HYDRAULIC RAM UNIT


Application January 18, 1954, Serial No. 404,558

3 Claims. (Cl. 121—38)

The present invention relates to a hydraulic ram unit adapted to perform punching, piercing and forming operations on a sheet metal structure.

The illustrated embodiment of the present invention comprises a tool carrying cylindrical ram having a piston therein on which the cylinder is advanced and retracted. The use of a movable cylinder and fixed piston may be found in some conventional ram units. However, in such conventional structures the piston means is generally supported by its protruding end on a rigid member and the cylinder is supported for movement on slide or guide ways. There are several objections with regard to such conventional ram unit construction. The machining and alignment of the ways on which the cylinder is slidable is a complicated, time-consuming expensive procedure. Also, the bearing surface available in such structure is substantially limited and accordingly is subject to relatively rapid wear. The wear of the guide ways results in misalignment of the piston with the cylinder causing excessive wear therebetween. Further, in the conventional structure any misalignment or looseness due to wear of the guide ways is aggravated when it is necessary to tilt the ram unit to perform operations on angularly situated surfaces of the workpiece.

It is an object of the present invention to provide a construction wherein the foregoing objections to a conventional ram unit structure are eliminated. In the illustrated embodiment of the invention the tool carrying cylinder or ram is journaled for axial movement within a substantially cylindrical housing. It will be recognized that it requires less effort to precision bore a cylindrical bearing surface than to machine a guide or slide way. Further, journauling the cylindrical ram in a cylindrical housing provides a maximum of bearing and support surface regardless of the angle of inclination at which it is necessary to operate the ram unit.

The present embodiment also includes an improved key device for preventing rotation of the tool carrying cylinder or ram relative to the cylindrical housing. The improved key device includes means for adjusting the key when necessary to compensate for wear thereon.

Other objects, features and advantages of this invention will be apparent from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference numerals designate corresponding parts in the several views.

Fig. 1 is a vertical sectional view of a hydraulic ram unit constructed in accordance with the present invention.

Fig. 2 is a view in part sectional taken substantially along the line 2—2 of Fig. 1 looking in the direction of the arrows.

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2 looking in the direction of the arrows.

Fig. 4 is a diagrammatic view of a simplified hydraulic circuit for operating the ram unit embodying the present invention.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawing, since the invention is capable of other embodiments and of being practiced and carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is illustrated by way of example, one embodiment of the present invention as applied to a piercing or punching mechanism. The mechanism comprises a cylindrical housing or body, generally designated 10, which is adapted to be secured to a table surface 11. Slidable within the bore 12 of the cylindrical housing 10 is a cylinder 13. The cylinder 13 is, as will more fully be explained, the main tool carrying cylinder or ram of the present device.

The cylinder 13 is provided with a bore 14 within which operates a piston 15. The piston 15 is provided with a rod 16 secured to a collar or end cap 17 by a nut 18 and a lock nut 19. The end cap 17 is secured to the cylindrical housing or body 10 by means of screws 20, the end cap, however, being spaced from the body by a barrel or spacer ring 21. The piston 15 is thus secured to the housing 10 and is rigidly held against movement relative thereto.

The left end of the cylinder ram bore 14, as viewed in Fig. 1, is provided with an end cap 22 secured to the end of the cylinder 12 by screws 22a and through which the piston rod 16 projects. The end cap 22 is provided with a suitable oil seal 22b to prevent leakage of hydraulic fluid.

Both the end cap 17 and the piston rod 16 are provided with fluid passageways 23 and 24, respectively. To advance the cylinder 13 to the right as viewed in Fig. 1, fluid under pressure is admitted through the end cap 17 passageway 23. The pressure of this fluid is exerted against the surface 25 of the end cap 22 thus causing the cylinder 13 to move toward the right as viewed in Fig. 1. Conversely, to retract the cylinder 13, that is, to move it to the left, fluid under pressure is admitted through passageway 24 to the bore 14 of the cylinder 13 and the pressure is exerted on the surface 26 of end cap 22. Suitable oil seals are provided to prevent fluid leakage. One such seal 27 is provided between the piston 15 and the walls of the bore 14. Also, oil rings 28 are provided between adjacent surfaces of the end cap 17 and the barrel or spacer ring 21 and the barrel of the body 10. An oil seal 29 is also provided between the cylinder 13 and the left end of the bore 12 of the body 10. There is also an oil seal 30 carried in the end cap 17 and surrounding the reduced end 16 of the piston rod 16.

It is to be understood that a simple conventional fluid system such as diagrammatically illustrated in Fig. 4 for example, is employed to direct hydraulic fluid to and from the passageways 23 and 24 in proper sequence.

Fluid is directed from a pressure source, represented by fluid line 31 through a three position four way valve 32 into passageway 23 thereby causing the ram to move toward the right as viewed in Figs. 1 and 4. Any fluid in the chamber formed by bore 14 will be exhausted through passageway 24 through the valve 32 into discharge line 33. Upon completion of the advance movement of the ram 13, that is, completion of the punching or piercing operation, the valve 32 will be manipulated, manually or automatically as the case may be, to permit fluid under pressure to flow through passageway 24 into
the chamber formed by the bore 14 so as to act against surface 26 of end cap 22 to cause the cylinder or ram 13 to retract or move to the left as viewed in Fig. 1. Fluid in the chamber of the barrel or spacer ring 21 will be exhausted through passageway 23.

The right end 34 of the cylinder or ram 14 has secured thereto by means of screws 35 a mounting plate 36. The mounting plate 36 has secured thereto by screws 37 an adaptor plate 38. The adaptor plate 38 provides the means for supporting, in the present instance, the punch means 18 of the device herein illustrated, by way of example, the punch member 39 coacts with a die element 40 mounted in a support member 41, the punch member 39 and die element 40 forming a punch couplet for piercing holes in a sheet of material. It is to be understood that the element and member may be a forming die couplet for forming a piece of metal to a desired shape.

The adaptor plate 38 is illustrated as supporting a pressure plate or slider element 42. The adaptor plate 38 is provided with openings 43 therein through which studs 44 extend, the studs being threaded into the slider element. The heads 45 of the studs are retractable in element 46 in the adaptor plate 38. Compression helical springs 47 are provided to normally urge the slider element away from the adaptor plate 38. The operative end 48 of the punch member 39 projects through a port 49 in the slider element.

The foregoing construction and mounting of the slider element 42 is conventional and the operation thereof may be briefly stated. As the ram 14 is moved to the right as viewed in Fig. 1, the slider element 42 and the punch end 39 substantially simultaneously contact the surface of the workpiece. The punch end will then penetrate the workpiece as the slider element springs 47 are compressed. Upon retraction of the punch slider element 42 the slider element will retain the workpiece against the die element support 41 until the punch end 39 has been withdrawn from the punched hole in the workpiece and again is flush with the surface of the slider element, whereupon both punch and slider element will be retracted in unison to the position shown in Fig. 1.

As illustrated, the punch 39 is located axially of the ram 14 and the port 49 is correspondingly centrally located in the slider element. However, it will be readily understood that variations in the shape and location of the punch are possible. That is, the punch may be a compound die element or may have to be located eccentrically of the ram axis to accomplish the desired result. Under such conditions, no angular rotation of the ram must occur otherwise the punch will lose its critical alignment with the opposing die element. In Figs. 2 and 3 there is illustrated an improved adjustable key means for preventing rotation of the cylinder or ram 13 relative to the housing or body 10.

It will be noted that the tool carrying cylinder or ram 13 is provided with a longitudinally extending key slot 50 having tapered side walls. Mounted on the front face 10a of the cylindrical housing 10 is a key 51 having a tapered nose portion 52 adapted to cooperate with the tapered side walls of the key slot 50. The key 51 is mounted in a guide slot 53 in the housing face 10a and is adapted to be moved radially of the cylinder or ram 13. A screw 54 is provided to lock the key in adjusted position. To further control the adjustment of the key 51, there is provided a key adjuster 55. The key adjuster 55 is provided with an inclined face 56 coacting with a cooperating or complementary, inclined face 57 on the key adjuster. The key adjuster 55 is adjustable inwardly and outwardly by means of an adjusting screw 58, as best viewed in Fig. 3. Inward movement or movement to the right as viewed in Fig. 3 will result in the key 51 being radially of the cylinder or ram 13. A set screw 59 is provided to lock the key adjuster in adjusted position.

It is believed apparent that the key 51 may be adjusted to give the desired slip fit of the key 51 in the keyway 50 and to maintain the cylinder or ram 13 against any tendency to rotate during its advancing and retracting movements.

Grease or oil cups 59 are provided leading to lubrication passageways 60 in the housing 10, which passageways surround the cylinder or ram 13.

It will be noted in Fig. 1 that the bore 14 is provided with a vent 70 opening into the keyway 50. This vent serves a dual function. On movement of the cylinder or ram 13 to the right as viewed in Fig. 1, relative to the piston 15 the vent 70 provides a means by which air may be sucked into the bore 14 to prevent a retarding vacuum from being created. On return movement of the ram or cylinder 13, the air in chamber 14 will be exhausted through the vent 70 and will blow down the keyway 50 keeping the keyway free of foreign matter.

It will be noted that the area of the surface 25 of the end cap 22 against which the fluid pressure acts to advance the ram 13 is larger than the area of the surface 26 of the end cap 22 against which the pressure acts to retract the ram. Thus, the force exerted by the ram in its operating stroke is greater than the force exerted during the retracting stroke, the desirability of which is believed readily apparent. Further, since the volume of fluid required to advance the ram is greater than required to retract the ram, the ram will be retracted faster than it advances in order to accommodate the flow of fluid from the pressure source, i.e., the pump. This feature also is advantageous in that it cuts down the non-operating time of the ram unit.

Although only one hydraulic ram unit is illustrated, it will be understood that any number of units may be grouped on the work table depending upon the number of piercing, punching or forming operations to be performed. The manner in which the ram or tool carrying cylinder 13 is journaled in the cylindrical housing or body 10 ensures that the ram will be fully supported and guided in its axial movements regardless of the angle of inclination at which the ram unit may be positioned. Also, it is not usual that the axis of the punch be concentric with the axis of the ram 13 and off center holes may be readily pierced or punched without materially affecting the alignment of the ram with its guide surfaces.

Further, it is believed readily apparent that the cost of manufacturing the present ram unit will be materially less than the cost of manufacturing a unit wherein the cylinder or ram 13 is guided on slide ways. It is much easier to precision bore a guide surface like the bore 12 of the body 10 and to fit a cylinder or ram unit 13 therein than to machine and align guide or slide ways and to fit a slide carriage thereon. Also, in the present embodiment, the axis of the piston 15, the ram 13 and the bore 12 of the body 10 are coincident which facilitates the alignment of these parts and results in a ram unit which is subject to a minimum of wear due to misalignment.

We claim:

1. A device for performing punching operations or the like on a piece of work, comprising a body member having a longitudinally extending internally cylindrical ram receiving portion, a tool carrying cylindrical ram journaled for axial movement within said ram receiving portion, a piston means within said ram means, said body member whereby said piston means is movable relative to said body member, fluid means for axially moving said ram in either direction relative to said body member and piston means, said ram having a longitudinally extending key slot in the outer surface thereof, key means carried by said body member, and means for adjusting said key means radially of said ram to compensate for wear and to maintain the latter in bearing engagement with the key-slot walls, said key means
and key-slot preventing turning movement of said ram relative to said body during axial movement of said ram.

2. A device for performing punching operations or the like on a piece of work, comprising a body member having a longitudinally extending cylindrical ram receiving portion, a tool carrying cylindrical ram journalled for axial movement within said ram receiving portion, a piston means within said ram and connected to said body member whereby said piston means is immovable relative to said body member, fluid means for axially moving said ram in either direction relative to said body member and piston means, said ram having a longitudinally extending key-slot in the outer surface thereof, said key-slot having tapered side walls, key means carried by said body member having a tapered end portion complementary to the tapered side walls of said key-slot, and wedge means carried by said body member adjustable to move said key means radially of said ram to maintain the same in bearing engagement with the key-slot walls, said key means and key-slot preventing turning movement of said ram relative to said body during axial movement of said ram.

3. A device for performing punching operations or the like on a piece of work, comprising a body member having a longitudinally extending internally cylindrical ram receiving portion, a tool carrying cylindrical ram journalled for axial movement within said ram receiving portion, a piston means within said ram and connected to said body member whereby said piston means is immovable relative to said body member and piston means, said ram having a longitudinally extending key-slot in the outer surface thereof, said key-slot having tapered side walls, key means carried by said body member having a tapered end portion complementary to the tapered side walls of said key-slot, and wedge means carried by said body member adjustable in a direction axially of said ram to move said key means radially of said ram to maintain the same in bearing engagement with the key-slot walls, said key means and key-slot preventing turning movement of said ram relative to said body during axial movement of said ram.

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