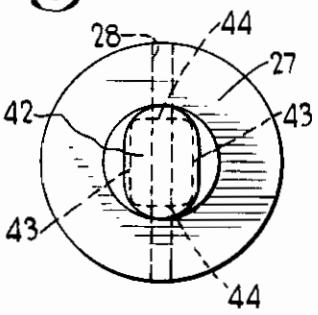


Fig. 16.

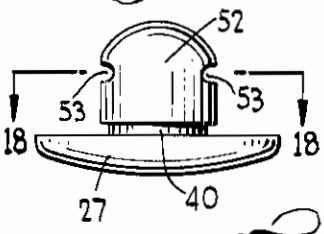


Fig. 17.

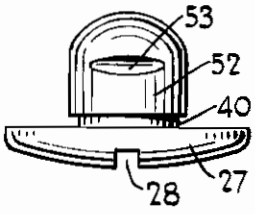


Fig. 19.

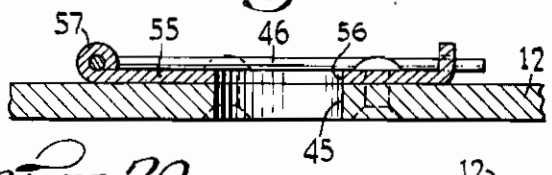


Fig. 15.

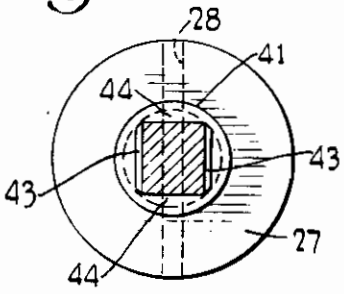


Fig. 20.

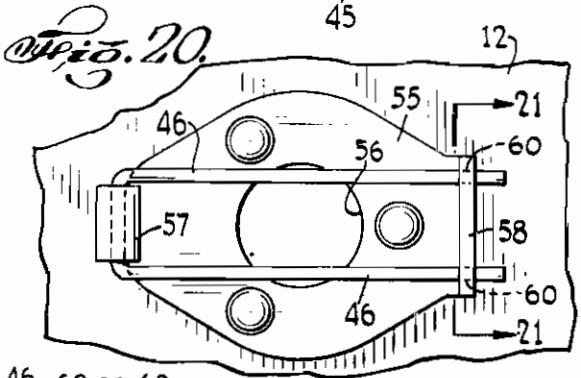
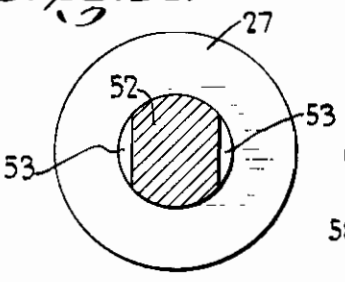


Fig. 18.



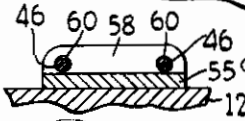
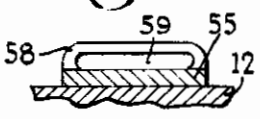


Fig. 21.

Fig. 22.



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ALIEN PROPERTY CUSTODIAN

FASTENING DEVICES

Fritz von Opel, Miami, Fla.; vested in the Alien Property Custodian

Application filed June 18, 1942

This invention relates to fastening devices, in particular removable fasteners, to join two or more objects which are substantially flat at the joint, such as e. g. plates or sheets of metal, laminated material, and the like, through substantially registering holes in them of equal or different sizes.

In particular the invention relates to removable fastenings for connecting a cover of any suitable shape with another object, such as a cowling with the rim of a man hole or filling-in orifice of another hollow body, such as e. g. a part of the wing or fuselage of an aircraft or the body of a vehicle.

More specifically the invention is concerned with removable fastenings for joining in a lap-joint two or more flat objects, such as e. g. plates or sheets of metal, such as aluminum or an aluminum alloy, laminated plastic material, and the like, which are accessible only from one side.

This application also forms a continuation in part of my copending patent application Serial No. 431,625, filed Feb. 20, 1942. In this my copending application I suggested a fastener comprised of a shank and head, the latter provided with a kerf or other means for turning the fastener, and a dish-like member through which the shank of the fastener, is passed. The dish-like member is mounted in a hole of one of the bodies to be connected with another one, e. g. by soldering, welding, spot welding, riveting or the like the rim of a flange of the dish to the edge of the hole. The center portion of the dish-like member is provided with a center hole and radially cut in to form somewhat springy flaps which engage a circular groove on the shank of the fastener when it is pressed into the center hole whereby the fastener is held in place.

It has been suggested previously to provide the shank of fasteners of this type with two bayonet slots opposite one another, and to arrange a springy member across the hole in the plate which is to be fastened to another one so that the springy member engages the bayonet slots and is fixed therein upon turning the shank. This necessitated a relatively long shank of the fastener, and machining of the bayonet slots required considerable and accurate work. It has also been suggested to arrange a broad arcuated spring member across the hole in the plate which is to be fastened to another one, to rivet the ends of that member to that plate and to provide that member with a great number of slots and bent portions in order to permit riveting of it to the plate and passing the shank of the fastener and projections connected therewith through the member; after the shank has been passed through the slots, it was to be turned until its projections entered depressions in that springy member.

It is an object of the invention to simplify the manufacture of the elements of fastening devices of such type and their mounting.

It is another object of the invention to use more simple shapes for the elements of the fastening device which can be easily produced in inexpensive mass production and mounted in holes of regular, such as circular shape, without deforming the rims of the holes.

It is a particular object of the invention to use a pair of wire-like springy connecting members arranged across the hole through which the shank of the fastener is to be passed, and which engage the recessed and/or flattened shank from opposite sides so as to hold it in place when inserted and until it is turned into a blocking or fixing position.

It is a specific object of the invention to use a pair of wire-like springy connecting members arranged across the hole through which the shank of the fastener is to be passed so that these members are elastically deformed when a recessed and/or flattened shank portion is introduced between them and thereby hold the shank in place, and are preferably still more elastically deformed when or while the shank is forcibly turned by a predetermined angle into a blocking position in which said members engage a recessed portion of the shank.

These and other objects of the invention will be more clearly understood when the specification proceeds with reference to the drawings in which sveral features of the invention are exemplified.

In particular, Fig. 1 shows a cross section with parts in elevation through two sheets or plates connected by a fastener and springy connecting member according to the invention, with a fastener just being inserted; Fig. 2 a similar cross section as Fig. 1 with the fastener being turned by about 90° into its locking position; Fig. 3 a view along line 3—3 in Fig. 1; Fig. 4 a top view upon the two plates and the fastener in its locking position according to Fig. 2; Fig. 5 a top view and Fig. 6 a side view of the springy connecting member; Fig. 7 a cross section with parts in elevation of a modification of the invention with a fastener in its locking position; Fig. 8 a view from below of a dish-like member used in Fig. 7; Fig. 9 a cross section with parts in elevation of another modification of the invention; Fig. 10 a top view of that modification with the fastener in locking

position; Fig. 11 a similar top view with the fastener inserted and being turned toward its locking position; Figs. 12 and 12*a* in elevation a fastener as used in the modification of the invention according to Fig. 9; Fig. 13 a side view and Fig. 14 a top view of the fastener; Fig. 15 a cross section along line 15—15 in Fig. 12; Fig. 16 an elevation of another fastener and Fig. 17 a side view thereof; Fig. 18 a cross section along line 18—18 in Fig. 16; Fig. 19 a cross section with parts in elevation and Fig. 20 a top view of a member usable in connection with the modification shown in Figs. 9 to 11; and Figs. 21 and 22 cross sectional end views along line 21—21 in Fig. 20.

Referring to Figs. 1 to 6, there is supposed that two sheets or plates 12, 13 are to be connected in a lap-joint. Plate 12 may be of any suitable material as mentioned above and form the outside wall of a wing, fuselage or any other part of an air-craft or other vessel. Plate or sheet 13 may belong to another part of such air-craft or vessel which is to be fastened to it and removed easily and readily, such as a lid or cowling to cover a man hole or other opening in the body of that air-craft or vessel. In particular, it is assumed that plate 12 and therefore plate 13 are accessible from one side only, in this case from the outside 14.

Plate or sheet 13 is provided with a hole 16 which is extended to lateral slots or recesses 17. Plate or sheet 12 is provided with an opening 18 of preferably circular shape the diameter of which equals or is slightly larger than the largest dimension of slots 17 plus hole 18. On the non-accessible side of plate 12 a springy, loop-like connecting member 20 is fastened, for instance by means of rivets the heads 22 of which are large enough to completely cover the bent ends of connecting member 20. The shanks 23 of the rivets are passed through the bent ends each of member 20 as well as holes in plate 12. The free ends of shanks 23 form sunk heads 24 the outer surfaces of which lie flush with the outer surface of plate or sheet 12. Member 20 may be made e. g. of springy steel wire and shaped the way shown in Figs. 5 and 6. The two lateral ends of the elongated loop formed by member 20 are curved so that shanks 23 can be passed therethrough and also lie flat on the inside surface of plate 12. Where member 20 freely crosses hole 18, it is somewhat bent inside the hole and provided with a dent or groove 25. On both sides of groove 25, upwardly projecting ramps 26 are formed. The elongated loop-like member 20 is arranged across hole 18 preferably in such a manner that its longest dimension coincides with that of slots 17 when body 13 is placed upon body 12.

In this exemplification of the invention a fastener is used comprising a flat or well rounded head 27 provided with a kerf 29, and a shank 29 in a transverse hole of which a pin 30 is fitted. Pin 30 and kerf 28 are preferably arranged in parallel so that the workman inserting the fastener can ascertain the position of the pin (which is invisible to him) from the position of the kerf.

If body 13 is to be fastened to body 12, body 13 is positioned upon plate 12 in such a way that hole 18 and slots 17 register with opening 18 and, in particular, the axis of hole 18 coincides with that of hole 10. Thereupon shank 28 of the fastener with the projecting ends of pin 30 is passed respectively through hole 18 and slots 17 from the accessible side 14 of the bodies 12, 13 and thereafter the fastener is turned by means of a tool inserted in kerf 28 so that the projecting ends of pin 30 slide over the springy member 20 and its ramps 26, whereby member 20 is somewhat deformed elastically and pressed inside hole 18. After completion of a turn of about 90°, the projecting ends of pin 30 catch the grooves 25 while member 20 is preferably still somewhat deformed elastically and thereby holds firmly in place the projecting ends of pin 30. This blocked position of the fastener and projecting ends of pin 30 is shown in Figs. 2 and 4. The connecting member 20 if elastically deformed in the locking position, presses the bodies 12, 13 one against the other and thereby prevents relative movements thereof.

In order to facilitate the turning of the projecting ends of pin 30 over the connecting member 20, the latter is advantageously provided with depressions 31 on both sides of ramps 26; the depressions are preferably deeper than grooves 25 so that the ends of pin 30 do not deform member 20 when they pass over these depressions but are to press the ramps 26 downwardly and thereby elastically deform member 20; the latter may be still so deformed when the ends of pin 30 lie in the recesses 25 which are shallower than the depressions 31.

The arrangement according to Figs. 7 and 8 differs from that just described with reference to Figs. 1 to 6 in that the fastener is not inserted through a hole and slots in body 13 but a dish-like member 32 is provided for receiving the fastener. To this end, a preferably circular hole 33 is provided in body 13 preferably of the same size as hole 18 in body 12 (although these two holes may also be of different shape, size or diameter). The dish-like member comprises an outer flange 34 which is e. g. welded, soldered or riveted to body 13, and an either rigid or springy center portion 35 provided with a hole 38 from which slots 37 extend radially so that somewhat springy flaps 38 are formed between them. Across hole 18 member 20 is arranged and riveted to body 12 the same way as described herein previously.

The fastener consists e. g. of a flat head 38 provided with a kerf 28; shank 29 is grooved at 40 so as to receive the projecting ends of flaps 38 when the fastener is pressed through hole 38 the diameter of which is only slightly larger than the inner diameter of the circular groove 40. Pin 30 is tightly fitted into a transverse hole of shank 29 and preferably arranged parallel to kerf 29 so that the position of pin 30 can be recognized from the accessible outside 14 of body 13.

Before assembling bodies 12, 13, shank 29 is pressed through hole 38 and thereby fixed in its position relative to the dish-like member 32; thereafter pin 30 is driven through the hole of shank 29. Body 13 is then positioned upon body 12 so that holes 33 and 18 register and pin 30 is parallel to the longest dimension of the springy connecting member 20. Upon turning the fastener by about 90°, pin 30 rides over and deforms member 28 until the projecting ends of pin 30 snap into grooves 25 of member 20. In this locking position of pin 30 the member 20 is preferably still elastically deformed as described with reference to Figs. 1 to 6 whereby any loosening of the fastener is avoided.

It is obvious that body or plate 13 can be provided with any desired number of holes 33, members 32 mounted in those holes and the fastener,

in each member, so that each body 13 is ready for being mounted on another body 12.

Referring to Figs. 9 to 14, there is another form of fastener shown which can be used for the purposes of the invention. The fastener consists of a head 27 provided with a kerf 28, and a shank 41 the top 42 of which is rounded or tapers and is flattened on opposite sides, as to be seen best on Figs. 12, 13 and 14. The opposite flattened sides of the top portion of the shank preferably end into shallow grooves 43, and grooves 44 are provided on both front ends of that portion which are deeper than grooves 43 if the latter are present. Thus the distance between the grooves 43 is considerably smaller than that between the grooves 44, and the bottoms or apices of grooves 43 and 44, respectively, are substantially straight and parallel, resulting in a substantially rectangular cross section of the shank portion between those two pairs of grooves 43, 44. If grooves 43 are omitted, the flattened sides of top 42 extend to the cylindrical portion of shank 41 (Fig. 12a).

Referring to Figs. 9 and 10, plate or sheet 12 is provided with a hole 45 of slightly larger diameter than shank 41 and plate or sheet 13 is provided with a hole 33 of considerably larger diameter for receiving a dish-like member 32 of substantially the same type as shown and described above with reference to Figs. 7 and 8. The center portion 35 of that member is radially slotted and provided with a hole so that shank 41 may be pressed therethrough and the flaps formed in the center portion of dish 35 enter a circular groove 40 near the bottom end of shank 41.

Across hole 45 and on the non-accessible side of plate or sheet 12, a hairpin-like springy member 46 is mounted. A rivet is passed through the bent portion of member 46 so that an enlarged portion of its head 47 rests on and a reduced portion 47' lies within that bent portion, while its shank 48 passes a hole in body 12 and is secured therein by means of a sunk head 49. The free ends of member 46 are slidably held in place by means of a substantially E-shaped head 50 of a rivet the shank 51 of which is riveted into a hole of body 12. Instead, a bridge can be arranged across the ends of member 46 and welded, etc., onto body 12.

It will be appreciated that the two legs of hairpin 46 can be flexed or bowed apart, and that thereby elastic stresses are caused therein.

In securing body 13 to body 12, fastener 41 is turned in a position in which the larger dimension of its flattened top portion 42 is parallel to member 46 and is then pressed through the latter whereby the legs of member 46 are somewhat deformed and bowed apart and either frictionally hold the top or snap into grooves 43 if provided. Thereby the fastener is held in place preliminarily. If no such grip of member 46 on top 42 is desired, grooves 43 are omitted and the legs of member 46 spaced so that top 42 can freely pass between them. Thereupon the fastener is forcibly turned by about 90° by inserting a tool into its kerf 28, whereby the legs of member 46 are further flexed apart, as shown in Fig. 11, and finally snap into grooves 44, as shown in Fig. 18. It will be appreciated that by the large deformation of member 46 required for turning the fastener into its blocking position and for returning it therefrom, and the great elastic stress thereby caused in member 46, furthermore by the shape of grooves 44, the fastener is firmly held in its blocked position. It is therefore possible to also hold the fastener in its blocked position with non-flexed, stress-free legs of member 46.

In order to separate again body 13 from body 12, the fastener is to be returned forcibly from its position shown in Figs. 2 and 4 by means of a tool inserted in kerf 28 whereby connecting member 29 is elastically deformed. The same way the fastener is to be returned from its position shown in Figs. 9, 10. Thereupon body 13 falls off or can be pulled off body 12, the latter if the legs of member 46 engage grooves 43 or grip the flattened sides of top 42 frictionally.

Instead of using a flattened top of the fastener as just described, its shank 52 may be cylindrical throughout and provided with one pair of parallel grooves 53 only on opposite sides below its preferably tapered or rounded off top, as shown in Figs. 16, 17 and 18. It will be appreciated that upon pressing shank 52 of the fastener through hole 45 of body 12, Figs. 9, 10, into a position in which the full cylindrical portion of shank 52 is to pass between the legs of member 46, the latter are flexed apart to the greatest extent and engage with corresponding friction the surface of the shank. Upon turning the fastener by about 90°, grooves 53 arrive in front of the legs of member 46 which snap into those grooves but still remain elastically deformed and are thereby pressed into the grooves with desired force. Grooves 53 have substantially parallel and straight bottoms and thereby lock shank 52 in its final position. In order to return the fastener to its initial position in which it was inserted, a tool is to be inserted into kerf 28 and the fastener to be turned back by about 90° with considerable force.

Instead of mounting member 46 on body 12 by means of rivets, an intermediate member can be used. This member, Figs. 19 to 22, consists of a flat center portion 55 provided with a hole 56 to be aligned with hole 45 of body 12. At one end of portion 55, a projection 57 is provided and rolled to form a lug through which member 46 can be slipped. It is also possible to roll projection 57 over the bent portion of member 46 and thereby to hold the latter firmly in place. At the opposite end of portion 55 another projection 58 is arranged in which either a single broad slot 59 or individual holes 60 are provided; projection 58 is bent upwardly as shown in the drawings. The free ends of member 46 are slipped through slot 59 or holes 60 and thereby the springy connector 46 is held in place.

Member 55 may be spot welded, soldered, or, as shown, riveted to body 12 by means of rivets 54.

It will be appreciated that any type of fastener as exemplified in Figs. 12 to 18 can be used in connection with the mounting illustrated on Figs. 19 to 22. It is also evident that the shank of the fastener may be mounted in body 13 by means of a dish-like member 50; any other shape and structure of a dish-like member and its mounting may be used for any and all purposes of the invention, such as described in my copending application Ser. #431625.

In the exemplification of the invention as shown in Figs. 9 ff. only a relatively short portion of the springy and preferably wire-like member 46 extends freely over hole 45, and thereby vibrations due to the elastic condition of that member are practically excluded.

It is understood that instead of a loop **20** or a hairpin-like member **40** also two separate springy wires can be arranged across hole **18** or **45** and held in place by bridges **50** engaging the ends of the individual wires on opposite sides of the hole. In such event a mounting member as shown in Figs. 20, 21 will be used to advantage, the center portion of which is provided however on both ends with upwardly bent portions **58** so that the end of each wire can be slipped through an individual hole **60**. In order to prevent any such wire to fall out of holes **60** its projecting ends may be broadened or flattened by pressure, such as a hammer blow, in the cold. The same way slipping out of individual wires from bridge **50** can be prevented. In order to prevent undesirable turning of the individual wires within their holders, one end of each wire may be soldered or welded to its holder or spun over the latter.

It is to be understood that the invention is not limited to any exemplification herein before described and shown in the drawings but is to be derived in its broadest aspects from the appended claims. Its outstanding features and advantages are the following: A number, two as a minimum, of elastic connecting members are arranged on one (the non-accessible) side of the bodies to be joined across the registering holes thereof and mounted on the non-accessible body outside its hole. A proper fastener is to be inserted from one (accessible) side of the bodies in a predetermined initial position relative to the connecting members in which its shank meets only slight or no obstruction at all to its passing these members; when so inserted and turned thereafter by a predetermined minimum angle, the fastener elastically deforms the connecting members and is eventually blocked by them. From this blocking position the fastener can be returned to its initial position in which the bodies can be separated, only by a force sufficient to elastically deform the connecting members. To these effects the shank of the fastener is provided near its free end with means capable of engaging the connecting members and to elastically deform them only while the fastener is being turned from its initial to its blocking position and vice versa; these means may also, if desired, so deform the members in the blocking position but are in any event clear of them in the initial position. These engaging means may consist either in projections, Figs. 1 through 7, or recesses, Figs. 9 through 20. The grip of the fastener is defined by the distance of the engaging means from the adjacent surface of its head, and equals or is somewhat smaller than the distance of the portions of the connecting members engaged by the projections or recesses of the shank in their blocking position from a surface of the joined bodies engaged by the head of the fastener. If the grip of the fastener equals that other distance, the connecting members **20**, Figs. 1 through 7 are not elastically deformed in the blocking position, while the members **48**, Figs. 9 to 20, are so deformed in the locking position but substantially in a direction crossing that of the forces tending to separate the joined bodies. If the grip of the fastener is somewhat smaller than that other distance, the members **20** and **46** are elastically deformed in the blocking position which in the first case additionally secures the engaging means (projections **30**) in their blocked position and in all cases counteracts relative vibrations of the joined bodies. In all cases, too, the fastener is to be turned back from its blocked position with considerable force (in a direction crossing that of any force acting during use upon and tending to separate the joined bodies) in order to elastically deform the connecting members and thereby unlock the engaging means **30**, **44** or **53**.

Particular advantages of the invention consist in its simplicity and inexpensiveness; the elements used do not project objectionally beyond the outer surfaces of the bodies; the connecting members may be arranged, as shown, substantially parallel in pairs and thereby in the blocking position engage the shank from symmetrically opposite sides; and the connecting members may also be arranged so as to engage the shank in its initial position with slight friction or in shallow recesses **43** arranged at smaller distance than the blocking recesses **44** whereby the assembly of the bodies is sometimes facilitated.

FRITZ v. OPEL.