United States Patent [19]

Mauk et al.

[11] **3,719,117**

[45] **March 6, 1973**

[54] **PUNCH HOLDER**

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[21] Appl. No.: **167,326**

[52] **U.S. Cl.** **83/698,** 279/9, 287/104

[51] **Int. Cl.** **B26d 1/06**

[58] **Field of Search**.....83/698, 527; 287/104, 103 R; 279/9 R

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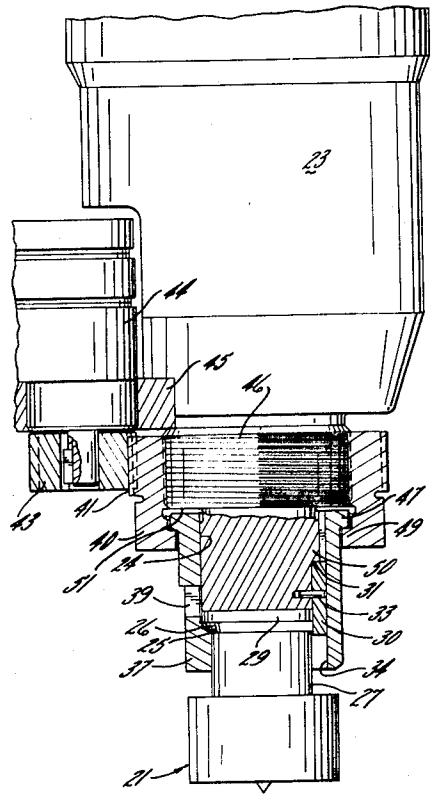
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[57] **ABSTRACT**

A punch press includes a tubular punch holder telescoped on the lower end of a reciprocable ram for up and down movement between (a) a clamped position in which the end of the ram holds a punch locked within the holder and (b) a released position in which the end of the ram is retracted upwardly relative to the holder to allow the punch to be removed from the holder. Formed in the side of the holder is an entryway correlated in size and shape to that of the punch so that the punch may be inserted into and removed from the holder by being moved radially in and out of the holder when the latter is in the released position.

14 Claims, 10 Drawing Figures



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SHEET 1 OF 3

Fig 1.

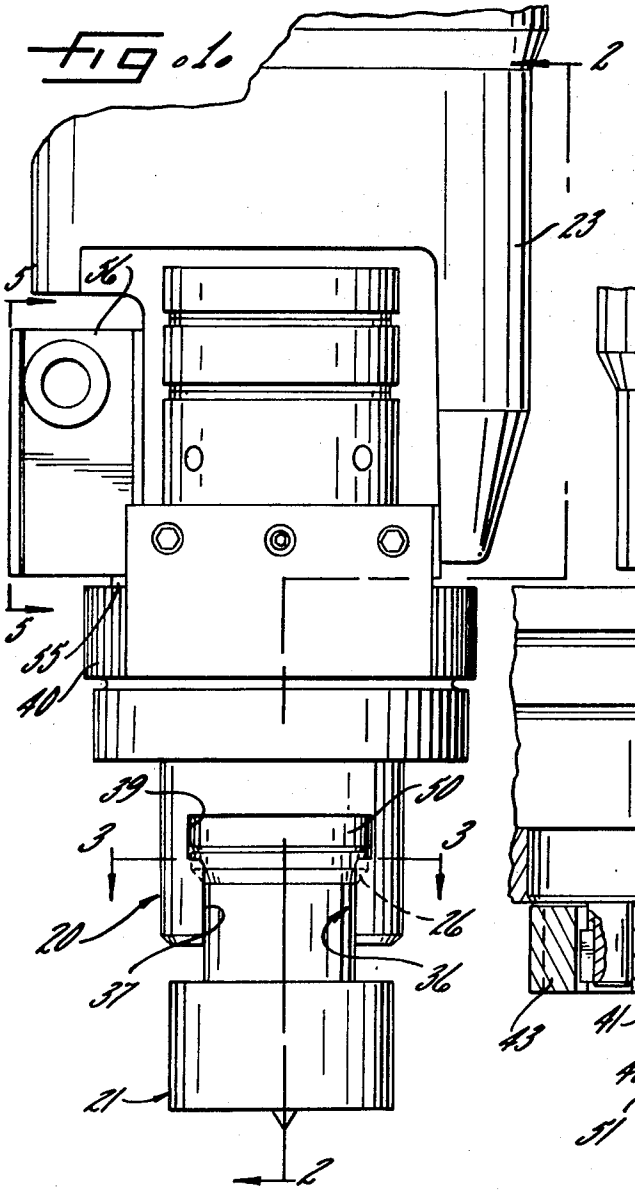
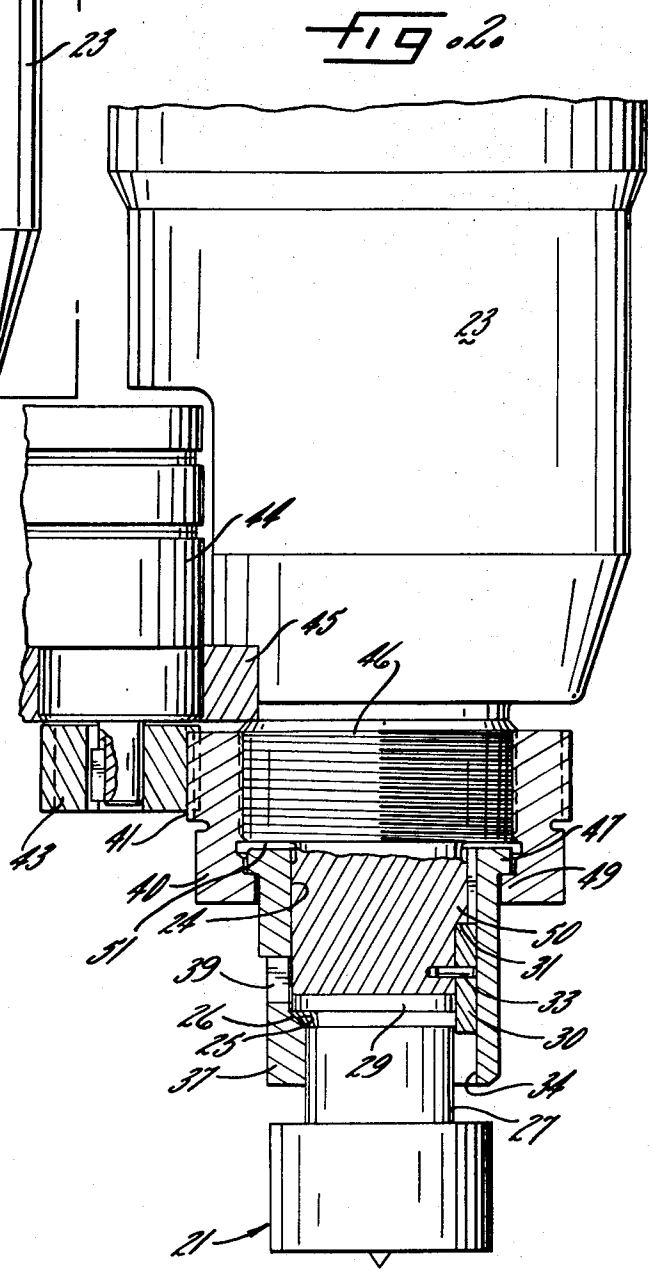


Fig 2.



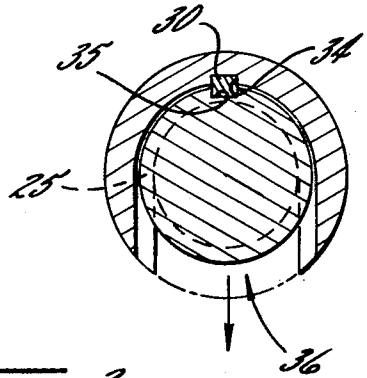


Fig 3.

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Fig. 4.

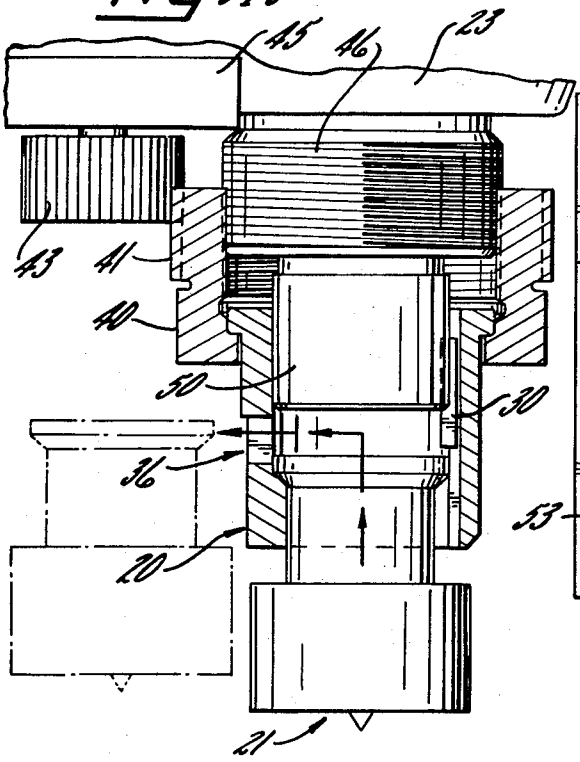


Fig. 5.

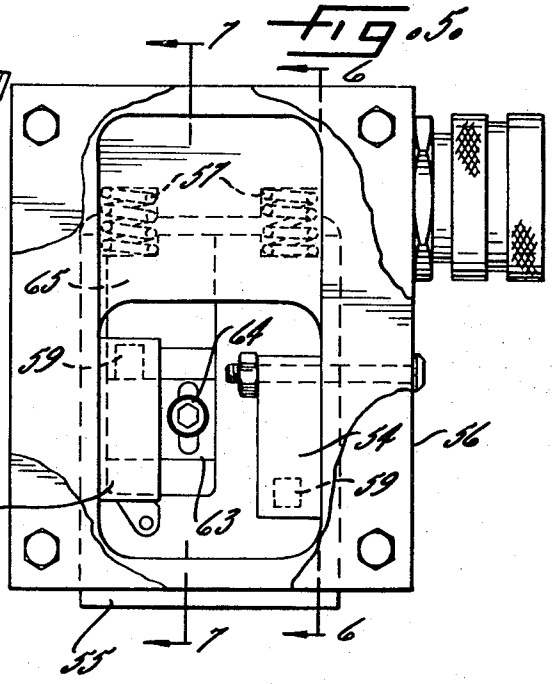
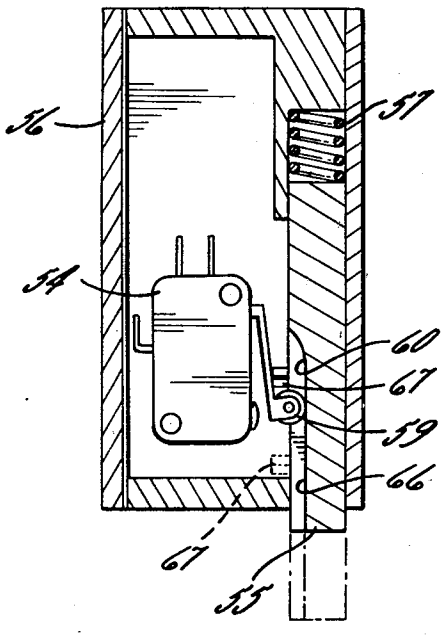


Fig. 6.



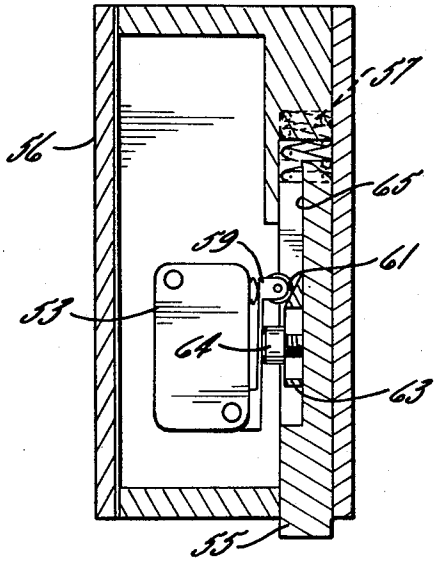


Fig. 7.

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Fig. 8.

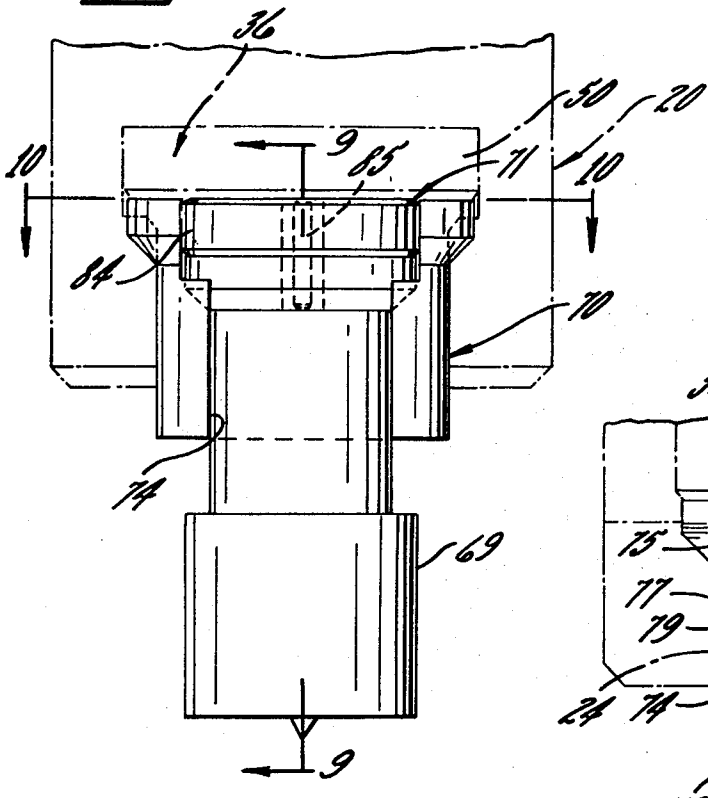
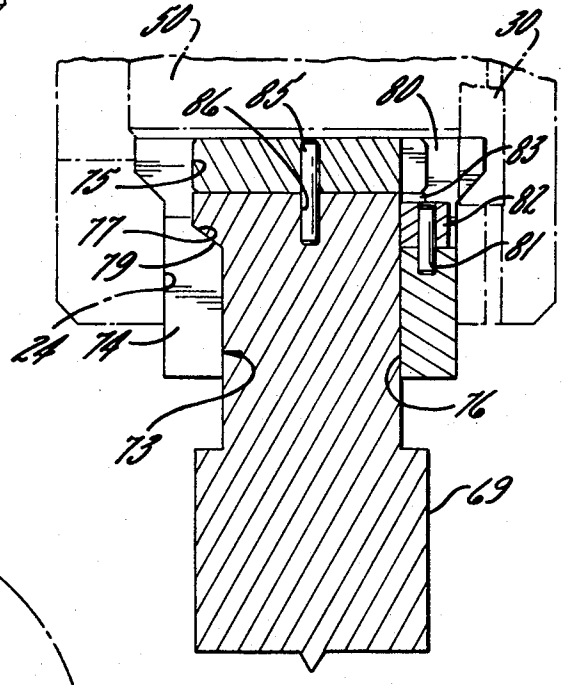


Fig. 9.



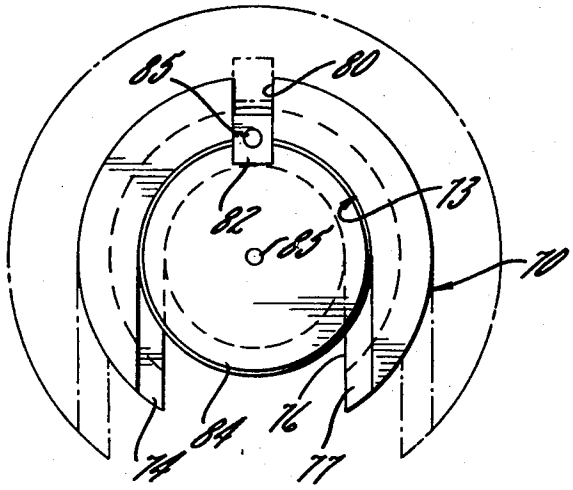


Fig. 10.

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PUNCH HOLDER

BACKGROUND OF THE INVENTION

The present invention relates to a punch holder of the type which is used to clamp and unclamp a punch on the end of the reciprocable ram of a punch press. More particularly, the invention relates to the type of holder with an axial passage narrowed by an annular mating surface or seat upon which the punch is supported by a complementary surface on the punch head to limit downward movement of the punch within the holder.

SUMMARY OF THE INVENTION

The primary object of this invention is to provide a novel punch holder of the above general character which, while still serving to rigidly anchor the punch in a precise radial, axial and angular position, is effective to simplify the tool changing operation and thereby substantially reduce the time and work previously required by a punch press operator to change punches.

A related object is to provide a punch holder which is movable automatically between clamped and released positions to clamp and unclamp the punch on the end of the ram, the holder uniquely retaining the unclamped punch on the ram to prevent the punch from falling out of the holder and interfering with the advance of a workpiece preparatory to the next punching operation and thus freeing the punch press operator for the performance of other tasks while the holder moves between the clamped and released positions.

A more detailed object is to provide a holder whose side is formed with a unique radial entryway which is closed when the punch is clamped in the holder and which is open when the punch is unclamped so that the punch press operator need only to move the unclamped punch radially out of the holder and loosely hang another in the holder to perform his part in changing punches.

A further object is to provide a holder which is power actuated between the clamped and released positions and which is stopped automatically upon reaching either of those positions.

Invention also resides in the provision of a novel adapter which enables use of the punch holder with punches of various sizes.

These and other objects and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevational view of a ram equipped with a new and improved punch holder embodying the novel features of the present invention.

FIG. 2 is a fragmentary cross-sectional view taken substantially along line 2—2 of FIG. 1.

FIG. 3 is a cross-sectional view taken substantially along line 3—3 of FIG. 1.

FIG. 4 is a fragmentary cross-sectional view similar to FIG. 2 but showing parts in moved positions.

FIG. 5 is a fragmentary side elevational view taken substantially along line 5—5 of FIG. 1.

FIGS. 6 and 7 are cross-sectional views taken substantially along lines 6—6 and 7—7 respectively, of FIG. 5.

FIG. 8 is a front elevational view showing an adapter used for mounting a smaller punch in the punch holder.

FIG. 9 is a cross-sectional view taken substantially along line 9—9 of FIG. 8.

FIG. 10 is a view taken substantially along line 10—10 of FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the present invention is embodied in a tubular punch holder 20 used to secure a punch unit 21 on the reciprocating ram 23 of a punch press for performance of a punching operation on a workpiece (not shown) when the ram is moved through advance and return strokes by a fluid operated actuator. Herein, the holder is telescoped onto the lower end of the ram and includes an axial passage 24 (FIG. 2) which is narrowed at its lower end by a downwardly tapered annular seat 25. A complementary mating seat 26 is formed on the punch 21 which, in the present instance, includes an elongated shank 27 and an enlarged head 29. The latter is located on the upper end of the punch and includes a frusto-conical lower surface which forms the complementary mating seat 26. When the punch is inserted into the holder, the two mating seats 25 and 26 engage each other as shown in FIG. 2 to center the punch radially in the holder and to limit downward axial movement of the punch within the holder thereby to keep the punch from being pulled downwardly out of the holder on the return stroke of the ram.

Upward vertical restraint for the punch 21 is provided as a result of the lower end of the ram 23 engaging the top surface of the head 29 in a clamped position (see FIG. 1) to securely seat the punch within the holder 20. Moreover, angular movement of the punch holder and the punch relative to each other and to the ram is prevented by an elongated key 30 (FIG. 2) fastened in a slot 31 in the side of the ram by a pin 33. The key extends radially outward from the side of the ram and slidably fits within a vertical keyway 34 grooved in the inner wall of the holder thus limiting relative angular movement of the holder and ram. The lower end of the key extends downwardly past the lower end of the ram and fits within a notch 35 (FIG. 3) which is cut in the side of the enlarged head of the punch unit so as to hold the punch in a particular angular orientation relative to both the ram and the holder. Thus, the punch is located in a precisely centered position on the end of the ram by the mating seats 25 and 26 and is located in a precise angular position by the key 30.

Frequently, the punch 21 is removed from the punch holder 20 and is replaced with a punch of a different size or shape. In accordance with the primary aspect of the present invention, the punch changing operation is greatly simplified through the provision of a novel punch holder 20 which avoids the need for the operator of the punch press to manually hold the punch 21 while the latter is being clamped to and unclamped from the holder. For this purpose, a novel entryway 36 is formed through one side of the holder to permit radial loading and unloading of the punch 21 into and out of the axial passage 24. After the punch has been loaded manually into the holder through the radial entryway 36, and hung loosely in the axial passage, the holder is auto-

matically moved upwardly on the ram 23 to a clamped position (FIG. 1) in which the lower end of the ram closes off the entryway and clamps the punch securely in the holder. While the punch is being clamped, the press operator need not hold the punch in place and is free to perform other tasks since the punch holder itself retains the punch during such clamping. When the punch is to be removed, the holder is automatically moved downwardly on the ram to a released position (FIG. 4) in which the lower end of the ram unclamps the punch and opens up the radial entryway 36 for subsequent manual unloading of the punch. As the punch is being unclamped, the operator need not hold the punch since, once unclamped, the punch simply hangs loosely in the axial passage 24 and cannot fall downwardly out of the holder and onto the workpiece. Accordingly, the punch holder of the present invention requires less time and attention on the part of the press operator during a punch changing cycle.

In the present instance, the entryway 36 includes an elongated slot 37 (FIG. 1) formed through the side of the holder diametrically opposite the keyway 34. Centered at the upper end of the slot is an enlarged generally rectangular opening 39 also formed entirely through the side of the holder to lead into the axial passage 24. The size and shape of the slot and opening conform generally to the cross-sectional size and shape of the shank 27 and the enlarged head 29, respectively, of the punch 21. Thus, when the holder is in its released position shown in FIG. 4 and the lower end of the ram 23 uncovers the entryway, the punch can be moved radially into the holder and then lowered into the passage with the seat 26 loosely engaging the seat 25 to prevent the punch from dropping out of the lower end of the passage.

When placing the punch 21 within the holder 20, the notch 35 on the periphery of the punch head 29 is aligned angularly with the key 30 extending along the side of the ram 23 opposite the entryway 36. The punch cannot be inserted completely into the holder without the notch interfitting with the key and, if the punch press operator finds that the notch and key are misaligned, a simple twist one way or the other will properly align the punch within the holder and allow the punch to be radially pushed into axial alignment with the ram.

It is possible to mount the holder 20 for relative axial movement between its clamped and released positions with respect to the lower end of the ram 23 in various ways without deviating from the concept of the present invention. For instance, the holder could be held in a fixed position on the ram with a separate lower end portion of the ram being movable up and down within the main portion of the ram to open and close the entryway 36. For simplicity in construction, however, the present arrangement employs a movable carrier in the form of a collar 40 (FIG. 2) connected at its lower end to the holder and internally threaded for vertical movement on an intermediate portion of the ram to carry the holder between the clamped and released positions. The upper end of the collar is formed with external gear teeth 41 meshing with the teeth of a drive gear 43 connected to be rotated by a reversible motor 44 which is mounted on the side of the ram by a support block 45. As the collar is turned, it moves upwardly or downwardly (depending upon the direction of turning) on an external thread 46 formed on the side of the ram. The gear teeth 41 spline with the gear 43 as the collar moves vertically thereby to enable movement of collar relative to the motor.

Herein, the holder 20 is loosely telescoped into the collar 40, an outer flange 47 (FIG. 2) at the periphery of the upper end of the holder resting on an annular lip 49 formed on the inner wall at the lower end of the collar to limit downward movement of the holder within the collar. As shown, the holder is telescoped over a reduced lower end portion 50 of the ram and slides up and down thereon when moved between the clamped and released positions. When in the clamped position as shown in FIG. 2, the top surface of the holder is spaced below the lower surface 51 of the threaded portion 46 of the ram because the length of the reduced portion 50 is longer than the distance between the top surface of the punch 21 and the top surface of the holder. Thus, when in the clamped position, the extreme lower end surface of the ram presses against the top surface of the punch to force the mating surfaces 25 and 26 together to seat the punch tightly in the holder.

In summary, the empty punch holder 20 is initially disposed in a lowered released position as shown in FIG. 4 in which the extreme lower end of the ram is located above the enlarged top opening 39 of the entryway 36. To load the punch 21 into the holder, the press operator simply moves the punch radially into the entryway and thereafter allows the punch to drop downwardly into the passage 24, the head 29 of the punch then being located below the enlarged opening and the punch hanging loosely in the holder by virtue of the engagement of the seats 25 and 26. The press operator next energizes the motor 44 to move the holder upwardly to its clamped position (FIG. 2) and, during such movement, the operator may move onto another task without danger of the punch falling downwardly onto the underlying workpiece, which usually is being advanced into position beneath the punch.

As the punch holder 20 moves upwardly to its clamped position (FIG. 2), the lower end portion 50 of the ram 23 closes off the enlarged opening 39 of the entryway 36 to preclude any possibility of the punch 21 escaping radially from the entryway. Thereafter, the head 29 of the punch engages the extreme lower end of the ram to press the seat 26 into tight clamping engagement with the seat 25 and thereby lock the punch tightly in the holder in an accurately centered position.

When the punch 21 is to be removed, the operator merely energizes the motor 44 in a direction causing the punch holder 20 to move downwardly to its released position (FIG. 4). During such movement, the head 29 of the punch moves downwardly away from the extreme lower end of the ram 23 to release the clamping pressure between the seats 25 and 26 and, in addition, the enlarged opening 39 moves downwardly from the lower end portion 50 to open up the entryway 36 for subsequent radial unloading of the punch. The operator need not, however, unload the punch immediately and indeed not attend to the punch at all during the unclamping since the seats 25 and 26 retain the punch in the holder until the operator removes the punch radially through the entryway.

Advantageously, the holder 20 is stopped automatically at the clamped and released positions. For this purpose, upper and lower limit switches 53 and 54 (FIG. 5) connected through appropriate circuitry with the motor 44 are tripped to deactivate the motor by a cam plate 55 which rides vertically with the collar 40 as it is moved between the two positions. As shown in FIGS. 1 and 5, the limit switches and the cam plate are carried on the side of the ram 23 within a rectangular housing 56. The cam plate is slidable within the housing, extends vertically through the bottom thereof and is resiliently biased downwardly by upper springs 57 so as to engage the upper edge of the collar. As the collar moves between the clamped and released positions, the plate slides past spring-loaded switch actuators 59 (FIGS. 6 and 7) which ride against two curved cam surfaces 60 and 61 on the plate to trip the proper limit switch and deactivate the motor which, in turn, stops the holder in one of the positions.

More particularly, the upper limit switch 53 is tripped as the holder 20 reaches the clamped position by the cam surface 61 which in the present instance is formed by a vertically adjustable block 63 (FIG. 7) fastened by a locking bolt 64 within a widened slot 65 cut in the cam plate 55. Vertical adjustment of the cam block 63 allows for precise stopping of the holder in the clamped position to avoid binding of the threads 46 by threading the collar 40 too far up on the ram 23 or to avoid not threading the collar far enough up on the ram and leaving the end of the ram short of the punch 21. The lower limit switch 54 serves to deactivate the motor as the holder reaches the released position and, in this instance, the curved portion of the cam surface 60 slides downwardly with the collar to engage the actuator 59 and thereby trip the switch. Herein, the cam surface 60 is formed by an elongated groove 66 cut within the cam plate with a curved upper end portion for sliding past the actuator to trip the lower limit switch 54.

Thus, the collar 40 is stopped at the clamped and released positions by the cam plate 55 as it rides on top of the collar to trip the upper and lower limit switches 53 and 54. Should the collar be removed from the lower end of the ram 23, a keeper pin 67 (FIG. 6) fastened to and extending outwardly from the cam plate engages the bottom wall of the housing 56 to prevent the cam from falling out of the housing.

In accordance with another aspect of the present invention, the holder 20 is adapted for use with a wide variety of shapes and sizes of smaller punches 69. For this purpose, novel provision is made of a tubular adapter 70 (FIG. 8) sized to fit within the holder to reduce the size of the axial passage 24 while still permitting radial tool changing, and provision also is made of a spacer 71 for effectively lengthening the punch for axial locking within the holder. With such adapters and spacers, the holder can be used in conjunction with a wide variety of differently sized and shaped punches which may be changed as easily and quickly as the one piece punch unit 21 and without need of changing the holder.

In the present instance, the adapter 70 is formed as a tubular member having an axial opening 73 (FIGS. 9 and 10) and an outer size and shape substantially equal to the size and shape of the upper end portion of the one-piece punch 21. The adapter thus is sized to fit within the axial passage 24 of the holder 20 in the same fashion as the one-piece punch. When the adapter is fitted within the holder, a T-shaped slot 74 formed in and extending from the top to the bottom of one side of the adapter aligns with the entryway 36 in the holder and extends completely through the side of the adapter into the axial opening 73. The latter extends axially through the adapter and includes an enlarged upper end portion 75 (FIG. 9) sized to receive the head of the small punch 69 and a narrowed lower end portion 76 sized to fit around the shank of the small punch. A holding surface 77 is formed between the two end portions and below the enlarged upper end of the T-slot for engagement with a complementary holding surface 79 on the punch to prevent the punch from sliding through the axial opening 73 when dropped into the adapter. Thus, the seating together of the two holding surfaces and the inside walls of the adapter act to hold the punch axially and radially within the holders.

To hold the small punch 69 angularly within the holder 20, a rectangular notch 80 (FIGS. 9 and 10) is cut through the side of the adapter 70 diametrically opposite the T-slot 74 and extends downwardly from the top of the adapter to about the mid-portion thereof. Mounted by a pin 81 (FIG. 9) in the bottom of the notch is a key 82 engageable within a keyway 83 formed in the periphery of the head of the smaller punch to hold the punch angularly within the adapter. The upper outer sides of the notch engage the key 30 on the side of the ram in a manner similar to the engagement of the key and the notch 35 in the periphery of the normal sized punch unit 21 to hold the adapter angularly within the holder.

To increase the effective length of the small punch 69 so that the latter may properly fit within the holder 20, the spacer 71 is mounted on top of the head of the punch. Herein, the spacer is formed as a circular metal slug 84 (FIG. 8) having a diameter equal to the enlarged upper end portion of the small punch. A center holding pin 85 is telescoped into a vertical hole 86 formed in the top of the punch to hold the spacer against the top surface of the head of the punch. When the punch is positioned in the adapter, the top surface of the slug is flush with the top surface of the adapter as shown in FIGS. 8 and 9 so that the lower end portion 50 of the ram 23 engages the top surface of the spacer as the holder is moved upwardly on the ram to lock the punch unit in the holder.

The small punch 69, the adapter sleeve 70 and the spacer 71 thus form a punch unit which is substantially the same size as the large punch 21 so that the small punch may be fitted into and locked in the same holder 20 as the large punch. In the appended claims, the terms "punch unit" are intended to encompass both a punch per se and a punch assembly with a punch whose effective size is increased by virtue of attaching elements such as an adapter, a spacer or the like to the punch.

We claim as our invention:

1. A punching machine for reciprocating an upright punch unit having an elongated shank with an enlarged head at the upper end thereof, said machine comprising a ram adapted for up and down reciprocation, a tubular punch holder having an axial passage therethrough and telescoped over said ram with the lower end of the ram

projecting into said passage, an elongated slot formed through one side of said holder, an enlarged opening formed through said holder at the upper end of said slot, the size and shape of said slot and opening being correlated with the size and shape of said shank and head, respectively, to permit movement of said punch unit radially into said punch holder, mating seats on said punch unit and the inner side of said punch holder and engageable with one another to limit axial movement of the punch unit downwardly within said holder, and means mounting said punch holder on the lower end of the ram for reciprocation with the ram and also for selective axial movement relative to the ram between (a) a clamped position in which the end of said ram closes off at least the upper end portion of said opening, engages the head of said punch unit and forces said seats into engagement to lock said punch unit in said holder, and (b) a released position in which the end of the ram releases said head and opens up said upper end portion of said opening to permit radial movement of said punch unit out of said holder.

2. A punching machine as defined by claim 1 including an operator for moving said holder axially relative to the ram between said clamped and released positions.

3. A punching machine as defined by claim 2 wherein said operator is power actuated.

4. A punching machine as defined by claim 2 wherein said mounting means includes a carrier connected between the ram and the holder and being movable axially relative to the end of the ram by said operator to carry said holder between said clamped and released positions.

5. A punching machine as defined by claim 4 wherein said holder includes an outer flange at a periphery of the upper end of the holder, said carrier being a collar with a generally horizontal annular lip on the lower end of the collar positioned to engage the lower surface of the flange and limit movement of said holder downwardly within the collar, a threaded upper end portion on the collar and holding the collar on the ram so that the collar may be turned to move axially relative to the lower end of the ram, and gear teeth on said upper end portion for engagement with said operator to be turned thereby to move said holder between said clamped and released positions.

6. A punching machine as defined by claim 4 in which said operator is power actuated and further including of means for automatically deactivating the operator once said holder is moved into said positions.

7. A punching machine as defined by claim 6 wherein said last-mentioned means includes a switch housing mounted on said ram above said carrier, first and second limit switches mounted within said housing, and first and second cams mounted within said housing and movable vertically with said carrier, said first cam actuating the first limit switch to deactivate said operator when said carrier moves the holder into said clamped position, and said second cam actuating the second limit switch to deactivate said operator when the carrier moves the holder into said release position.

8. A punching machine as defined by claim 1 further including means for holding said punch holder angular movement relative to the end of the ram and for holding said punch unit against angular movement relative to said holder.

9. A punching machine as defined by claim 8 wherein said holding means includes a key fastened to the side of the ram, and a longitudinal keyway formed in the inner wall of said punch holder to receive said key and prevent the holder from moving angularly relative to the end of the ram.

10. A punching machine as defined by claim 9 wherein the enlarged head of said punch unit includes a notch to hold said key extending past the end of the ram to fit within said notch to hold said unit against angular movement relative to said holder and the end of the ram.

11. A punching machine as defined by claim 1 wherein said punch unit includes a punch with an elongated body having an enlarged upper end portion, said body being substantially smaller than the slot and opening in the side of the holder, the diameter of said enlarged upper end portion being smaller than the smallest diameter of said axial passage, said punch unit further including an adapter sleeve with an entryway formed through one side thereof, said entryway conforming to the size and shape of said punch body to permit said tool to be moved radially into the adapter sleeve, holding surfaces on said punch and on the inside of said adapter sleeve and engageable with one another to limit axial movement of the punch downwardly within the sleeve, and a spacer mounted on top of the enlarged upper end portion of the punch with the top surface of the spacer substantially flush with the top edge of the sleeve.

12. A punching machine as defined by claim 11 including means for preventing relative angular movement of said punch holder, said adapter sleeve and said punch with respect to each other and with respect to said ram when mounted together on the end of the ram.

13. A punching machine as defined by claim 12 wherein said holding means includes a first key fastened to the side of the ram, a longitudinal keyway formed in the inner wall of said punch holder to receive said first key and hold the holder angularly oriented on the end of the ram, a first notch formed in the outside wall of said adapter sleeve, said key extending past the end of the ram to fit within said first notch to hold said adapter sleeve against angular movement relative to said holder and the end of the ram, a second key fastened to the inside wall of said adapter sleeve, a second notch formed in the enlarged upper end of the said punch, and said second key extending into said second notch to hold said punch against angular movement within said adapter sleeve.

14. For holding a tool having an elongated shank with an enlarged head at one end thereof, the combination of, an outer sleeve member formed with an axially extending passage, and elongated slot formed through one side of said sleeve, an enlarged opening formed through said sleeve at one end of said slot, said slot and said opening being sized and shaped to permit radial movement of said shank and said head, respectively, into said passage when said tool is moved radially toward said sleeve, coacting surfaces on said tool and the inner side of said sleeve and engageable with one another to limit axial movement of the tool in one direction within the sleeve, and an inner member telescoped into said sleeve member, one of said members being movable axially relative to the other member between (a) a clamped position in which one

end of said inner member closes off at least a portion of said opening, engages the head of said tool and forces said surfaces into engagement to lock said tool in said sleeve, and (b) a released position in which said one end of said inner member releases said head and opens up said one portion of said opening to permit radial movement of said tool out of said sleeve.

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