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FLUID OPERATED HAND TOOL

Filed Nov. 4, 1964

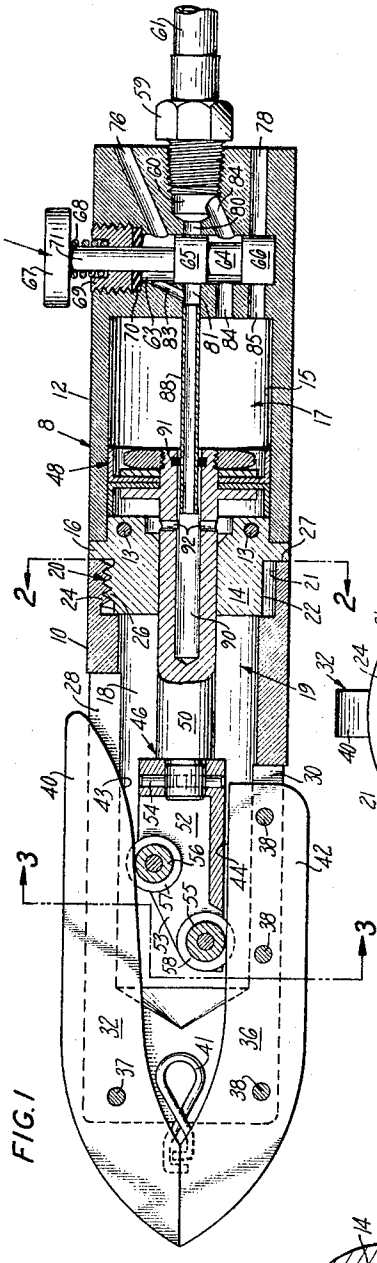

FIG. 1

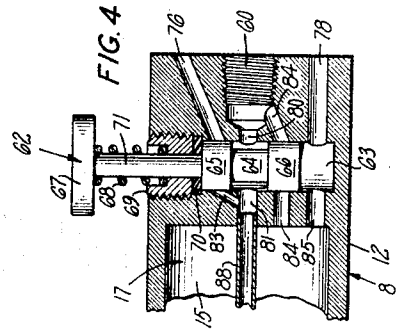

FIG. 4

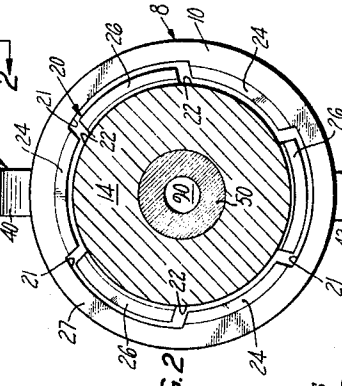

FIG. 2

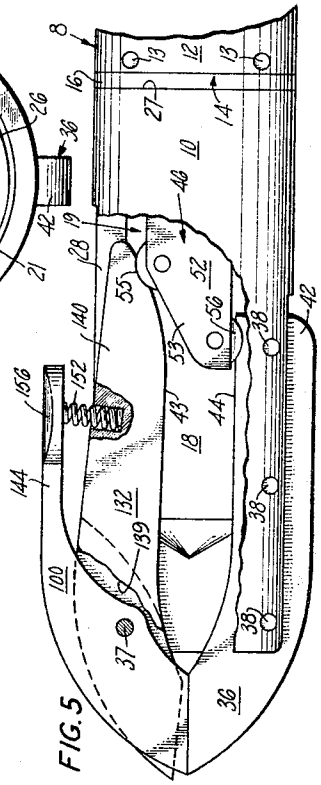

FIG. 5

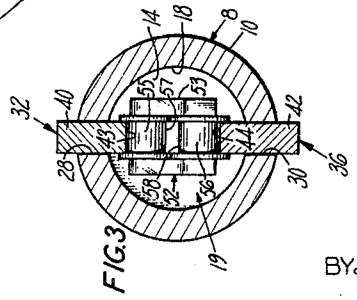

FIG. 3

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FLUID OPERATED HAND TOOL

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The present invention relates to fluid operated hand tools and more particularly to fluid operated hand tools having opposed jaws useful for clamping, gripping, swaging or the like.

A principal aim of the present invention is to provide an improved pneumatically operable hand tool having a compact and lightweight assembly and a clamping, gripping or swaging action of improved capabilities.

Another aim of the present invention is to provide a pneumatically operable hand tool of the type described which is useful with sources of compressed air conventionally available at manufacturing and repair facilities.

A further aim of the present invention is to provide an improved fluid operated hand tool having detachable jaws that may be easily replaced for selectively adapting the hand tool for different clamping functions and thereby provide a basic hand tool of unusual flexibility.

Another aim of the present invention is to provide a fluid operated hand tool having a combination of parts of low cost manufacture adapted for economical and convenient assembly.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth, and the scope of the application of which will be indicated in the appended claims.

In the drawing:

FIG. 1 is a longitudinal section view, partly broken away, showing an embodiment of the fluid operated hand tool of the present invention with a control button thereof in a fully depressed position;

FIG. 2 is an enlarged transverse section view of the embodiment of the fluid operated hand tool of FIG. 1 showing the cooperative parts of a quick-disconnect thereof in an aligned disconnected relationship;

FIG. 3 is a transverse section view of the embodiment of the fluid operated hand tool of FIG. 1 taken substantially along line 3—3 of FIG. 1;

FIG. 4 is a fragmentary longitudinal section view of the embodiment of the fluid operated hand tool of FIG. 1 showing the control button thereof in a normal or withdrawn position; and

FIG. 5 is a fragmentary longitudinal view, partly broken away, illustrating a modified embodiment of the fluid operated hand tool of the present invention.

Referring now to the drawing in detail wherein like numbers represent like parts, a first embodiment of a fluid operated hand tool of the present invention is illustrated in FIGS. 1–4. This embodiment is shown with an elongated generally cylindrical tool housing **8** having a diameter suitable for convenient manual manipulation of the tool and comprising separable forward and rear housing portioins **10**, **12** respectively. A plug or bushing **14** is fixed within the forward end of a longitudinally extending forwardly opening bore **15** in the rear housing portion **12** by a pair of transverse pins **13** and with its annular flange **16** abutting the forward end of the rear housing portion. The plug **14** accordingly encloses a longitudinally extending operating cylinder **17** of the bore **15**. The plug **14** is adapted for receipt within the rearward end of a longitudinally extending rearwardly opening bore **18** in the forward housing portion **10** and is accordingly adapted to enclose a longitudinally extending

operating cylinder **19** of the bore **18**. In addition to providing an end cap for each of the bores **15**, **18**, the plug **14** cooperates with the rear end of the forward housing portion **10** to provide a quick-disconnect attachment **20** between the housing portions. In the illustrated embodiment the quick-disconnect **20** is provided by a breech lock, best seen in FIG. 2, comprising angularly spaced axially extending grooves or slots **21**, **22** and intermediate threaded portions **24**, **26** on the forward housing portion **10** and plug **14** respectively. The threaded portions and axial slots thereby cooperate to provide for attaching the housing portions by inserting the forward housing portion longitudinally onto the plug **14** and rotating the forward housing portion relative to the plug until the rear end **27** of the forward housing portion **10** abuts the annular flange **16** and thereby securely locks the housing portions together.

The forward housing portion **10** is slotted from its forward end to provide a pair of diametrically opposed slots **28**, **30** opening into the operating cylinder **19**, and a jaw assembly comprising a pair of jaw plates **32**, **36** are mounted within the slots **28**, **30**, respectively. The jaw **32** is mounted within the slot **28** on a transverse pivot pin **37**, and the opposing jaw **36** is fixed within the slot **30** by a series of laterally extending retaining pins **38**. The jaw plates are provided with arched lever arms **40**, **42** having opposed inner edge portions **43**, **44**, respectively, disposed within the forward operating cylinder **19**. A torsion spring **41** received in part within the slot forwardly of the operating cylinder **19** has opposed offset ends received within conforming slots in the jaws to provide for pivoting the jaw **32** to its normal or open position.

The pivotal jaw **32** is actuated against the bias of the torsion spring **41** for clamping, gripping, swaging or the like by a ram **46** having a push rod **50** longitudinally reciprocable within a central opening in the plug **14**, an actuating piston **48** fixed to the rear end of the push rod for operation within the operating cylinder **17** and a jaw operator **52** fixed to the forward end of the push rod for longitudinal movement within the operating cylinder **19**. The jaw operator **52** includes a roller support **53** fixed on the end of the push rod by a transverse pin **54** and a pair of axially offset and diametrically related parallel rollers **55**, **56** rotatable on the support **53** for engagement with the jaw edge portions **43**, **44**, respectively. The edge portion **43** of the pivotal jaw **32** is convexly curved to provide a camming edge whereas the edge portion **44** of the stationary jaw **36** extends parallel to the axis of reciprocable movement of the ram **46** to provide a guide or support for the ram. Thus, upon forward movement of the ram **46** from its withdrawn position the jaw **36** functions as a lateral guide or support for the ram and the roller **55** functions to pivot the jaw **32** to provide cooperative action between the jaw faces for crimping, swaging, gripping or the like.

To facilitate operative alignment of the jaws with the rollers **55**, **56** when assembling the housing portions **10**, **12** and to further assist in guiding the reciprocating ram **46**, the rollers are provided with spaced annular flanges forming intermediate peripheral recesses or slots **57**, **58** for receiving the rearwardly extending lever arms of the jaws. An operator is thereby assured of having the rollers and jaws in aligned relationship by simply fitting the opposed jaw edges within the peripheral recesses **57**, **58**, when the forward housing portion is assembled with the rear housing portion, for which purpose the ram **46** may be extended to enable the forward housing portion to be inserted onto the ram before the forward housing portion **10** is inserted onto the plug **14**.

For selectively extending and retracting the ram **46** a control valve is positioned in the rear housing portion **12** rearwardly of the operating cylinder **17** is adapted for

connection to an external source of, for example, compressed air, as by means of a flexible conduit **61** having a connector **59** threaded into an inlet or supply port **60** in the rear face of the tool housing. The control valve includes a spool valve **62** reciprocable within a radial valve bore **63** and having a pair of spaced lands **65, 66** and an intermediate segment **64** of reduced diameter which cooperate to provide four-way valving action for selectively connecting the ends of the operating cylinder **17** with the supply port **60** and to exhaust. The spool valve **62** is provided with a stem portion **71** having a push button **67** at its outer end for depressing the valve against the bias of a compression spring **68** interposed between the push button and a cap **69** threaded into an enlarged outer end of the bore **63** and securing a valve seal **70** therein. The ends of the spool valve operating chamber are connected to the atmosphere by exhaust passages **76, 78** to provide a balanced valve action, and accordingly the spool valve **62** can be easily depressed with the button **67** and when released is quickly returned to its normal position by the compression spring **68**. A first supply passage **80** intersecting the valve bore **63** extends between the supply port **60** and the operating cylinder **17** coaxially with the cylinder **17**. The forward end portion **81** of this supply passage **80** is also connected to the upper end of the valve operating chamber by a diagonal exhaust passage **83** and accordingly also functions as an exhaust passage adapted for communication with the exhaust passage **76** when the valve is depressed. A second supply passage **84** intersecting the valve bore **63** at a point offset from the central supply passage **80** connects the supply port **60** with the rear end of the cylinder **17** for supplying pressure fluid to the rear end of the cylinder when the spool valve is depressed. A second longitudinally extending passage **85** connecting the rear end of the cylinder **17** with the lower end of the valve operating chamber functions as an exhaust passage adapted for communication with the exhaust passage **78** when the spool valve is released.

A supply and exhaust tube **88** is provided for establishing fluid communication between the forward end of the operating cylinder **17** and the passage **81**, for which purpose the forward end of the tube **88** is fixed within the passage **81** and is received within a longitudinally extending rearwardly opening enlarged bore **90** in the push rod **50**. A seal **91** within the enlarged bore **90** and encircling the tube **88** provides for sealing the bore **90** from the rear end of the operating cylinder **17** and a pair of diametrically opposed radially extending passages or orifices **92** in the push rod provide for connecting the enlarged bore **90** with the forward end of the operating cylinder **17**. Accordingly, with the spool valve in its normal or withdrawn position, as seen in FIG. 4, the forward end of the operating cylinder **17** is connected to the supply port **60** and the rear end of the operating cylinder **17** is connected to exhaust to effect withdrawal of the ram. With the spool valve depressed, as seen in FIG. 1, the rear end of the operating cylinder **17** is connected to the supply port **60** and the forward end of the operating cylinder is connected to exhaust to extend the ram **46**. With the ram fully extended, as shown in FIG. 1, the forward end of the supply and exhaust tube is positioned rearwardly of the orifices **92** to provide direct fluid connection therebetween and to thereby provide for initial rapid withdrawal of the ram. When the ram is withdrawn from its fully extended position, the fluid flow is restricted at an increasing rate by the annular conduit surrounding tube **88** to control the rate of withdrawal of the ram. Of course, upon extending the ram this fluid restriction decreases to ensure quick and complete operation of the pivotal jaw **32** without at the same time causing undue impact with the workpiece or with the stationary jaw **36**.

A modified jaw assembly illustrated in FIG. 5 is constructed for initially gripping or holding a workpiece before the pivotal jaw **132** is actuated. For this purpose,

an auxiliary jaw **100** is mounted on the pivot pin **37** of the pivotal jaw **132** within a recess **139** formed on the pivotal jaw plate **132**. The auxiliary jaw **100** is provided with a rearwardly extending lever arm **144** spaced outwardly of the rearwardly extending lever arm **140** of the jaw **132** and is biased into engagement with the stationary jaw **36** by a compression spring **152** mounted between the auxiliary jaw **100** and the pivotal paw **132**. The spring also functions to bias the pivotal jaw **132** to its retracted position. The auxiliary jaw **100** may be provided with a button **156** to facilitate retraction of the auxiliary jaw and thereby assist in the manual insertion and accurate positioning of the workpiece between the auxiliary and stationary jaws **100, 36**.

Thus it can be seen that the fluid operated hand tool of the present invention can be easily manipulated to provide a clamping, gripping or swaging function or the like of improved capabilities with a conventional source of compressed air. Additionally, the hand tool of the present invention is adapted for securely and accurately holding a workpiece prior to actuation of the main jaws and is adapted for selective attachment of the jaws in accordance with each particular operation.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

I claim:

1. A fluid operated hand tool comprising an elongated manually manipulatable tool housing having separable forward and rear housing portions with quick-disconnect means for detachable connection thereof, a pair of forwardly extending cooperating jaws mounted on the forward housing portion, at least one of the jaws being mounted for pivotal movement about a laterally extending axis for cooperative action with the other jaw, said jaws having rearwardly extending lever arms with opposed inner edge portions receivable within the forward housing portion, a longitudinally extending operating cylinder in the rear housing portion, an actuating piston longitudinally reciprocable within the operating cylinder, a rod fixed to the piston projecting forwardly thereof, a pair of rollers supported on the rod engageable with said opposed inner edge portions of the lever arms respectively for effecting operation of the jaws upon longitudinal movement of the actuating piston, at least one of the rollers having an annular groove adapted for receiving the edge portion of the respective lever arm for maintaining the rollers in operative alignment with the lever arms, and manually operable fluid valve means in the rear housing portion rearwardly of the operating cylinder for controlling the longitudinal movement of the piston.

2. A fluid operated hand tool comprising an elongated manually manipulatable tool housing having forward and rear housing portions with quick-disconnect means for detachable connection thereof, a longitudinally extending operating cylinder in the rear housing portion, an actuating piston longitudinally reciprocable within the operating cylinder, a pair of cooperating jaws mounted on the forward housing portion, one of said jaws being pivotally mounted on the forward housing portion and the other of said jaws being fixed to the forward housing portion, the jaws having rearwardly extending lever arms with opposed inner edge portions receivable within the forward housing portion, the opposed edge portion of the pivotal jaw being inclined to the longitudinal axis of the piston to provide a jaw camming edge, the opposed edge portion of the fixed jaw being substantially parallel to the longitudinal axis of the piston, a rod fixed to the piston projecting forwardly thereof, roller means on the rod engageable with said opposed edge portions of the lever arms respectively for operating the jaws upon longitudinal movement of the actuating piston, and manually operable fluid valve means in the rear housing portion rearwardly of the

operating cylinder for controlling the longitudinal movement of the piston.

3. The fluid operated hand tool of claim 2 wherein the roller means includes a pair of rollers mounted on the rod for rotation about parallel laterally extending axes for engagement with the opposed inner edge portions of the lever arms respectively, with one of said rollers positioned forwardly of the other, and with at least one of the rollers having a peripheral groove for receiving the edge portion of the respective lever arm.

4. A fluid operated hand tool comprising an elongated manually manipulatable tool housing, a pair of main jaws mounted on a forward end portion of the housing for extension forwardly thereof, one of said main jaws being fixed to the housing and the other of said main jaws being mounted on the housing for pivotal movement about a laterally extending axis between open and closed positions, an auxiliary jaw supported on the forward end portion of the housing adjacent the pivotal main jaw for pivotal movement independently thereof for cooperative engagement with the fixed main jaw, resilient means urging the auxiliary jaw into engagement with the fixed jaw, and manually operable motor means for selectively pivoting the pivotal main jaw between its open and closed positions.

5. A fluid operated hand tool comprising an elongated manually manipulatable tool housing having diametrically opposed slots extending longitudinally from the forward end thereof, a pair of opposed main jaws mounted within the slots respectively for extension forwardly of the housing, one of said main jaws being fixed within its respective slot and the other of said main jaws being mounted for pivotal movement about a laterally extending axis within its respective slot between open and closed positions, said pivotal main jaw having a rearwardly extending lever arm with an inner edge portion receivable within the housing, an auxiliary jaw pivotally mounted in side-by-side relationship with the pivotal main jaw for cooperative action with the fixed main jaw for holding a workpiece, the auxiliary jaw having a rearwardly extending lever arm outwardly of the lever arm of the pivotal main jaw, spring means urging the auxiliary jaw into cooperative action with the fixed main jaw, and manually operable motor means for engaging the inner edge portion of the pivotal main jaw for selectively operating the pivotal main jaw between its open and closed positions.

6. A fluid operated hand tool adapted to be connected to a source of pressurized fluid comprising an elongated tool housing having forward and rear housing portions, a pair of cooperating jaws mounted on the forward housing portion for extension forwardly thereof, the jaws having rearwardly extending lever arms with opposed inner edge portions within the forward housing portion, a longitudinally extending operating cylinder in the rear housing portion; a ram longitudinally reciprocable within the housing between forward and rear positions engageable with said opposed edge portions for operating the jaws upon longitudinal movement thereof and including an actuating piston longitudinally reciprocable within the cylinder dividing the cylinder into forward and rear chambers; manually operable fluid valve means in the rear housing portion located rearwardly of the operating cylinder for controlling the longitudinal movement of the ram, passage means connecting the fluid valve means with the forward and rear chambers of the operating cylinder for selectively admitting pressure fluid to and exhausting it from the forward and rear chambers thereof and including a fixed longitudinally extending supply and exhaust tube within the operating cylinder having one end in communication with the fluid valve means and the other end in communication with the forward chamber of the operating cylinder.

7. The fluid operated hand tool recited in claim 6 wherein the fluid valve means includes a radially extending valve bore in the rear housing portion rearwardly of the cylinder, a manually operable spool valve reciprocable within the valve bore, a supply port in the rear housing portion rearwardly of and in communication with the valve bore, and supply passage means connecting the valve bore with the supply and exhaust tube and with the rear chamber.

8. A pneumatically operated hand tool adapted for connection to a source of compressed air comprising an elongated manually manipulatable tool housing having forward and rear housing portions with quick-disconnect means for detachable connection thereof, said forward housing portion having opposed slots at the forward end thereof and said rear housing portion having a longitudinally extending cylinder therein, a pair of cooperating jaws mounted within the opposed slots respectively, one of said jaws being pivotally mounted within its respective slot and the other of said jaws being fixed within its respective slot, said jaws having rearwardly extending lever arms with opposed inner edge portions disposed within the forward housing portion, the edge portion of the pivotal jaw being rearwardly tapered, the edge portion of the fixed jaw being substantially parallel to the longitudinal axis of the cylinder; a ram comprising an actuating piston longitudinally reciprocable within the cylinder dividing the cylinder into forward and rear chambers, a rod fixed to the piston projecting forwardly thereof, and a pair of spaced rollers mounted on the rod for rotation about parallel lateral axes for rolling engagement with the opposed inner edge portions of the lever arms respectively; manually operable valve means in the rear housing portion rearwardly of the piston cylinder for controlling the longitudinal movement of the piston, and a fixed longitudinally extending supply and exhaust tube within the cylinder in communication with the valve means, said ram having a rearwardly opening bore receiving the supply and exhaust tube for connecting the tube with the forward chamber.

9. A fluid operated hand tool adapted to be connected to a source of pressurized fluid comprising an elongated tool housing having forward and rear housing portions, a pair of cooperating jaws mounted on the forward housing portion for extension forwardly thereof, the jaws having rearwardly extending lever arms with opposed inner edge portions within the forward housing portion, a longitudinally extending operating cylinder in the rear housing portion; a ram longitudinally reciprocable within the housing between forward and rear positions engageable with said opposed edge portions for operating the jaws upon longitudinal movement thereof and including an actuating piston longitudinally reciprocable within the cylinder dividing the cylinder into forward and rear chambers; manually operable fluid valve means in the rear housing portion rearwardly of the operating cylinder for selectively admitting pressure fluid to and exhausting it from the forward and rear chambers for controlling the longitudinal movement of the ram, a fixed longitudinally extending supply and exhaust tube within the cylinder having one end in communication with the valve means and the other end in communication with the forward chamber, said ram having a central rearwardly opening bore therein receiving the supply and exhaust tube and dimensioned at least in part to provide an annular conduit therearound, and passage means between the annular conduit and the forward chamber, said passage means positioned rearwardly of the forward end of the supply and exhaust tube with the ram in its rear position to effect a restriction of the fluid flow between the supply and exhaust tube and the forward chamber which varies with the position of the ram.

10. A fluid operated hand tool comprising an elongated manually manipulatable tool housing having separable forward and rear housing portions, a pair of cooperating jaws mounted on the forward housing portion for extension forwardly thereof, a longitudinally extending oper-

ating cylinder in the rear housing portion, an actuating piston longitudinally reciprocable within the operating cylinder, manually operable fluid valve means in the rear housing portion located rearwardly of the operating cylinder and supply and exhaust passage means establishing communication with the operating cylinder on opposite sides of the piston for selectively admitting fluid to and exhausting it from the operating cylinder for controlling the longitudinal movement of the piston, an elongated ram fixed to the piston and extending axially forwardly thereof into the forward housing portion for operating the jaws upon longitudinal movement of the piston, and releasable connecting means for maintaining the forward and rear housing portions in assembled relation and for quick detachment thereof.

11. A fluid operated hand tool comprising an elongated manually manipulatable tool housing having forward and rear housing portions, the forward housing portion having a longitudinally extending rearwardly opening bore therein and the rear housing portion having a longitudinally extending forwardly opening bore therein to provide a longitudinally extending operating cylinder, a pair of cooperating jaws mounted on the forward housing portion operable for cooperative action, a double acting piston longitudinally reciprocable within the operating cylinder dividing the cylinder into forward and rear chamber portions, a piston rod projecting forwardly from the piston into the bore of the forward housing piston, a bushing slidably receiving the piston rod and fixed within the forward end of the bore of the rear housing portion for enclosing the forward end of the longitudinally extending operating cylinder, jaw operating means on the forward end of the piston rod for effecting operation of the jaws upon longitudinal movement of the double acting piston; fluid control means including manually operable fluid valve means in the rear housing portion rearwardly of the bore therein for selectively admitting pressure fluid to and exhausting it from the forward and rear chamber portions for fluid operation of the double acting piston in both longitudinal directions, and disconnect means for detachable connection of the forward and rear housing portions for permitting replacement of the forward housing portion.

12. A fluid operated hand tool adapted to be connected to a source of pressurized fluid comprising an elongated tool housing having forward and rear housing portions, a pair of jaws mounted on the forward housing portion operable for cooperative action, a longitudinally extending operating cylinder in the rear housing portion, a ram longitudinally reciprocable within the housing between forward and rear positions for operating the jaws upon longitudinal movement thereof and including an actuating piston longitudinally reciprocable within the operating cylinder dividing the operating cylinder into forward and rear chamber portions; fluid control means for selectively admitting pressure fluid to and exhausting it from the forward and rear chamber portions for controlling the longitudinal movement of the ram including manually operable fluid valve means in the rear housing portion rearwardly of the operating cylinder and a fixed longitudinally extending supply and exhaust tube within the operating cylinder having one end in communication with the fluid valve means and the other end in communication with the forward chamber portion.

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