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Forichon

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[54] **TOGGLE-JOINT PRESS**

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[30] **Foreign Application Priority Data**

Jan. 28, 1974 France 74.02670

[52] **U.S. Cl.** **72/451;** 72/453; 100/272

[51] **Int. Cl.²** **B21J 9/18**

[58] **Field of Search** 72/451, 453; 100/272, 281, 100/286

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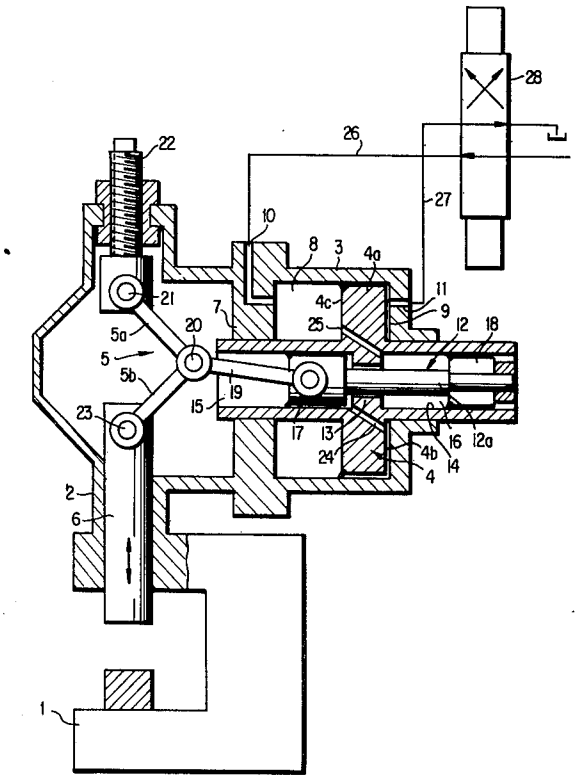
[57] **ABSTRACT**

A toggle-joint press, in particular one which is pneumatically operated and used variously for bending, encasing, cutting and other stamping operations, is characterized by a control piston comprising two coaxial and relatively moveable piston parts arranged within a cylinder having means for stopping and thus limiting the travel of one of the piston parts therein in both directions of travel, while the other piston part may continue its motion to a limiting means defined within a bore in the one piston part in which the other piston part moves, and through connections of the other piston part to a toggle-joint assembly of a press thus providing for the return of a tool holding piston.

10 Claims, 4 Drawing Figures



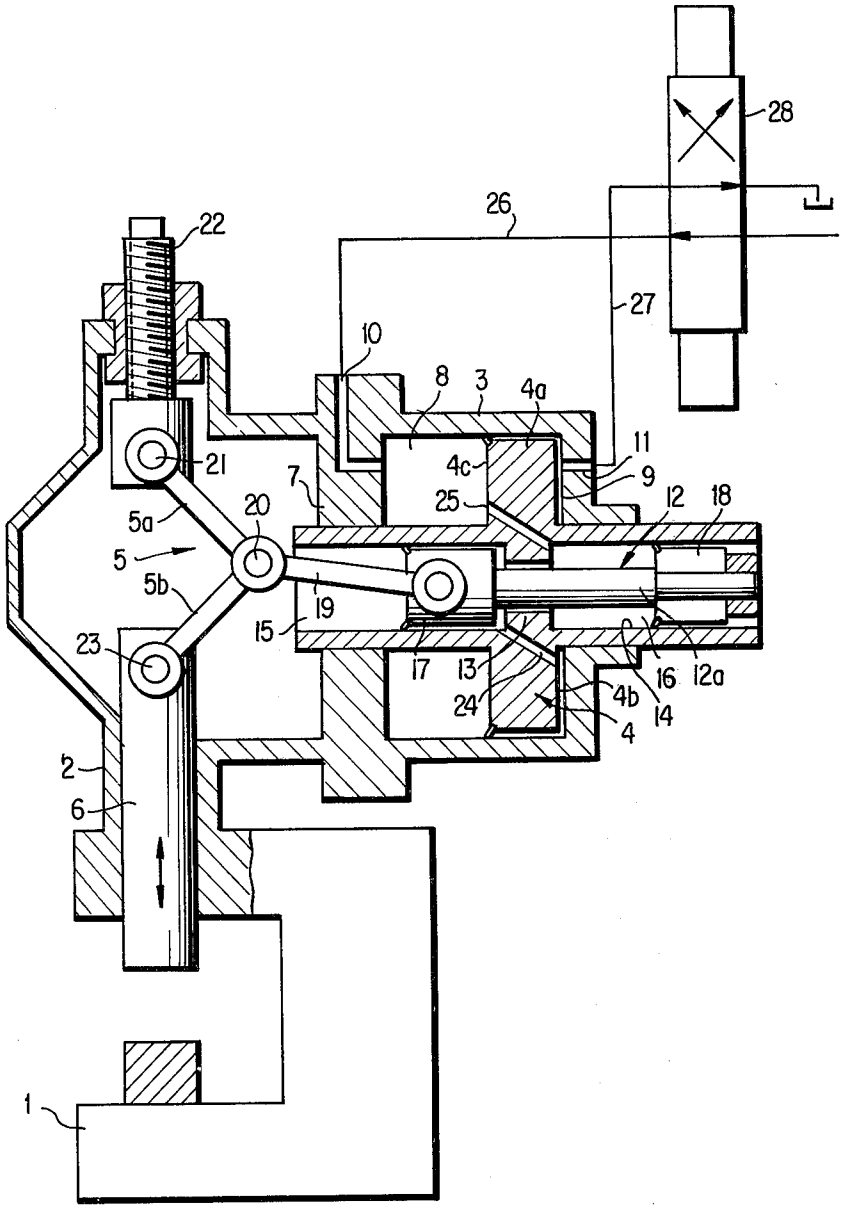

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FIG.1

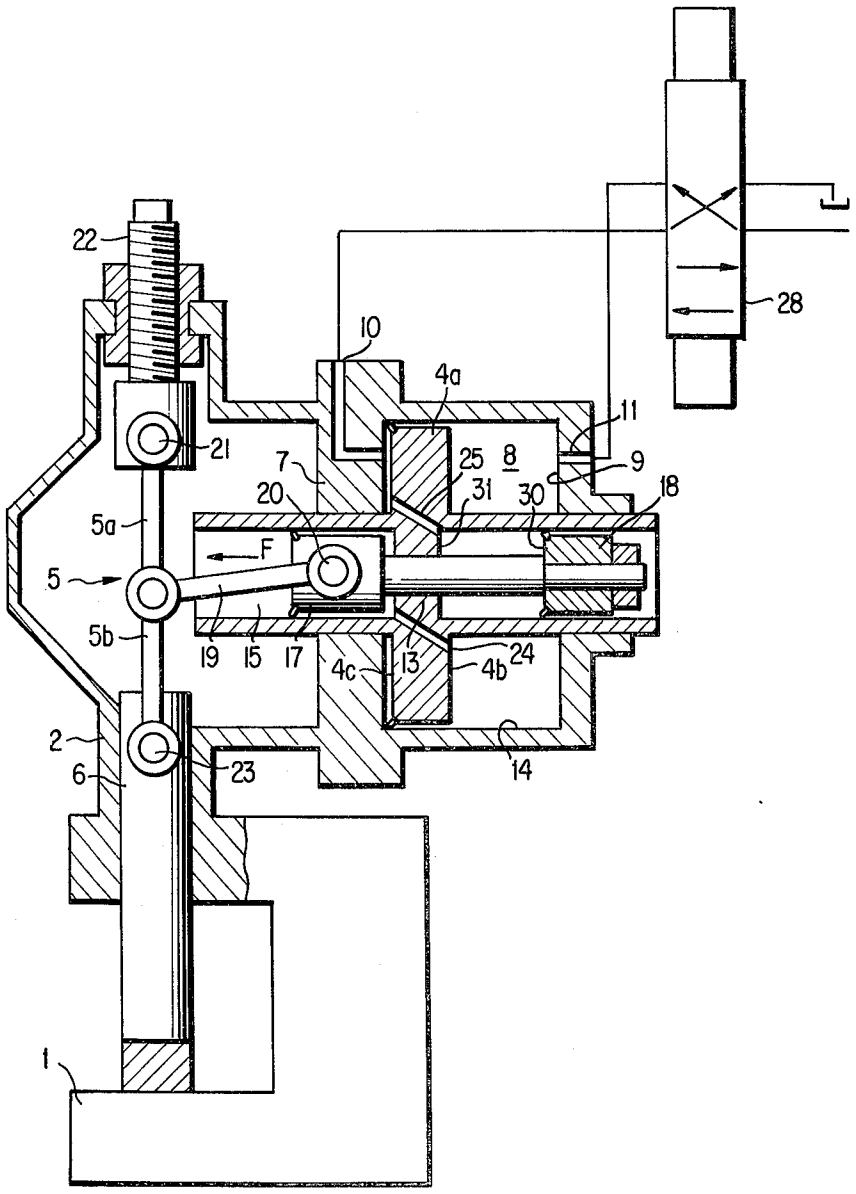
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FIG. 2

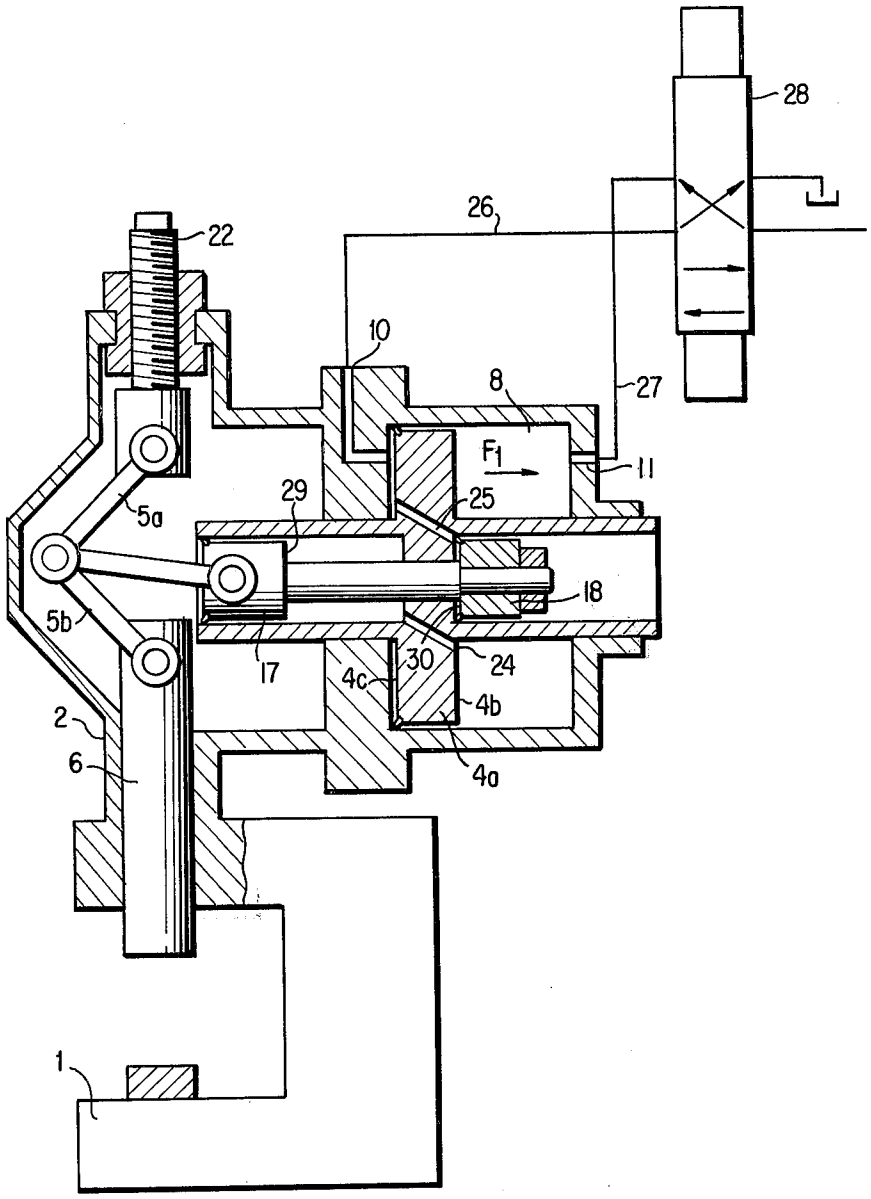

FIG.3

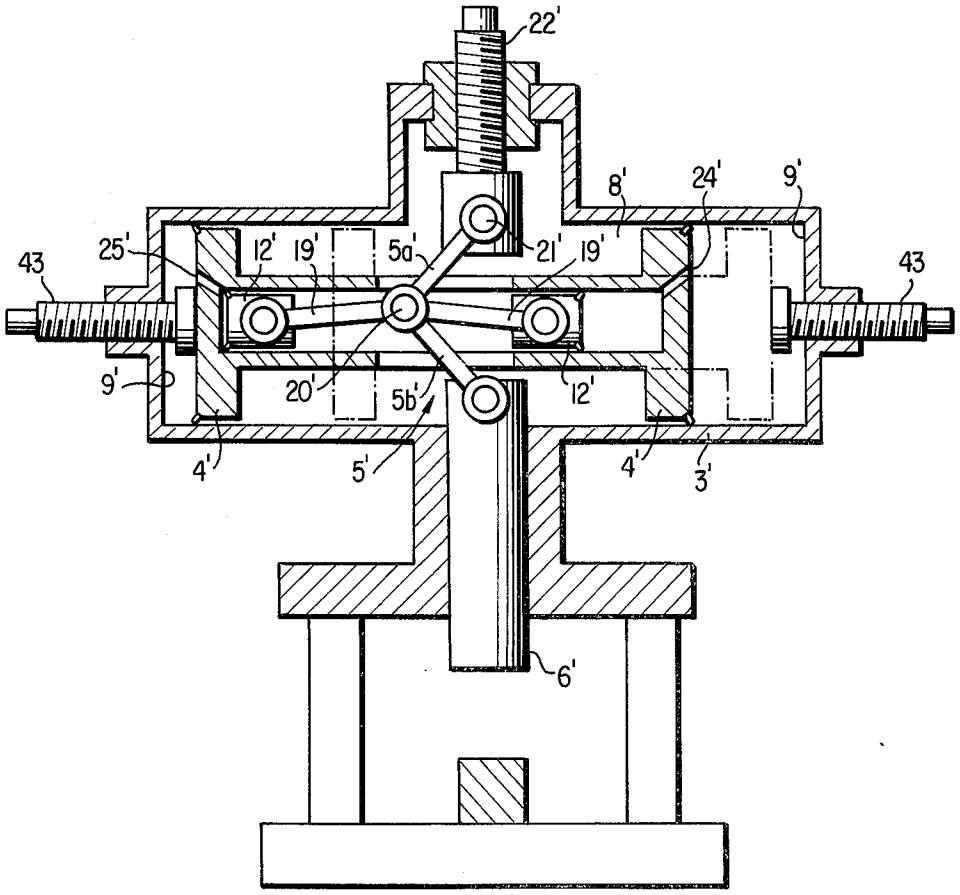

FIG. 4

TOGGLE-JOINT PRESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a toggle-joint press, and more particularly to pneumatic toggle-point presses which are used for bending encasing, cutting and various other stamping operations.

2. Description of the Prior Art

Toggle-joint presses of known design generally consist of a sealed cylinder in which a piston is moved in linear translation by a pressurized fluid, such as, for example, air. This linearly moveable piston transmits its thrust to a toggle-joint mechanism which operates to amplify and retransmit the thrust to a tool-holding piston. The retraction of the tool-holding piston, after completion of the operation, is effected by the compressed air which is always admitted to the return side of the toggle-joint control piston. Also well known is the equipping of such toggle-joint presses with a screw device for permitting regulation of their force by varying the lower dead point of the tool-holding piston, such regulation being obtained by turning the screw which is generally located on the upper part of the head of the press. The force of the press can also be varied by adjusting the air supply pressure with a reducing valve. Finally, it is common to equip these presses, when desired, with a regulating screw provided with a handwheel, this arrangement being intended to limit the travel of the tool-holding piston by varying its high point without, however, modifying its lower limit. Thus, when the work requires little travel, this arrangement permits significant increase in the rate of output.

These conventional toggle-joint presses, whether or not equipped with these regulating devices, all have the major drawback of a rather slow operating cycle, which results from the dead or lost time encountered during the return of the tool-holding piston to its raised position after completion of an operation. The time required for this return operation is all the longer, since there must occur a transition to decompression of the fluid having served to drive the tool-holding piston downward and to compression of that fluid which must then raise it.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved toggle-joint press which is reliable in operation and which eliminates the lost time problem of previous presses of this character.

Another object of this invention is to provide a toggle-joint press having improved rate of output characteristics.

Yet another object of the invention is to provide a highly efficient fluid operated toggle-joint press which is fully reliable in operation.

The foregoing and other objects are achieved by the present invention which, according to at least one aspect thereof, involves a toggle-joint press having a cylinder in which at least one control piston is moveable, the control piston being tied by a connecting rod to the knee of a toggle-joint formed by at least two rods, one being hinged at a fixed point and the other being hinged to a tool-holding piston. The control piston consists of two coaxial parts, being relatively movable with respect to one another, and the cylinder is provided with means for blocking, and thus limiting, the travel of one of the relatively moveable coaxial parts, while the other part continues in its motion to return the tool-holding piston to its raised position.

According to a preferred embodiment of the present invention, the two coaxial pistons, or moveable piston parts, have a pressurized supply of fluid which automatically drives them as a unit during the descent of the tool-holding piston, until an outer one of the pistons is stopped by a shoulder of the cylinder, after which an inner one of the pistons continues moving to return the tool-holding piston to its raised position.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description thereof, when considered in connection with the accompanying drawings, wherein like reference characters designate like or corresponding parts throughout the several views, and in which:

FIG. 1 is a schematic view of a press formed according to this invention and showing the tool-holding piston in its raised position and the control piston being disposed in a rightward-most position;

FIG. 2 is a schematic view of the press shown in FIG. 1, but illustrating the tool-holding piston in its lowered operative position and the control piston being disposed in a leftward-most position;

FIG. 3 is a schematic view of the press shown in FIGS. 1 and 2 with the tool-holding piston being in a raised position, but with the toggle assembly being articulated oppositely as shown in FIG. 1; and

FIG. 4 is a schematic view of another embodiment of the present invention, wherein a pair of joined control pistons are employed.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now to the drawings, and more particularly to FIGS. 1–3 thereof, there is shown a pneumatically operated toggle-joint press, which obviously could be operated by a suitable liquid just as well, such as, for example, oil. This press consists essentially of six elements, namely, a base or stand **1**, a housing **2** supported on the base, a cylinder **3** connected to the housing **2** and having a control piston **4** movably disposed therein, a system of rods generally designated by reference numeral **5** and a tool-holding piston **6** movably disposed in the housing **2**. The cylinder **3** is attached to the housing **2** in a known manner and is isolated therefrom in an airtight manner by a partition **7**, one side thereof forming a shoulder within the cylinder, with a chamber **8** of the cylinder **3** being bounded at its axial ends by an end face **9** of the cylinder and the shoulder of the partition **7**, and being supplied at its two ends with a pressurized fluid through passages **10** and **11**. The control piston **4** moveably disposed in cylinder **3** has a head portion **4***a* provided with a driving face **4***b* and a return face **4***c* on opposing surfaces thereof. The piston thus moves in one axial direction or the other within cylinder **3** depending upon whether the pressurized fluid enters the chamber **8** through the passage **10** or through the passage **11**.

According to the present invention, the control piston, which heretofore has been constructed as a solid piece, is now made in tubular fashion and in and of itself serves as the cylinder for a smaller diameter coax-

ial piston **12**, such that the two pistons **4** and **12** are moveable relative to one another and thus are capable of simultaneous or successive displacements. The outer piston **4** is provided with a portion **13** projecting radially inwardly into the axial bore **14** thereof substantially intermediate its length which serves as an annular shoulder **13** within the axial bore **14**, separating the bore **14** into two independent chambers **15** and **16**. The inner piston **12** has an intermediate shaft portion **12***a* which slides in the constriction formed in the axial bore **14** by the annular shoulder **13**, and the opposing ends of the shaft portion **12***a* of inner piston **12** are provided with enlarged piston heads **17** and **18**. The head **18** moves within the chamber **16** on one side of the shoulder **13**, while the head **17** slides back and forth in the chamber **15** formed on the other side of the shoulder. The head **17** is connected by a rod **19** to the toggle joint **5**, which consists in the illustrated embodiment of two links **5***a* and **5***b*, being articulated at a common axis **20** and being connected at their respective other ends to a fixed point **21** to be further described herein and to a fixed point on the moveable tool-holding piston **6**.

The link **5***a*, hinged at **21**, is connected to a regulating screw **22** threadably engaged within housing **2** to permit varying the lower dead point of the tool-holding piston **6** without changing the stroke of the press, so that the force may be regulated. The link **5***b* is connected to the tool-holding piston **6** at an axis of articulation **23** and this piston is vertically moveable, being driven by the toggle-joint mechanism.

As another characteristic of the invention, each of the two chambers **15** and **16**, within which the inner piston heads **17** and **18** of the inner piston move, is connected with the chamber **8** in which the head **4***a* of the outer piston **4** moves. This is effected, as shown best in FIG. **2**, by a passage **24**, formed in the outer piston head **4***a* and through which chamber **15** communicates with chamber **8** on the driving face **4***b* side of the outer piston **4**, while the chamber **16** communicates with the chamber **8** on the return face **4***c* side of the outer piston **4** through another passage **25** also formed in the outer piston head **4***a*.

A description of the operation of the toggle-joint press of the present invention as characterized herein follows. Beginning with FIG. **1**, which shows the press in its raised position and ready to work, it is seen that the outer control piston **4** is in its most rightward position, as illustrated, being stopped against the end **9** of its cylinder **3**, and that the inner piston **12** is likewise in its most rightward position, being stopped with its head **17** against the annular shoulder **13** of the outer piston. It is also seen that the links **5***a* and **5***b* are separated by an angle of less than 180° and that the tool-holding piston **6** is in its upper or raised position. From the diagram of the fluid power supply, also shown in the Figure, pressurized fluid is seen to be fed through the line **26** leading through the passage **10** to the return side of the chamber **8** thereby retaining the outer piston **4** in the position shown, while the line **27** connected to passage **11** opening from the side of chamber **8** contacting the face **4***b* of the piston **4** is connected to a reservoir.

If the sense of the pressure fluid supply is reversed by the action of one or more solenoid valves **28**, as shown in FIG. **2**, the line **26** may be connected instead to the reservoir, while pressure is then applied in line **27**, whereby the two inner and outer pistons **12** and **14**, respectively, move leftwardly together as a unit until the face **4***c* of piston **4** is stopped against the partition **7** closing the cylinder. At this stage, the links **5***a* and **5***b* are vertically aligned and the tool-holding piston **6** is in the working or pressing position. It is at this time that the fluid, under pressure in the right side of chamber **8**, goes through the passage **24** provided in piston **4** and into chamber **15** against the rear or right end face **29** of piston head **17** of piston **12**, whereby the piston **12** is driven forwardly that is, in the direction of the arrow F, while the outer piston **4** remains blocked and in a stationary state. The stroke of the piston **12** is limited by the head **18**, or by the front face **30** thereof being stopped against the rear face **31** of the annular shoulder **13** formed on the inside of the piston **4** in the bore thereof. At this stage, the parts are now positioned as shown in FIG. **3**. It is seen in this FIGURE that the head **18** of the inner piston **12** is pressed against the annular shoulder **13** and that, on the other hand, the head **17** has now reached the end of its travel, wherein the links **5***a* and **5***b* have passed beyond their position of vertical alignment shown in FIG. **2** and again form an angle of less than 180°, though oppositely or reversely disposed relative to the vertical axis of piston **6** and corresponding to a new return of the tool-holding piston **6**.

In this first motion, there is thus produced, in succession, a downward stroke of the tool-holding piston **6** during the simultaneous displacement of the two coaxial pistons and a return or upward stroke of this tool-holding piston to its upper position during the continued displacement of only the inner piston **12**.

If the sense of fluid pressure is reversed again, such that the line **27** becomes connected to the reservoir and the line **26** becomes operational, there is again produced a simultaneous displacement of the two coaxial pistons **4** and **12**, in the direction indicated by an arrow F_1 in FIG. **3**, since the piston head **18** of inner piston **12** is still engaged by the internal annular shoulder **13** of piston **4**, so that it will be carried thereby. This motion ends when the face **4***b* of piston **4** stops against the back wall **9** of the cylinder **3**, after which the pressure in chamber **8** on the return side of piston **4** is transmitted through the passage **25** formed in the piston **4** and into the chamber **16** of the inner piston **12**, where it acts on the forward face **30** of the piston head **18**, or the return face of the inner piston **12**. Under these conditions, the inner piston **12** moves with respect to the now stationary outer piston **4** and returns to the position shown in FIG. **1**, where the rear face **29** of the piston head **17** is stopped against the annular shoulder **13** of piston **4**.

During this double displacement of the two coaxial pistons, there is provided, on the one hand, a second downstroke of the tool-holding piston **6** during the simultaneous displacement of the pistons, then another return or raising of the piston **6** during the continued displacement of only the inner piston **12**.

In this way and by this conception of combined and then independent movements of the coaxial pistons **4** and **12**, there is obtained in a complete cycle an operation wherein the outer piston **4** provides the downstroke of the tool-holding piston **6** twice while the inner piston **12** returns it each time to its raised position. Thus, it is no longer the same piston which produces both the downstroke and the return of the tool-holding piston, as is common in the known presses.

According to another embodiment of the invention, such as shown in FIG. **4**, a cylinder **3'** is designed to accept not just a single control piston, but two identical pistons **4'** spaced apart and fixedly joined by a common

or internal rod therebetween. As in the mode of realization illustrated in the embodiment shown in FIGS. 1 to 3, these pistons 4' likewise serve as cylinders for auxiliary pistons 12' which are joined by two like connecting rods 19' to a unique toggle-joint 5' consisting of two links 5a' and 5b', being articulated at a common axis 20' and being connected at their respective other ends to a fixed point 21' of a regulating screw 22' and to a fixed point on the moveable tool-holding piston 6'.

The operation of this arrangement is similar to that illustrated in FIGS. 1 to 3, since the chambers in which the two auxiliary pistons 12' move both communicate with the chamber 8' of the outer pistons 4' through respective passages 24' and 25' formed therein. An essential difference in this mode of realization resides in the fact that one can adjust the starting position, that is, the upper dead point of the tool-holding piston 6', because of two screw stops 43 located in the end faces 9' of the cylinder. Simultaneous adjustment of these screws permits obtaining, in conjunction with the screw 22' for setting the force, a variation in the high point of the tool-holding piston 6' according to the stroke desired and the work to be done. It is sometimes desirable, for example, to be able to adjust the stroke of the tool-holding piston to increase the rate of output.

This press, as provided by the present invention, is reliable in operation and also offers the important advantage of eliminating any dead or lost time inherent in returning of tool-holding pistons in known presses to their raised positions, since, the control piston being made in two parts, the smaller diameter inner auxiliary pistons assure this return without the necessity of proceeding to a decompression or a loss of fluid, assuring the displacement of the large diameter outer piston. This press therefore permits practically doubling the rate of output of known presses, which constitutes a significant technical advance over existing equipment.

Obviously, many other modifications and variations of the present invention are possible in light of these teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A fluid-driven toggle-joint press of the type comprising a cylinder having a control piston means moveable therein which is joined by a connecting rod to the knee of a toggle joint formed by at least two links, one link being hinged at a fixed point and the other at the end of a tool-holding piston, the press being characterized by the improvement comprising:

said control piston means being formed of two relatively moveable coaxial pistons; and

means for stopping and thus limiting the travel of at least one of said coaxial piston while permitting the other to continue its motion to effect the return of the tool-holding piston.

2. A toggle-joint press as set forth in claim 1, further comprising adjustment means for varying the high point of said tool-holding piston in a return position thereof.

3. A toggle-joint press as set forth in claim 1, wherein said coaxial pistons are moveable one within a bore formed in the other and said stopping and travel limiting means comprises shoulder means formed in the bore of the other piston dividing said bore into two airtight chambers.

4. A toggle-joint press as set forth in claim 3, wherein said coaxial pistons are moveable one within a bore formed in the other and said outer piston comprises spaced apart and joined piston heads slidable in said cylinder and said inner piston comprises spaced apart piston heads slidable in said bore and connected by respective rods to a common toggle joint.

5. A toggle-joint press as set forth in cllaim 3, wherein said one piston moveable in the other includes a piston rod slidable in the means forming said shoulder and two piston heads at opposite ends of said piston rod being disposed respectively in said two chambers.

6. A toggle-joint press as set forth in claim 5, wherein said inner piston is joined to said knee of said toggle joint.

7. A toggle-joint press comprising:

a base;

a housing supported on said base;

a tool-holding piston being moveable along a given line in said housing between an operative and a return position;

a cylinder in said housing;

a first piston moveably disposed axially in said cylinder and having an elongate axial opening formed therein, and means in said opening to define a pair of oppositely facing stops;

control means for supplying pressurized fluid to said cylinder selectively to the ends thereof for causing said first piston to move axially therein;

a second piston moveably disposed axially in said opening and having a pair of piston heads at the ends thereof,

a first one of said piston heads being engageable by a first one of said stops for causing said second piston to move simultaneously with said first piston when said first piston moves in one direction and for limiting the travel of said second piston in the other direction independently of said first piston, and the second one of said piston heads being engageable by the second one of said stops for causing said second piston to move simultaneously with said first piston when said first piston moves in the other direction and for limiting the travel of said second piston in said one direction independently of said first piston, said second piston thereby having a longer path of linear translation than said first piston;

conduit means connecting said cylinder on opposite sides of said first piston moveable therein to said opening in said first piston;

a toggle-joint composed of two links connected at one end thereof in a knee joint, with the other end of one link being hingedly fixed within said housing and the other end of the other link being hingedly connected to one end of said tool-holding piston; and

at least one connecting rod being hingedly connected at one end to said knee joint and at its other end to one of said piston heads of said second piston;

whereby upon movement of said first piston to its limit of travel in said one direction, said second piston moving therewith through the engagement of said first stop with said first piston head, said tool-holding piston is moved to said operative position and said pressurized fluid then passes through said conduit means in said first piston to further move said second piston in said one direction independently of said first piston to cause said tool-

holding piston to be moved to said return position, and upon movement of said first piston to its limit of travel in said other direction, said second piston moving therewith through the engagement of said second stop with said second piston head, said tool-holding piston is moved to its operative position and said pressurized fluid then passes through said conduit means in said first piston to further move said second piston in said other direction independently of said first piston to cause said tool-holding piston to be moved to said return position.

8. A toggle-joint press as set forth in claim **7**, wherein said stops are formed by an internal annular shoulder formed in said axial opening.

9. A toggle-joint press as set forth in claim **7**, wherein said first piston comprises a pair of opposed coaxially disposed piston heads having respective hollow piston rods facing each other forming said axial opening for said piston heads of said second piston, said stops being defined by the inside axial ends of said hollow piston rods, and each of said piston heads of said second piston are connected to said toggle joint through hinged connecting rods.

10. A toggle-joint press as set forth in claim **7**, further comprising means for selectively adjusting the return position of said tool-holding piston.

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