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HYDRAULICALLY EXPANDING HOLLOW RIVET

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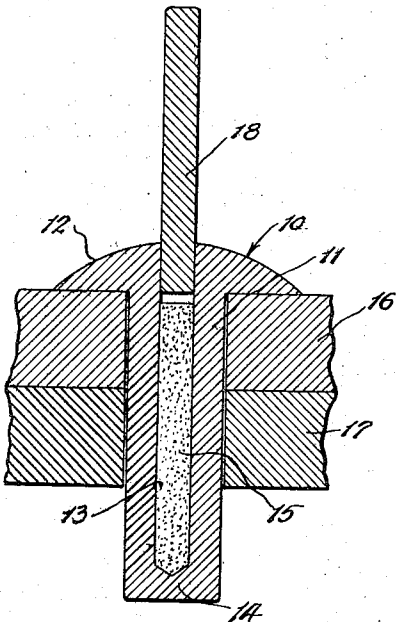


Fig. 1.

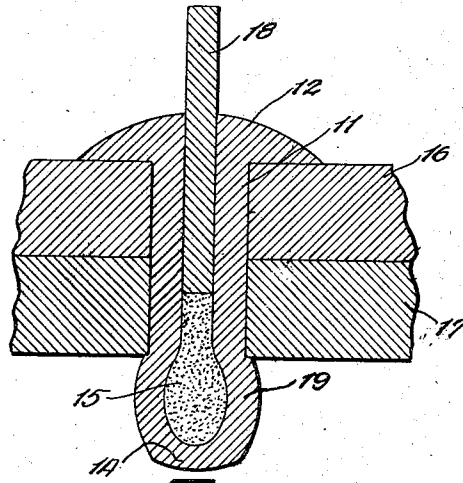


Fig. 2.

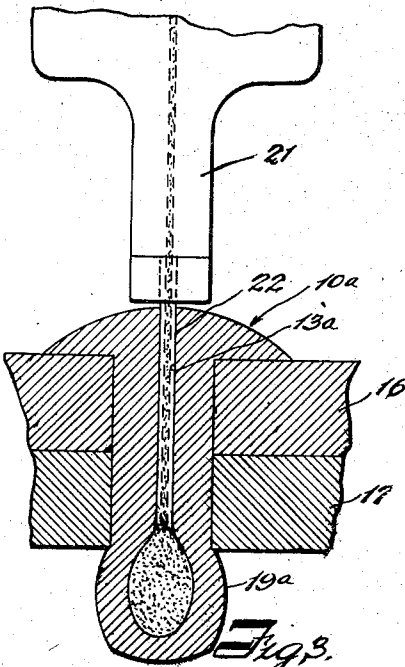


Fig. 3.

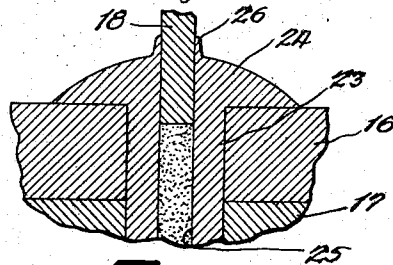


Fig. 4.

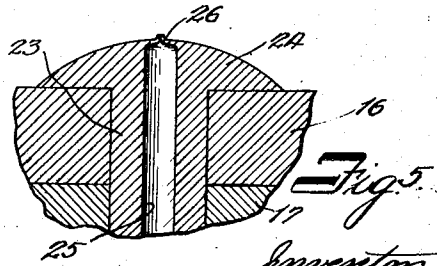


Fig. 5.

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# UNITED STATES PATENT OFFICE

2,562,724

## HYDRAULICALLY EXPANDING HOLLOW RIVET

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4 Claims. (Cl. 218—29)

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This invention relates to rivets and methods of riveting, more particularly to methods of riveting employing an improved rivet capable of being set and secured entirely from one side of the structure being riveted and wherein heating or hammering of the rivet is eliminated, and the invention has for an object the provision of improved methods of this character.

It has heretofore been proposed to apply rivets to the work and to finally set and secure the rivets while operating entirely from one side of the structure being riveted, the necessity for such rivets and methods of riveting arising from the fact that in many structures one side of the work is relatively or completely inaccessible. In carrying out such prior methods, however, hollow rivets have been employed and the upsetting or expanding force has heretofore been applied either by resort to explosive forces, the hollow rivet being provided with a charge therein capable of being detonated, or by driving pins or similar expanding tools into the hollow rivets having specially formed constrictions or shoulders therein to be engaged and forced outwardly by the pins.

The use of explosives in operations of this character is of course inherently dangerous and costly, and in addition explosive operations are difficult to control. Such mechanical expedients as have heretofore been proposed have not resulted in uniform setting and securing of the rivets without recourse to skilled operators and careful manipulation. Something is yet to be desired, therefore, in methods and rivets of the above character, and it is accordingly a further object of this invention to provide an improved method of riveting wherein an externally applied and controlled fluid pressure is exerted on the interior of the rivet to cause radial expansion and setting of the rivet.

In carrying out the invention in one form, a rivet is provided having a shank portion and an enlarged head on one end thereof, the head and the shank being provided with a substantially axial or longitudinally extending bore which extends inwardly from the head end of the rivet and terminates short of the opposite end of the shank. The hollow rivet thus provided is inserted in the suitable openings of the structure to be riveted, and the bore or similar internal chamber is substantially filled with a pressure transmitting fluid medium which is preferably a liquid or a flowable plastic, substantially incompressible material, and pressure is then applied to such medium from an externally located and controlled source so as to cause the shank por-

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tion of the rivet to be radially enlarged. The pressure exerted is of sufficient magnitude to overcome the yield point of the metal employed to form the rivet, and consequently the shank portion of the rivet which extends through the work is radially expanded into tight contact with the work and the portion of the shank which projects beyond the work is bulged outwardly to form an inner or second head on the rivet.

In one embodiment of the invention the filling material utilized may be a plastic substance, such as paraffin, and a small, closely fitting pin or plunger may be inserted into the open end of the bore in the rivet and forced inwardly by externally applied pressure so as to cause expansion of the rivet. In another embodiment of the invention, a pressure gun having a nozzle resembling a hypodermic needle may be inserted into the bore of the rivet and hydraulic pressure applied in sufficient force to cause the desired expansion and bulging of the shank. Where it is desired to close or conceal the open end of the bore after the rivet has been expanded or set, the head of the rivet may be provided with a small flange or rim surrounding the open end of the bore, and this may later be deformed inwardly so as to substantially close and conceal the open end of the bore.

For a more complete understanding of the invention, reference should now be had to the drawing in which:

Fig. 1 is a somewhat diagrammatic longitudinal sectional view of one form of rivet embodying the invention, showing the rivet located in the work before the setting or expanding operation has been performed;

Fig. 2 is a similar view of the rivet and work shown in Fig. 1, illustrating the rivet after it has been set or expanded;

Fig. 3 is a view similar to Fig. 2 but illustrating another method of applying the desired fluid pressure for expanding the rivet;

Fig. 4 is a fragmentary view illustrating a modified type of rivet which may be employed; and

Fig. 5 is a similar fragmentary view showing the rivet of Fig. 4 in its finished form, illustrating the manner in which the hole or bore in the rivet may be substantially closed and concealed.

Referring now to Figs. 1 and 2 of the drawing, the invention is shown as applied to a rivet 10 having a shank portion 11 and an enlarged head 12 on one end of the shank portion. As shown, the rivet 10 is provided with a substantially axial or longitudinally extending bore 13 which ex-

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tends inwardly from the head-end of the rivet and terminates short of the opposite end so as to leave an end wall 14 of substantial thickness. Although the bore 13, which provides an interior chamber in the rivet, may be of any suitable diameter, a bore having a diameter equal to substantially one-third the diameter of the rivet shank has been found to be suitable.

As indicated in Fig. 1, the bore 13 is partially filled with a pressure-transmitting material 15, which may be of any desired character so long as it is of a fluidic nature and capable of flowing under pressure. The material 15 may, for example, be an incompressible oil or may take the form of a plastic material such as paraffin or the like. Where it is desired to fill the bore at the time of manufacture of the rivet, it is of course desirable to employ a plastic material which will not flow except when subjected to pressure.

As shown in Fig. 1, the rivet 10 is inserted through suitable holes in a structure to be riveted, such for example as the aligned holes illustrated in the plates 16 and 17, and there will usually be a slight clearance between the shank portion of the rivet and the holes in the plates. In order to apply pressure to the interior of the bore or chamber 13, any suitable means may be employed and in Fig. 1 this means is illustrated as comprising a closely fitting pin or tool 18 which is inserted in the open end of the bore 13 so as to engage the filling material 15.

When the pin 18 is driven inwardly from the position shown in Fig. 1 to the position shown in Fig. 2, for example, pressure will of course be exerted on the interior of the rivet shank and consequently the portion of the shank 11 which extends through the plates 16 and 17 will be radially enlarged or expanded so as to provide a tight fit between the rivet and the plates. At the same time, the projecting portion of the shank, since it is unsupported externally, will be bulged outwardly as shown in Fig. 2, so as to provide a head portion 19 on the inner end of the rivet. It will thus be seen that by this improved method of expanding the rivet a tight fit within the material being riveted is provided, and the manner in which the expanded head is formed insures that the rivet will be drawn tightly into the work so that the originally formed head 12 tightly engages the adjacent surface of the plate 16. Furthermore, there is less possibility of modifying the grain structure of the rivet so as to cause crystallization, as may happen when the rivet is driven by impact, and the well known "hour glass" form, which may be produced by the application of impact forces on opposite ends of the rivet, is avoided.

Any convenient means for driving the pin 18 may of course be employed, such for example as air operated or electrically operated hammers, or if desired the pin may be driven by hand, utilizing sharp light hammer blows. Of course, the pin 18 may be provided, if desired, with suitable means to limit the extent to which it can be driven into the rivet, and such means are particularly useful where the pin 18 itself constitutes the hammer element of an automatic hammer, since the pressure thus exerted on the interior of the rivet may in this fashion be accurately predetermined and controlled.

In Fig. 3 another method of expanding or setting the rivet is illustrated, the means there employed for exerting an externally applied and controlled pressure being a suitable pressure gun

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21 having a nozzle 22 which is in the form of a hypodermic needle, and which may be inserted into the open end of a suitable bore 13a in a rivet 10a. In this embodiment of the invention, the bore or chamber 13a is not necessarily previously filled with a pressure-transmitting material, but this material may be supplied directly from the pressure gun 21 during the expanding or setting operation. The expanding force here utilized may of course be exerted by any fluid medium capable of being supplied under pressure from conventional pressure guns. While hydraulic mediums are preferably employed, the invention is of course not limited thereto.

In the rivet 10a illustrated in Fig. 3, the bore or chamber 13a may of course be of any desired diameter, and the nozzle or needle 22 is of a diameter to provide a relatively close fit so that upon the application of a pressure medium through the nozzle 22 the projecting end of the rivet will be expanded or radially enlarged to form a suitable head 19a.

In Fig. 4 a modified type of rivet is illustrated having a shank portion 23 and a head portion 24, the head and the shank being provided with a longitudinal bore 25 similar to the bore 13 of Fig. 1. The head 24 of the rivet is provided, as shown, with a suitable flange or rim 26 surrounding the open end of the bore.

After the rivet has been expanded or set by means of an externally applied and controlled fluid pressure exerted within the bore 25, the pressure-exerting means, such, for example, as the pin 18, may be withdrawn and the flange or rim 26 may then be smashed or crushed inwardly so as to substantially close and conceal the outer end of the bore 25, as illustrated in Fig. 5. In some cases it may be desirable to retain the pressure-applying pin inside the rivet shaft as a means of increasing the shear strength. In such cases the length of the pin may be so proportioned that it is driven to a position just flush with the surface of the rivet head, where it may be retained, for added strength, by peening of the flange or rim 26.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The method of riveting plates or the like together, which consists in providing contiguous substantially aligned openings therethrough, inserting in said openings a rivet of material capable of acquiring a permanent set, said rivet having a head and a shank and a chamber extending axially from said head to a point near the end of the shank, the chamber in said shank extending beyond said plates a sufficient distance to permit the bulging of the side wall of said chamber into a head, and hydraulically expanding said shank laterally into snug engagement with the walls of said openings and upsetting said exposed shank end against a plate to form said head by introducing a fluid into said chamber and subjecting it to sufficient pressure applied in a series of successive hammer-like impacts.

2. The method of riveting plates or the like together, which consists in providing contiguous

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substantially aligned openings therethrough, inserting in said openings a rivet of material capable of acquiring a permanent set, said rivet having a head and a shank and a chamber extending axially from said head to a point near the end of the shank, the chamber in said shank extending beyond said plates a sufficient distance to permit the bulging of the side wall of said chamber into a head, and hydraulically expanding said shank laterally into snug engagement with the walls of said openings and upsetting said exposed shank end against a plate to form said head by introducing an incompressible fluid into said chamber and subjecting it to sufficient pressure applied in a series of successive hammer-like impacts.

3. A method of fastening together a plurality of contiguous members characterized by the use of a hollow rivet, said method including the steps of: entering the rivet through said members from one side of the members so that it extends beyond said members; providing a mass of substantially incompressible fluent material inside the rivet; inserting a pin into the rivet adapted to displace said mass of material by hydraulic action and thereby expand the rivet on the other side of said members; and forcing said pin into said rivet by a series of successive hammer-like impacts.

4. A method of fastening together a plurality

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of contiguous members characterized by the use of a hollow rivet, said method including the steps of: entering the rivet through said members from one side of the members so that it extends beyond said members; providing a mass of substantially incompressible fluent material inside the rivet; inserting a pin into the rivet adapted to displace said mass of material by hydraulic action and thereby expand the rivet on the other side of said members; and forcing said pin into permanent position in said rivet by a series of successive hammer-like impacts.

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