United States Patent [19]

Headman

[11] **3,766,627**

[45] **Oct. 23, 1973**

[54] **STUD INSERTION APPARATUS FOR AN AUTOMATIC MACHINE OR PRESS**

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[73] Assignee: **Penn Engineering & Manufacturing Corp.,** Danboro, Pa.

[22] Filed: **July 31, 1972**

[21] Appl. No.: **276,776**

[52] **U.S. Cl.** ..... **29/208 C,** 29/208 D

[51] **Int. Cl.** **B23p 19/04**

[58] **Field of Search** ..... 29/208 C, 208 D, 29/208 R, 432.2

[56] **References Cited**

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3,465,410 9/1969 Ernest et al. ..... 29/208 C

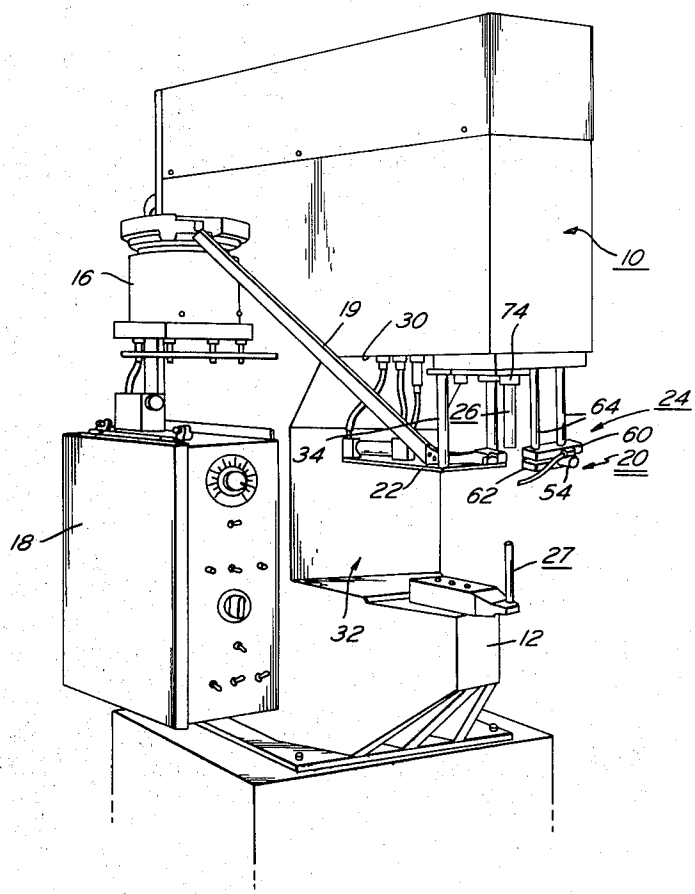
Primary Examiner—Thomas H. Eager

Attorney—Joseph G. Denny, III et al.

[57] **ABSTRACT**

This invention relates to an improved stud insertion apparatus for an automatic machine or press in which the stud is transported to a position in abutment with the face of the punch, depending centrally therefrom, and retained by the punch assembly. Thereafter, while the stud is so retained by the punch assembly, the stud holder assembly disengages from the stud and retracts from under the path of the punch assembly leaving the stud suspended from the face of the punch and ready to be inserted into the work piece by the punch.

15 Claims, 9 Drawing Figures



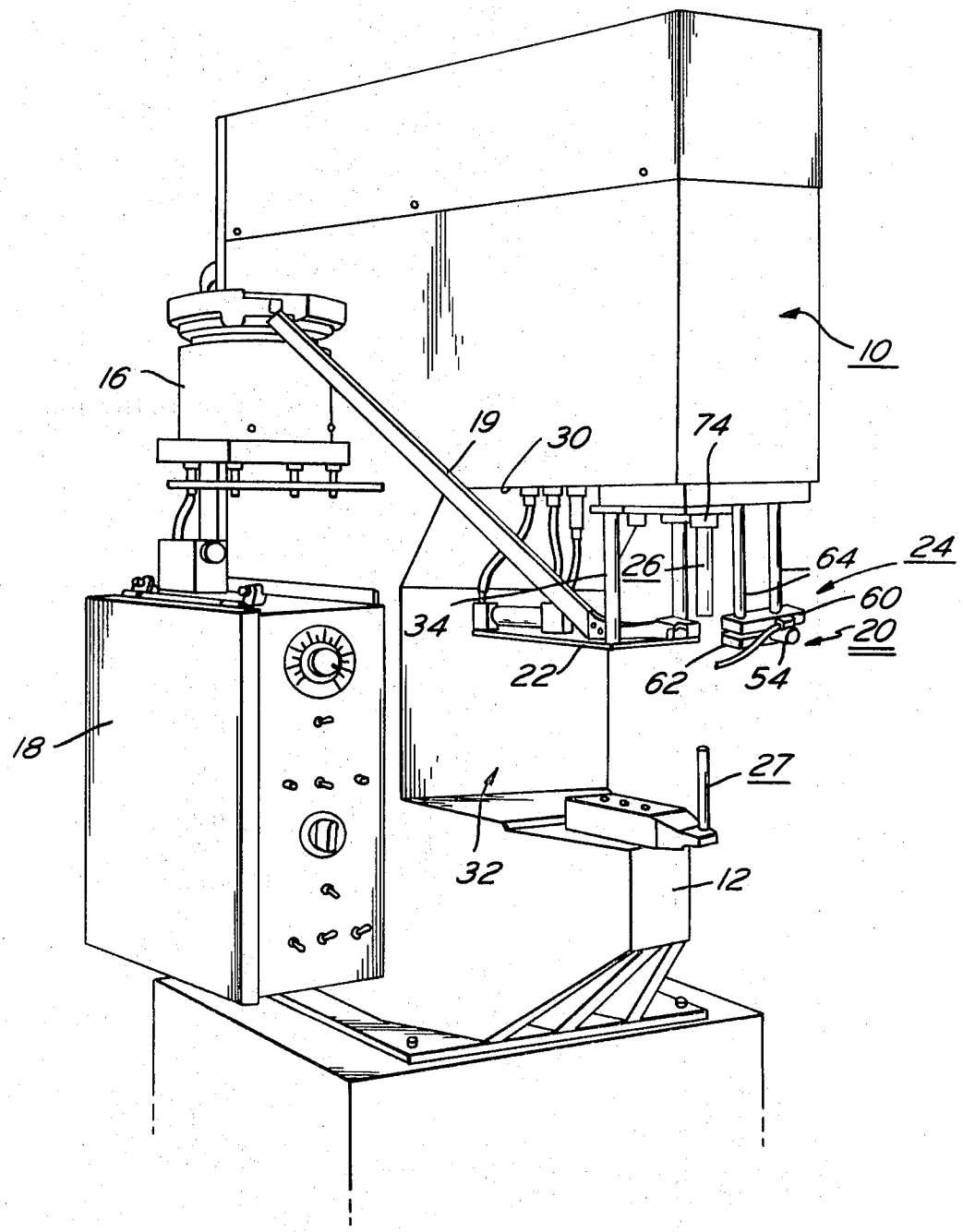


FIG. 1

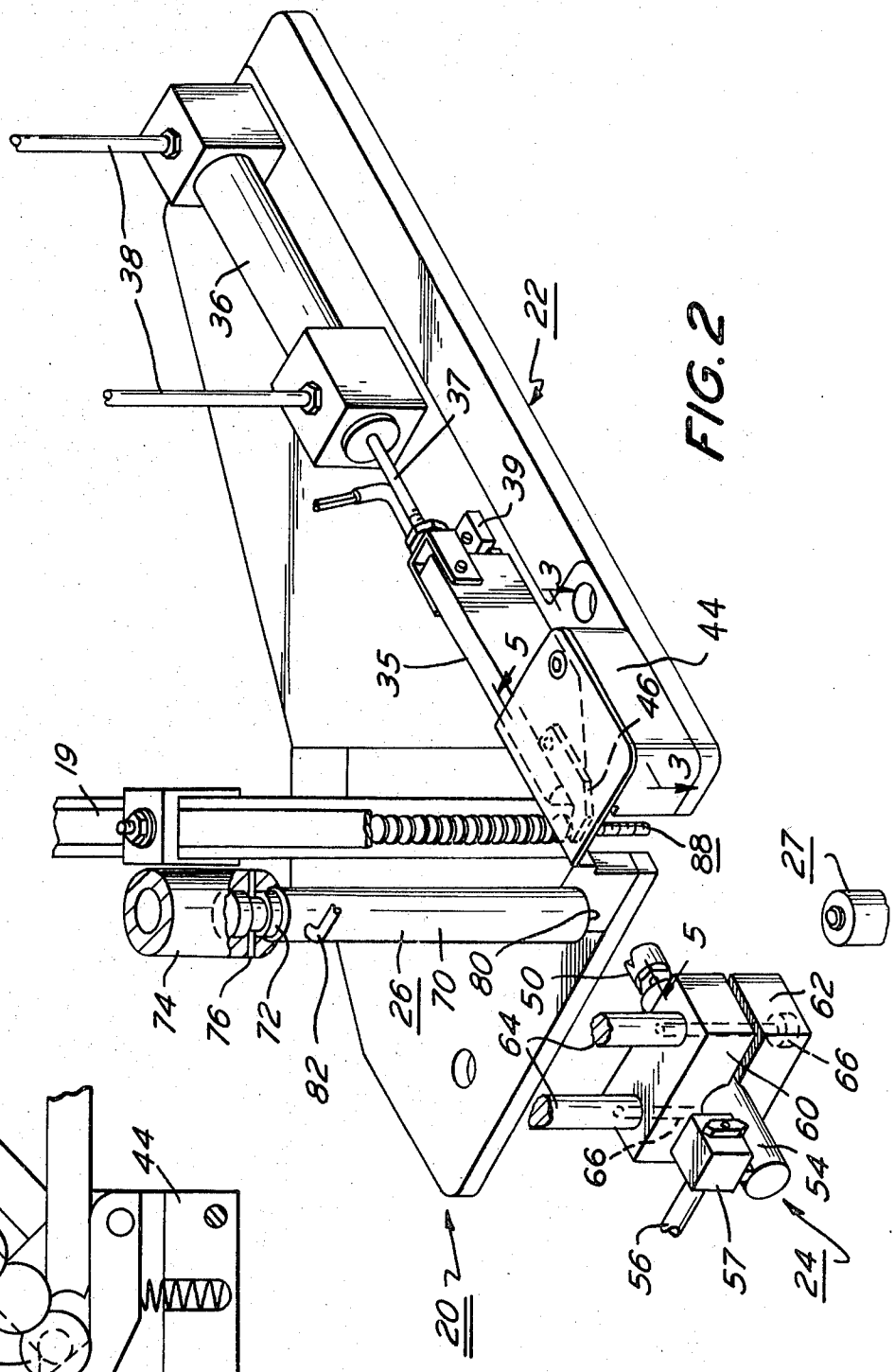

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FIG. 2

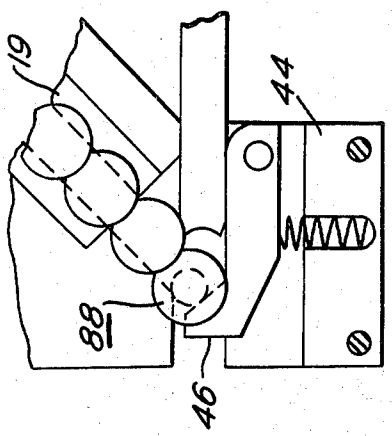

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FIG. 3

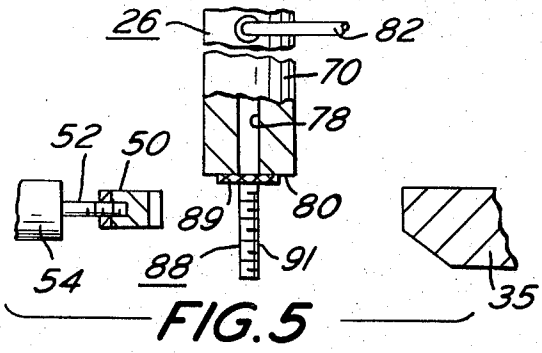


FIG. 5

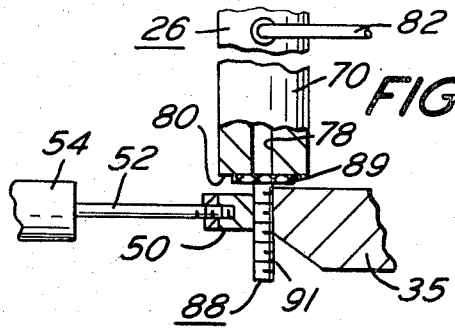
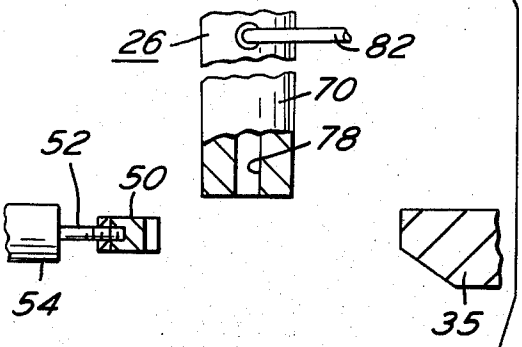


FIG. 4



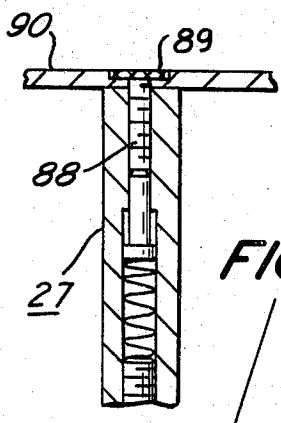


FIG. 6

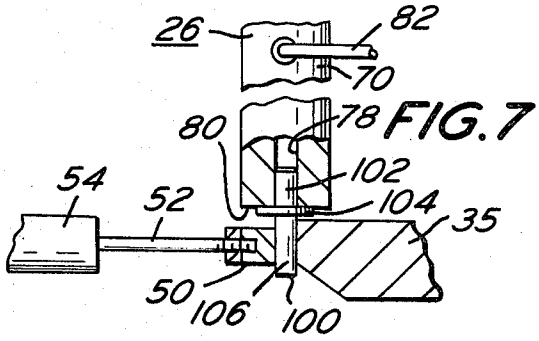


FIG. 7

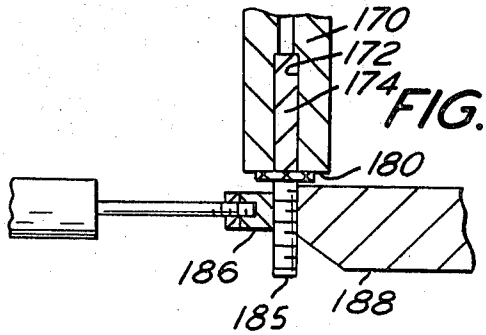


FIG. 8

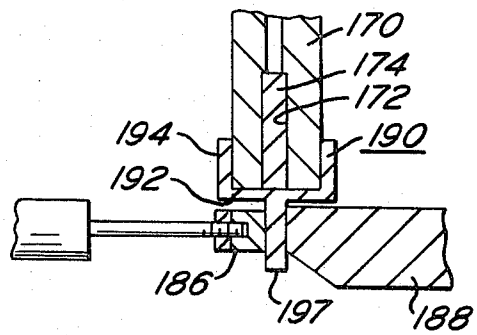


FIG. 9

STUD INSERTION APPARATUS FOR AN AUTOMATIC MACHINE OR PRESS

CROSS-REFERENCE TO RELATED PATENT

This application discloses structure related to the press shown in U.S. Pat. No. 3,465,410.

BACKGROUND OF THE INVENTION

This invention provides a modified stud insertion apparatus comprising a more economical punch assembly and a modified stud holder assembly for the automatic machine or press described and claimed in the aforesaid patent.

It is intended that the stud insertion apparatus disclosed herein may be substituted for the corresponding portions of the press described in the aforesaid patent.

In the aforesaid prior patent, the punch assembly comprises a cone-like case carrying opposed leaf springs arranged to grasp the stud delivered to it by a pusher and a punch assembly. The stud was grasped between the opposed leaf springs, requiring the punch assembly to maintain a certain alignment with the delivery path of the stud. The modified punch assembly has much fewer and less expensive parts, thereby substantially reducing the cost thereof.

Further, with the previous punch assembly it was found that the leaf springs required adjustment and replacement from time-to-time, because the ends thereof were subject to wear and were some times accidentally cut off by the punch. By eliminating the need for these leaf springs, the replacement problem is also eliminated.

Also, since the cone-like case of the punch assembly extended below the punch in the previous embodiment, depending on the length of the stud, it was difficult (and sometimes impossible) for the operator to visually determine whether the stud was correctly aligned axially prior to actuating the punch downwardly. If the stud was not correctly aligned axially at such time, the stud would be pushed into the work piece at other than a right angle thereto, resulting in an improper placement of the stud in the work piece.

BRIEF SUMMARY OF THE INVENTION

The object of this invention is to provide a stud holder assembly, i.e., a stud pusher and a stud stop, together with a punch assembly in a press otherwise made in accordance with the aforesaid patent, the new parts being more economical to manufacture and to maintain than the corresponding parts shown in the aforesaid patent which they replace.

The press to assemble a stud to a workpiece includes a frame which carries the punch assembly and the stud holder assembly, i.e., the stud pusher and the stud stop. The punch assembly includes a punch automatically movable in a path from an upper to a lower position and back to the upper position. The punch assembly also includes a vacuum or magnetic means for retaining the stud in abutment with the punch face.

The stud pusher automatically advances at the proper time and transports the stud against the stud stop and in central alignment with and below the punch. Thereafter the stud pusher and the stud stop are both retracted out from under the downward path of the punch at which time the vacuum or magnetic means retain the stud in abutment with the punch face. The advancing and retracting of the stud pusher and the stud stop is done by appropriate pneumatic means provided with solenoids and electrical timing means connected to the solenoids for sequentially energizing the solenoids, so that the stud pusher transfers a stud to the punch while the punch is in its upper position and then the stud pusher and stud stop are both retracted, whereupon the punch drives the stud into the workpiece and clinches it thereto.

The foregoing and other objects of this invention, the principles of this invention, and the best modes in which I have contemplated applying such principles will more fully appear from the following description and accompanying drawings in illustration thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front perspective view of the automated press constructed in accordance with this invention with a vacuum type punch assembly, showing the side on which the feed hopper assembly and the electrical control unit are mounted;

FIG. 2 is an enlarged, partial perspective view of the press shown in FIG. 1, showing the punch assembly, anvil assembly, stud pusher assembly, stud stop assembly and a portion of the track for feeding the studs, the view taken from the other side relative to FIG. 1, and the view being further taken just after the foot switch has been actuated, the stop block and stud pusher have retracted and at the instant prior to downward movement of the punch for insertion of a stud into a workpiece, the stud which hangs down from the punch at such time and the workpiece being both omitted for clarity;

FIG. 3 is an enlarged partial, top view taken along the line 3—3 in FIG. 2;

FIG. 4 is an enlarged, partial sectional view through the vacuum type punch, stud pusher and stud stop shown in FIGS. 1 and 2, but showing a stud transferred to the punch and the stud pusher and stud stop in their extended positions, i.e., the initial positions of the various parts just before the foot switch is actuated to commence the stud insertion cycle;

FIG. 5 is an enlarged, partial sectional view through the vacuum type punch, stud pusher and stud stop shown in the previous views, but showing the stud retained by the punch and the stud stop and stud pusher both fully retracted, the view being taken along the line 5—5 in FIG. 2 and showing the positions of the parts just before the punch moves downwardly;

FIG. 6 is an enlarged, partial sectional view similar to FIG. 5, but also showing the anvil and the workpiece and showing the stud after it has been driven into the workpiece;

FIG. 7 is a view similar to FIG. 4, but showing a set-up pin for properly positioning the various parts relative to each other; and

FIGS. 8 and 9 show a modified form of this invention and are views corresponding to FIGS. 4 and 7, but show a magnetic type punch and a set-up cut therefor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the press or assembly machine 10 comprises a generally upright frame 12. The press 10 includes a suitable pneumatic and hydraulic circuit, not shown in detail, but which may be as that shown in the aforesaid patent. As illustrated in FIG. 1, a stud feed hopper assembly 16 is secured to one side of the

frame 12, as is also an electrical control unit 18, the details of the latter not being shown, but which may also be as that shown in the aforesaid patent.

From the stud feed hopper assembly 16 a track 19 feeds studs to a stud holder assembly 20 comprising a stud pusher assembly 22 and a stud stop assembly 24 for centering a stud under the punch assembly 26.

The stud pusher assembly 22 is suspended from the roof 30 of the mouth 32 of the press by columns 34, shown in FIG. 1 but omitted in FIG. 2 for clarity, and comprises a stud pusher 35 and a pneumatic cylinder 36. The stud pusher 35 is connected by a suitable linkage 37 to a piston (not shown) movable between opposite ends of the cylinder 36 to supply air thereto for actuating the piston. When the stud pusher 35 is in its rearwardmost position, as shown in FIG. 2, the rear portion of the pusher 35 engages and depresses an electrical switch 39 signaling to the circuit of the press the position of the stud pusher 35.

Referring to FIGS. 2 and 3, the forward portion of the stud pusher assembly 20 also includes a block 44 supporting a pivotal, spring biased finger 46 restraining the lead stud in a manner similar to that shown in the aforesaid patent.

The stud stop assembly 24 comprises a stud stop block 50 having a V-shaped face to help center the stud under and centrally with the punch assembly 26. The stud stop block 50 is connected by a rod 52 to a piston (not shown) movable back and forth within a pneumatic cylinder 54, the piston being biased to the (initial) position of the rod 52 and block 50 shown in FIG. 2. The cylinder 54 has a suitable pipe 56 connected to the left hand end (as shown in FIG. 2) of the cylinder 54 to actuate the piston, and the rod 52, against the spring bias, to the right when suitable air pressure is applied, the rod 52 and block 50 being returned to their initial position by the spring when the air pressure decreases sufficiently.

The cylinder 54 is supported between plates 60 and 62 which are connected to each other and to columns 64 by screws 66 so that by loosening the screws 66 the cylinder 54, and, hence, the rod 52 and block 50 may be moved back and forth relative to the punch assembly 26. To further adjust the block 50, the rod 52 is provided with a threaded end received in a suitable threaded opening in the block 50, as shown in FIG. 5.

The punch assembly 26 includes a punch 70 having an upper end portion 72 secured to the punch ram 74 (partially shown in FIG. 2) by a suitable set screw 76 extending through the ram 74 and into engagement with an undercut cylindrical surface on the punch upper end portion 72. The punch 70 has a central passage 78, as shown in FIG. 5, in communication at its lower end with the horizontal punch face 80 and at the upper end with a conduit 82 connected by a suitable fitting to a threaded transverse opening near the top of the punch 70. The conduit 82 is connected to a suitable vacuum pump for producing the required vacuum at the punch face 80, so that the head 89 of the stud 88 is held or retained against the punch face 80, as shown in FIG. 5, because of the vacuum pressure in the passage 78.

Centered below the punch assembly 26 is an anvil assembly 27. The anvil assembly 27 includes an anvil 91 with a central opening within which is a plunger 92, the plunger 92 being spring biased upwardly by the spring 93, as shown in FIG. 6, the plunger 92 being depressed by the threaded shank of the stud 88 when the stud 88 is driven into the workpiece.

The press 10 is actuated by the pneumatic and hydraulic circuit (not shown herein) which is fully disclosed in the aforesaid patent, but which may be summarized as comprising first hydraulic and pneumatic means for advancing and retracting the punch assembly 26 with a first force to place the stud 88 (FIG. 2) through the hole in the workpiece 90 (FIG. 6), and a second hydraulic and pneumatic means (not shown) for applying a second force, higher that the first force, to the punch assembly 26, during the end portion of the advance of the punch assembly 26, to then clinch the head 89 of the stud 88 to the workpiece 90. Further, the first and second hydraulic and pneumatic means include solenoids and electrical timing means (also not shown) connected to the solenoids for sequentially energizing the solenoids, as is also disclosed in the aforementioned patent.

After the press 10 is properly set-up, the operator depresses a foot switch (not shown) which controls the electrical circuit of the press and initiates the cycle. At the proper time in the cycle, the stud pusher 35 (of the stud pusher assembly 22) advances and transports the lead stud 88 under the punch 70. Simultaneously with the advance of the stud pusher 35, the stop block 50 advances toward the punch 70, both advancing to the position shown in FIG. 4. Thus, the stud 88 is engaged by the pusher 35 and carried, by its head 89, under and into central alignment with the punch 70 and its passage 78. That is, as the stud pusher 35 moves toward the punch 70, the pusher 35 engages the shank of the lead stud 88 and the head 89 thereof rests on the pusher 35. The pusher 35 at such time carries the stud 88 toward and under the punch 70 and centers the stud 88 in the V-shaped face of the block 50. The top surface of the pusher 35 (upon which the head 89 of the stud 88 rests) is below the punch face 80 an amount equal to the largest head thickness to be installed by the press plus an increment sufficient to facilitate movement of the head under the punch face 80, but not so great as to impair the lifting and holding action of the vacuum in passage 78.

The distance that the pusher 35 moves to the left, as viewed in FIGS. 2 and 3, is preset so that the pusher 35 will stop before it rams the shank 91 of the stud 88 against the stop block 50, although the inertia of the moving stud 88 tends to carry it against the stop block 50, centering itself in the V-shaped face thereof at such time. It is believed that as the stud 88 approaches the passage 78, the vacuum effect tends to gradually lift the stud 88 against the punch face 80 and that some lifting may take place before the stud 88 has been carried to its full extent toward the stop block 50.

Referring to FIGS. 4, 5 and 6, it is seen that the diameter of the punch face 80 is larger than that of the head 89 of stud 88 for a proper installation in the workpiece 90. However, with such a punch face diameter, it overhangs both the stop block 50 and the pusher 35. No interference takes place between the punch face 80 and the stop block 50 or the pusher 35 because they have already been sufficiently retracted when the punch face 80 moves down.

The initial position of the punch 70, stud 88, stud stop 50 and the stud pusher 35 is shown in FIG. 4. To commence the cycle to insert the stud 88 into the workpiece 90, the operator depresses an electrical foot

switch (not shown) signalling the press to start its cycle and to insert a stud into the workpiece **90**. Just after actuation of the foot switch (not shown), the stud stop **50** and the stud pusher **35** simultaneously retract, the retracted positions of the stop **50** and pusher **35** being shown in FIG. **2**, but note that the stud **88** which would hang at such time from the punch face **80** and the workpiece **90** have both been omitted in FIG. **2** for clarity of illustration. Thus, just after actuation of the press by the operator and just before downward movement of the punch **70** to insert a stud into the workpiece, the various parts are in the positions shown in FIG. **2**, except that the stud **88** and the workpiece **90** which rests on the anvil assembly **27** have both been omitted in FIG. **2**.

To commence the cycle, the operator depresses an electrical foot switch (not shown) signalling the press to commence its cycle to insert a stud into the workpiece. Before the cycle is initiated the tooling pieces appear as in FIG. **1**, except that the stud **88**, the pusher **35** and the stop block **50** are in the positions shown in FIG. **4**. When the cycle is initiated, the air flow to the cylinder **54** is terminated and the piston (not shown) within the cylinder **54** is retracted, for retracting the stop block **50** to the position shown in FIG. **5**, under the bias of the return spring (not shown) which is so biasing the piston within cylinder **54**, thereby retracting stop block **50**. Simultaneously with the retraction of the stop block **50**, the stud pusher **35** is retracted to the position shown in FIG. **5** by terminating the flow of air pressure to the right-hand end of the cylinder **36** and instead supplying suitable air pressure to the left-hand end of the cylinder **36** which causes the piston (not shown) within the cylinder **36** to move to the right carrying to the right the linkage **37** and the pusher **35**. When the stud pusher **35** has fully retracted, its righthandmost portion depresses the switch **39**, closing the circuit which then permits the ram **74** to move downwardly.

After the punch inserts the stud into the workpiece, the punch **70** returns to its initial position, i.e. the position shown in FIG. **2**, and the stop block **50** and stud pusher **35** are extended to the positions shown in FIG. **4**, the stud pusher **35** at such time transferring another stud to the punch face **80**, whereby the press is ready to start another cycle.

The advance of the stop block **50** and of the stud pusher **35** is accomplished by simultaneously and automatically supplying the required air pressure to the cylinders **36** and **54**, causing the linkages **37** and **52** of the stud pusher **35** and the stop block **50**, respectively, to advance (toward each other and the punch **70**). At such time the forward portion of the stud pusher **35** engages the shank of the lead stud **88** with a part of the head **89** resting on the stud pusher **35**, the stud pusher **35** carrying the stud **88** toward the stop block **50** and centering the stud **88** under the punch **70**. As the stud **88** nears the end of its travel it may lift upwardly by the vacuum in passage **78**, and may lift itself slightly off of the stud pusher **35**, but will in any event be lifted to the punch face **80** when it is centered below the punch **70**. The stop block **50** is spaced well below the head of the stud as shown, in FIG. **4**. Another stud is now in position ready for the operator to initiate the next cycle.

To facilitate the retraction of the stop block **50**, a quick release spring operated exhaust valve **57** may be placed between the air pipe **56** and the cylinder **54** which automatically opens to exhaust the air from the cylinder when the supply of air to the cylinder is terminated.

FIG. **7** illustrates an arrangement for properly positioning the punch face **80**, the stop block **50** and the stud pusher **35** relative to each other by use of a set-up pin **100**. The set-up pin **100** has the general shape of a stud but includes a central (upward) projection **102** which is slidably received within the central passage **78**. The set-up pin **100** includes a flange **104** corresponding to the head of a stud, the thickness of the flange **104** being made a few thousandths of an inch thicker than the head of the stud to be inserted by the press. Likewise, the pin **100** includes an unthreaded shank **106** corresponding to the threaded shank of the stud to be inserted by the press, the shank **106** being a few thousandths of an inch larger than the major diameter of the threaded shank of the stud to be inserted, so that (during the insertion of studs) the movement of the stud pusher **35** to the left is terminated without the pusher **35** ramming the shank of a stud against the stop block **50**.

To set-up the parts involved in their proper relationship, for the fully advanced positions of the stop block **50** and stud pusher **35**, a vacuum is produced in the passage **78**, the pin **100** is inserted as shown in FIG. **7**, and the stop block **50** is brought into engagement with the shank **106** (on the left) and the stud pusher **35** is brought into engagement with the shank **106** (on the right).

FIG. **8** illustrates a modification of this invention in which the punch **170** has a central hole **172** into which is inserted a cylindrical permanent magnet **174** secured to the punch **170** by an interference fit. The lower, end face of the magnet **174** and the punch face **180** (of the punch **170**) are coplanar. The magnet **174** is made large enough to provide a sufficient magnetic attractive force on the stud **185** so as to attract and retain to the punch the heaviest stud to be inserted by the press. This embodiment is intended for use with studs that are made of magnetizable material, whereas the previous, vacuum type embodiment is, of course, intended for use with studs that are made of non-magnetizable material, but may also be used with studs of magnetizable material.

Referring to FIG. **9**, an arrangement for properly positioning the punch face **180**, the stop block **186** and the stud pusher **188** relative to each other by the use of a cup **190** of magnetizable material is illustrated. The cup **190** has a flange **192** corresponding to the head of the stud to be inserted, but having a thickness which is a few thousandths of an inch thicker than the head of the stud to be inserted. The flange **192** has a peripheral, upstanding collar **194** slidably received around the punch **170**, as illustrated, for centering the cup **190** relative to the punch **170**. Depending centrally from the flange **192** is an unthreaded shank **197** which is a few thousandths of an inch in diameter greater than the major diameter of the threaded shank of the stud to be inserted by the press.

While this invention has been described in connection with studs, it will be seen that various types of other fasteners, such as stand-offs and blind nuts, could also be inserted, so long as the fasteners have a radially outwardly extending flange, such as the head **89**, to rest on the pusher **35** and a center of gravity such that they will rest on the pusher **35** as they are transferred from the track to the punch face **80**.

Having described the invention, I claim:

1. A stud insertion apparatus for use as part of an assembling machine to assemble a stud to a workpiece wherein said machine includes a frame and said stud insertion apparatus comprises:

a punch assembly and a stud holder assembly carried by said frame, said punch assembly including a punch movable in a path from an upper position to a lower position and back to said upper position and first means for retaining said stud in abutment with said punch,

said stud holder assembly comprising a stud stop assembly and a stud pusher assembly, and

second means for advancing said stud pusher to transport said stud against said stud stop in central alignment with and below said punch and thereafter retracting said stud pusher and said stud stop out from under the path of said punch.

2. The combination recited in claim 1 wherein said second means includes a pneumatic means for advancing and retracting said stud pusher and said stud stop.

3. The combination recited in claim 1 wherein said second means includes solenoids and electrical timing means connected to said solenoids for sequentially energizing said solenoids so that said stud pusher transfers said stud to said punch while said punch is in its upper position and then said stud pusher and said stop are both retracted, whereupon said punch drives said stud into said workpiece.

4. The combination recited in claim 2 wherein said second means includes solenoids and electrical timing means connected to said solenoids for sequentially energizing said solenoids so that said stud pusher transfers said stud to said punch while said punch is in its upper position and then said stud pusher and said stud stop are both retracted, whereupon said punch drives said stud into said workpiece.

5. The combination recited in claim 4 wherein said stud pusher assembly includes a stud pusher engageable with said stud for transporting said stud to said punch assembly and electrical switch means engageable by said stud pusher to sense the rearwardmost position of said stud pusher, and pneumatic means connected to said stud pusher for advancing said stud pusher toward said punch assembly and retracting said stud pusher therefrom, said stud stop including a V-shaped stop block, and pneumatic means connected to said stop block for advancing said stop block toward said punch assembly and retracting said stop block therefrom.

6. The combination recited in claim 1 wherein said first means is a vacuum type means.

7. The combination recited in claim 6 wherein said punch has a punch face and a passage extending through said punch and in communication with said punch face, a conduit connected to said passage and vacuum producing means connected to said passage.

8. The combination recited in claim 1 wherein said first means is a magnet type means.

9. The combination recited in claim 8 wherein said punch is of non-magnetic material except for a central portion of permanent, magnetic material, the central permanent, magnetic portion extending to and forming part of the punch face.

10. For use in an assembling machine for assembling a fastener in a hole in a workpiece such as the machine disclosed in U.S. Pat. No. 3,465,410, the combination comprising:

a punch assembly including a punch having a holding means for retaining a fastener to said punch without grasping or surrounding said fastener,

a fastener holder assembly for transporting said fastener to said punch assembly,

said fastener holder assembly comprising a pusher and a stop movable toward each other with a fastener during transfer of the fastener to the punch assembly and away from each other and out from under said punch assembly after said fastener is delivered to said punch assembly, and

control means responsive to the position of said fastener holder assembly for signalling that said fastener has been transferred to said punch assembly and that both the stop and the pusher have moved out from under the punch assembly.

11. The combination recited in claim 10 wherein said holding means comprises a passage communicating with the face of the punch and with which a pump for producing a suitable vacuum is in communication to produce a suitable lifting force at the punch face so as to retain said fastener thereto.

12. The combination recited in claim 10 wherein said holding means comprises a permanent magnet sufficiently close to the face of the punch to produce a sufficient magnetic force to retain said fastener to the punch face.

13. For use in an assembling machine for assembling a fastener in a hole in a workpiece such as the machine disclosed in U.S. Pat. No. 3,465,410, the combination comprising:

a punch assembly including a punch having a holding means for retaining a fastener to said punch,

a fastener holder assembly for transferring said fastener to said punch assembly,

said fastener holder assembly comprising a pusher and a stop movable toward and away from each other from a fastener holding position to a punch assembly actuation position and back to said fastener holding position,

said pusher including a surface upon which a portion of said fastener may rest during movement of said pusher toward said fastener holding position and while said pusher remains in said fastener holding position,

said pusher and stop remaining in said fastener holding position until said machine is actuated to begin the cycle for inserting said fastener into a workpiece, whereby said fastener is supported below said punch assembly by said pusher,

switch means for actuating the machine and initiating the cycle for inserting the fastener, and

second switch means actuated by said fastener holder assembly when said pusher and stop have both moved out from under the punch assembly to permit actuation of the latter.

14. The combination recited in claim 13 wherein said holding means comprises a passage communicating with the face of the punch and with which a pump for producing a suitable vacuum is in communication to produce a suitable lifting force at the punch face so as to retain said fastener thereto.

15. The combination recited in claim 13 wherein said holding means comprises a permanent magnet sufficiently close to the face of the punch to produce a sufficient magnetic force to retain said fastener to the punch face.

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