Jan. 11, 1944. V. W. PETERSON ET AL 2,338,736

RIVETING

Filed Dec. 13, 1940

Fig. 1

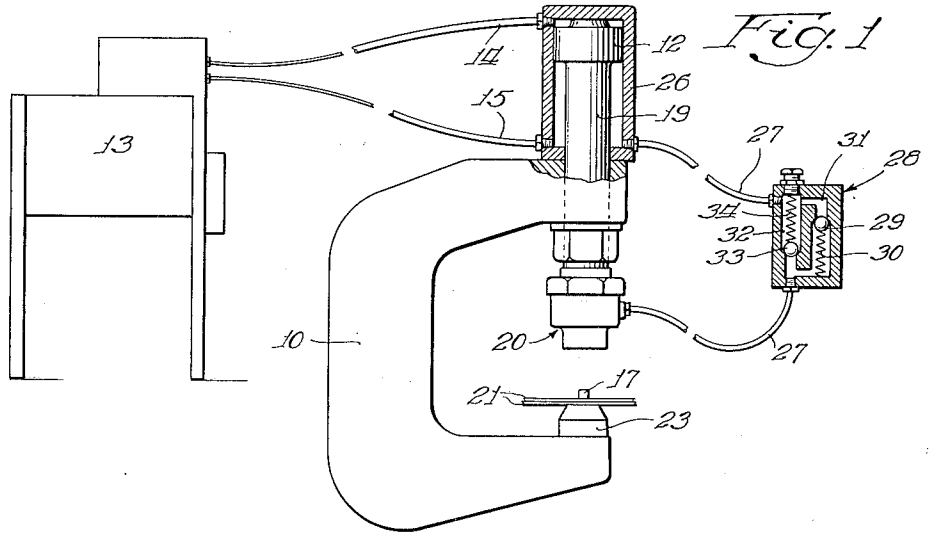


Fig. 2

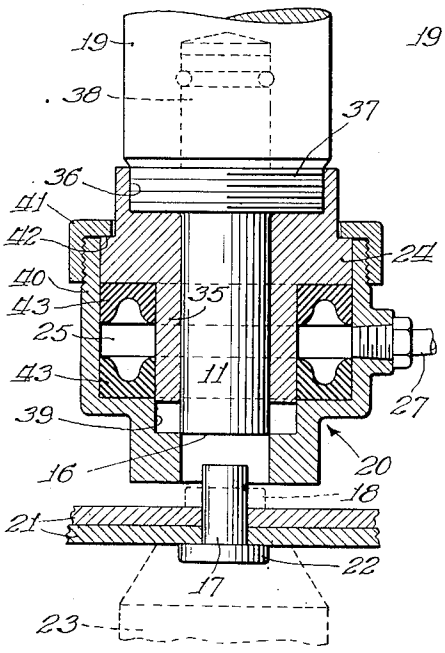


Fig. 3

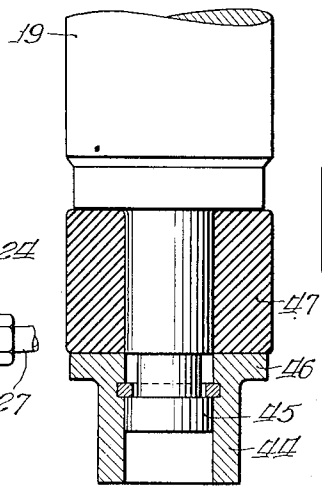
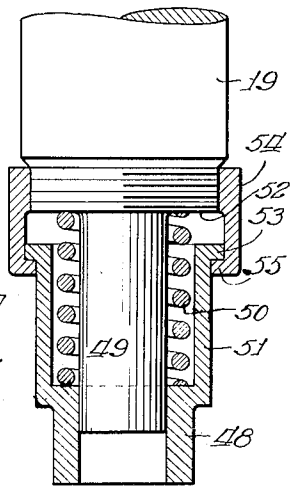


Fig. 4



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Patented Jan. 11, 1944

2,338,736

UNITED STATES PATENT OFFICE

2,338,736

RIVETING

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Application December 13, 1940, Serial No. 369,946

2 Claims. (Cl. 78—52)

This invention relates to riveting and, among other objects, aims to improve the efficiency of heading of rivets and the quality of the headed rivet.

The nature of the invention may be readily understood by reference to one illustrative embodiment thereof described in the following specification illustrated in the accompanying drawing.

In said drawing:

Fig. 1 is a diagrammatic elevation of an operating unit and riveter equipped to form flat heads by cold compression;

Fig. 2 is an enlarged sectional elevation of the heading tool equipped with a hydraulically actuated pressure pad for aligning the work; and

Figs. 3 and 4 are views similar to Fig. 2 showing other forms of pressure pads.

Cold-headed rivets are superior to those hot-headed. Additional advantages accrue if the rivet be formed with a flat head instead of the conventional button head. The points of superiority need be only generally referred to here. Among other advantages are: (1) increase of ultimate strength and elastic limit; (2) the metal in the rivet is elastic up to its elastic limit, thereby insuring transmission of pressures through the length of the rivet and resulting in uniform upsetting throughout; (3) no perceptible temperature shrinkage—they fill the hole, making caulking unnecessary; have no tendency to become loose or leak with vibrating loads or shocks, yet there is no excessive initial tension in the rivet; (4) there is no useless excess metal since all metal in the head is useful and effective. Cold driven flat heads better resist corrosion since they present only a flat surface and a thick (not thin) edge. In addition there are economic advantages: Reduction in size of riveting crews and less fatigue than with hot rivets. Being well formed, no extra labor is required to replace loose burnt or badly formed rivets. Very little energy is required to insert a cold rivet in the hole. Since cold rivets do not upset with a fin between the plates, there is a saving in "bolting up" time. Since lower driving pressures are required for cold forming a flat head and lower residual tension, there is less distortion of the work, thereby effecting a saving in the labor heretofore required for straightening the work after riveting.

The foregoing is premised on the use of correct and safe driving pressures. Of course, much higher pressures are required for cold compression driven rivets and there is consequently greater danger of over-stressing the rivet. In the present method, over-stressing of the rivet is avoided by the combination of two features, namely: permitting free lateral flow of the rivet head and at the same time limiting the maximum compression exerted on the rivet. By permitting free lateral spread of the metal (as distinguished from confining it, as in a so-called button head rivet) a satisfactory head (a flat head) may be formed without development of the high compressive stresses necessary for forming a button head by cold compression; and by limiting the maximum compressive force, overdriving, that is, over-stressing, of the rivet is avoided.

Attempts have been made heretofore to avoid over-stressing by positively limiting the approach of the heading tool with reference to the work but this has not been successful because of small variations in rivet length and variations in the character of the metal. For example if the rivet be too long it presents an excess metal for heading and the metal will be over-stressed. On the other hand, if the rivet be too short the tool will be arrested in its advance before the rivet is adequately driven and a proper head formed.

In the illustrative apparatus, the tool comprises a press yoke 10, in this instance of C-shape, made from heat-treated alloy steel having a strength of about 150,000 to 175,000 pounds per square inch and capable of withstanding working stresses up to 125,000 pounds per square inch. The heading tool or rivet set 11 is operated by a double-acting piston 12 to which hydraulic pressure fluid is supplied by a power unit 13. The latter is advantageously provided with an intensifier by means of which intensified pressures of the order of 5,000 pounds per square inch may be supplied to effect the final rivet squeeze. The tool is closed on the work by low pressures supplied in sufficient volume to advance the tool rapidly on the work. When the predetermined maximum safe pressure is reached (limited so as not to over-stress the rivet) the power unit advantageously reverses the pressure and returns the tool. One form of apparatus for performing this operation is illustrated in our United States Patent No. 2,163,627.

If desired, the rivet yoke may be connected to the power unit through flexible lines 14 and 15 to permit mobility of the tool. The supply lines 14 and 15 are reinforced as disclosed in the above mentioned patent so as to be capable of carrying maximum pressures in the area of 5,000 pounds per square inch without objectionable stretching.

The end 16 of the heading tool or rivet set

is preferably flat and without lateral obstruction to permit the metal of the rivet 17 to flow freely laterally to form the rivet head 18.

To align the work and rivet properly with the heading tool (prerequisite to a properly driven rivet), the press plunger 19 is advantageously provided with a yieldable device 20 (elsewhere called for convenience a pressure pad) for engaging the work (here shown in the form of a pair of plates 21 to be riveted) in advance of engagement of the rivet by tool 11 in order to center the work and align the rivet with the tool. Even though the head 22 of the rivet be seated in the stationary die 23, it is possible for the work to be tilted sufficiently to tilt the rivet and thereby cause the rivet to be formed with an offset head or otherwise improperly driven. This is prevented by the pressure device. Automatic alignment of the work and the rivet is very important for uniform high quality and high speed.

The pressure device 20 is here shown in the form of a hydraulically actuated sleeve forming a cylinder for a piston 24 whose advance in the sleeve cylinder is resisted by liquid in the annular space 25. The aforesaid liquid is supplied under pressure from the plunger end of the press cylinder 26 through line 27. In the latter is inserted a by-pass and check valve 28 whose function is to permit pressure liquid to flow freely into the annular space 25 but whose discharge is resisted until a predetermined pressure has been built up. In the present instance the aforesaid device comprises a by-pass valve 29 closed by a light spring 30 which functions to allow liquid from the press cylinder to reach the space 25 through the by-pass passage 31. The by-pass valve 29 prevents return of liquid through passage 31. The return passage 32 is controlled by a check valve 33 seated by spring 34 adjusted to require predetermined back pressure in space 25 before opening to allow fluid to return to the plunger end of the press cylinder. In this connection, it should be noted that the pressure device is not connected with the relatively high pressures generated in the head end of the press cylinder. Upon return of the press plunger the return pressure supply through line 15 will also be directed through line 27 to restore the pressure device to its initial position. The pressure at which the check valve is adjusted to open is predetermined by the amount of pressure necessary to be exerted by the pressure device properly to align the work and the rivet with the rivet set 11. These pressures are relatively low.

In the present instance the plunger 24 of the pressure device is in the form of an annular sleeve 35 surrounding rivet set 11 but terminating short of the lower end thereof. The upper end of the sleeve is threaded at 36 to the shoulder 37 on the rivet set. The stud 38 of the latter is removably held in a conventional manner in the end of plunger 19 which bears directly against shoulder 37 and serves to transmit the compressive forces to the rivet set 11. The lower end of sleeve 35 slides within a reduced portion 39 of the outer sleeve 40 of the pressure device. The latter sleeve is slidable relative to piston 24, its forward advance being limited by an annular nut 41 screwed on the sleeve 40 and engaging the shoulder 42 on piston 24. Line 27 conducting fluid to the space 25 is advantageously connected to sleeve 40. The line 27 should be sufficiently flexible to allow for the movement of the rivet set 11 and the pressure device. Appropriate packing 43 prevents leakage from the cylinder space 25.

In Figs. 3 and 4, other forms of pressure devices are shown. In Fig. 3 the work engaging device or pressure pad 44 is in the form of a sleeve slidable relative to the rivet set 45 and provided with a flange 46 bearing against a cushion 47 which may be soft rubber. When the pressure pad 44 engages the work, it exerts sufficient pressure to align the work and rivet with the rivet set. Advance of the latter into engagement with the rivet is permitted by yielding of the cushion 47 which on return of the rivet set restores the pressure pad 44 to its advance position.

In Fig. 4 the pressure pad is also in the form of a sleeve 48 slidable relative to the rivet set 49 and resiliently advanced by compression spring 50. The latter is enclosed in an enlarged portion 51 of the pressure pad and bears against the shoulder 52 of the rivet set. The portion 51 is flanged at 53 and its forward advance is limited by an annular nut 54 screwed on shoulder 52 and having a flange 55 lying under flange 53.

It will be understood that the resistance offered by these pressure devices is relatively small compared to the capacity of the work piston, and, therefore, does not materially interfere with the advance of the work piston and the heading tool.

The present apparatus and its method of use makes available in an efficient and economical manner all the advantages of cold compression rivets.

Obviously the invention is not limited to the details of the illustrative apparatus since these may be variously modified. Moreover, it is not indispensable that all features of the invention be used conjointly since various features may be employed to advantage in different combinations and subcombinations.

Having described our invention, we claim:

1. Riveting apparatus comprising in combination a compression riveter having an operating cylinder and plunger, a rivet set actuated thereby, a pressure pad movable with said rivet set and adapted to engage the work in advance of engagement of the rivet by said set, said pressure pad having a fluid cylinder and piston adapted to permit said pad to move relatively to said set to permit the latter to engage the rivet, a line connecting said pressure pad cylinder with the plunger side of said operating cylinder, and a valve in said line set to open when a predetermined pressure is reached in said pad cylinder.

2. Riveting apparatus comprising in combination a double-acting operating cylinder and plunger, a rivet set operated thereby, a pressure pad movable with said rivet set and adapted to engage the work in advance of engagement of the rivet by said set, said pressure pad having a fluid cylinder and piston adapted to permit said pad to move relatively to said set to permit the latter to engage the rivet, a line connecting said pressure pad cylinder with the plunger side of said operating cylinder, a relief valve in said line set to open to permit fluid to escape from said pressure pad cylinder into said operating cylinder, and a check valve in said line adapted to permit fluid to by-pass said relief valve and to flow into said pad cylinder on the return stroke of said set to advance the pressure pad to its initial position.

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