United States Patent

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[31] R 46,446; R 46,447

[54] **CONTROLLABLE HYDRAULIC PRESS FOR PAPER CUTTING MACHINES OR THE LIKE**
6 Claims, 4 Drawing Figs.

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[51] Int. Cl. F01b 15/00, F15b 11/08, F15b 13/64
[50] Field of Search ..... 91/208, 216 (Cursory), 449 (Cursory)

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ABSTRACT: The hold-down device HD for stacked sheets in a paper cutting machine receives motion from a piston **2** which is reciprocable in a cylinder **1** and has an axial blind bore **2a** receiving a portion **4** of the cylinder to define therewith a working chamber **3** which can receive hydraulic fluid at a lower and a higher pressure. The lower fluid pressure suffices to move the piston with reference to the cylinder. The latter accommodates a reciprocable control member CM which normally seals the working chamber from a second chamber **16** in the cylinder but permits entry of fluid into the second chamber when exposed to fluid at the higher pressure. Such fluid then bears against an annular face **13** of the piston and against a surface **14** of the control member to maintain the control member in a position in which the two chambers communicate with each other against the opposition of a strong closing spring **12**.

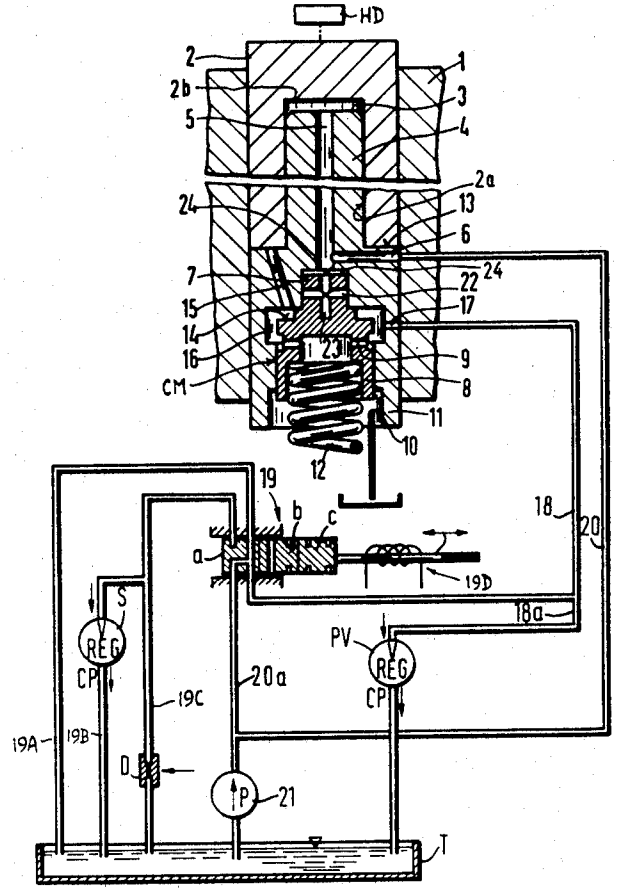
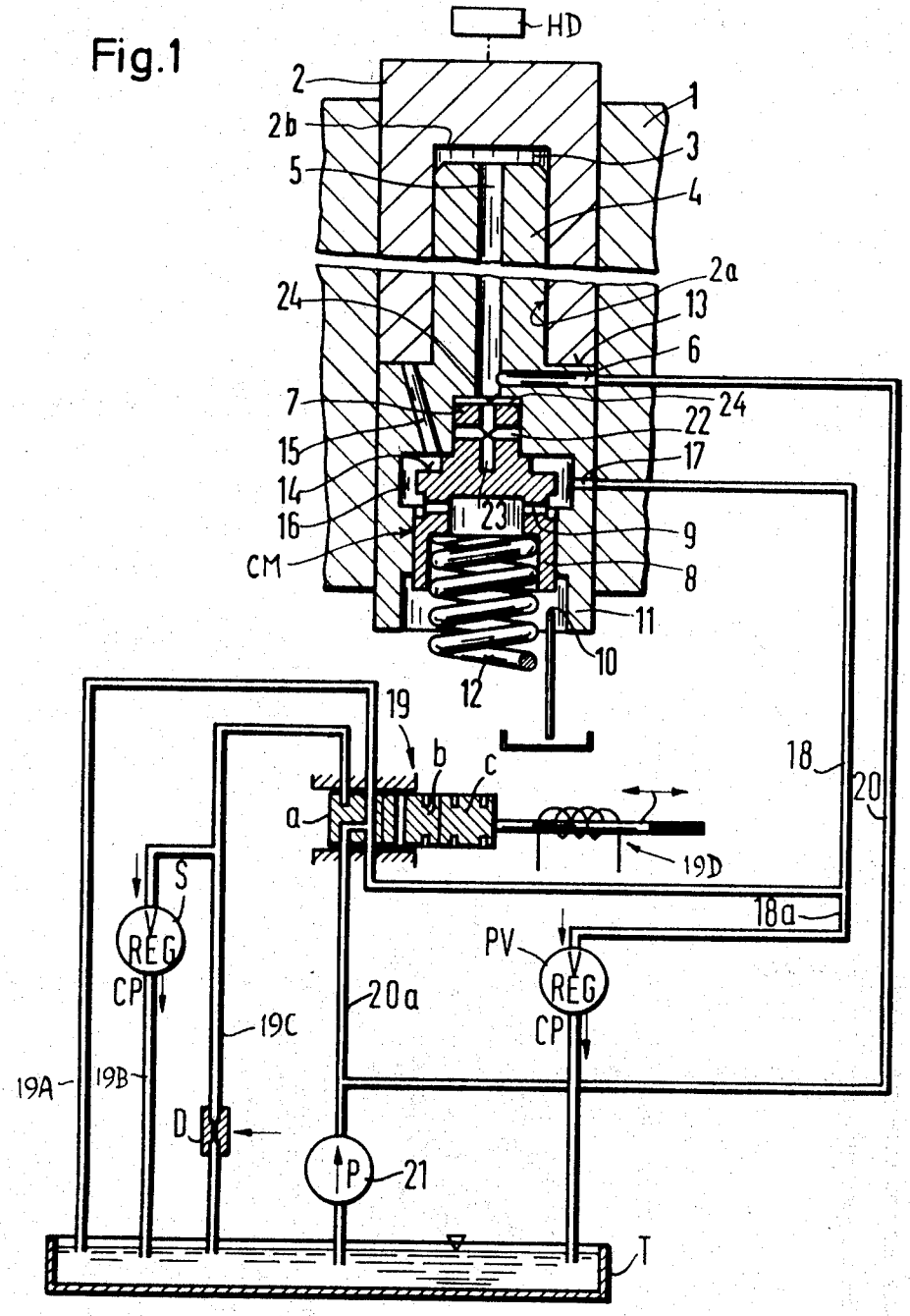


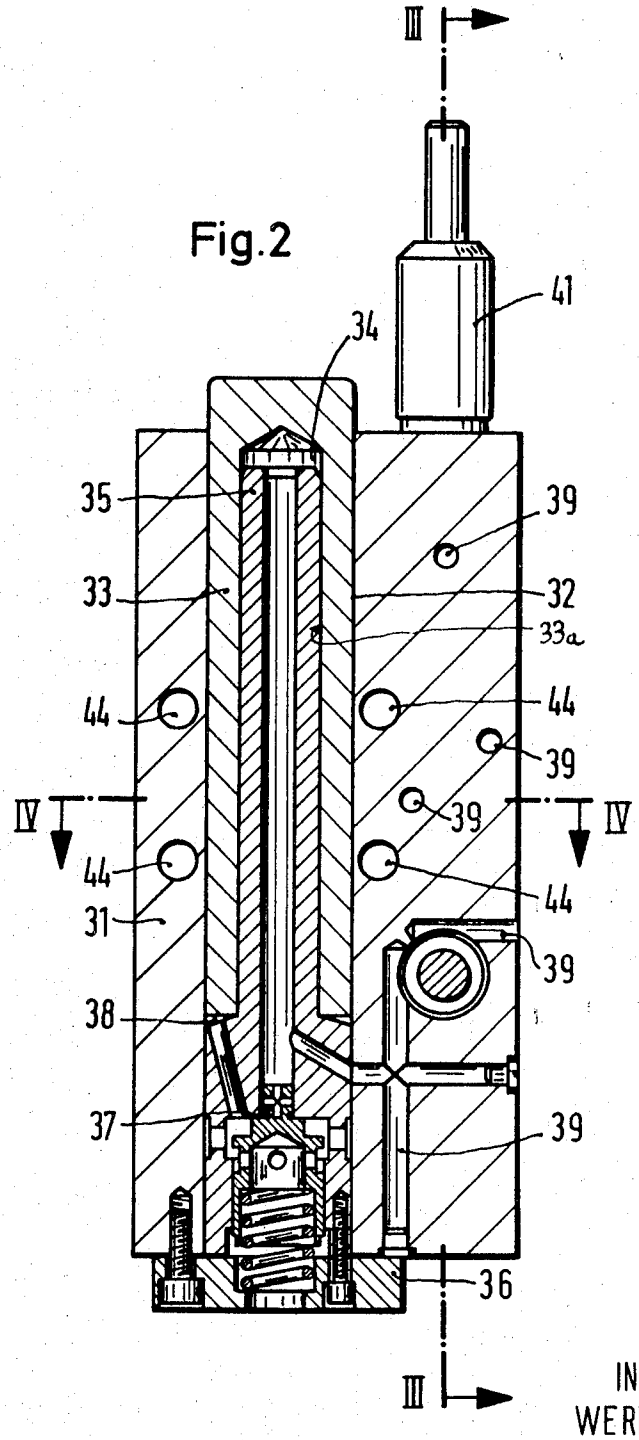
Fig.1



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Fig.2



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Fig.3

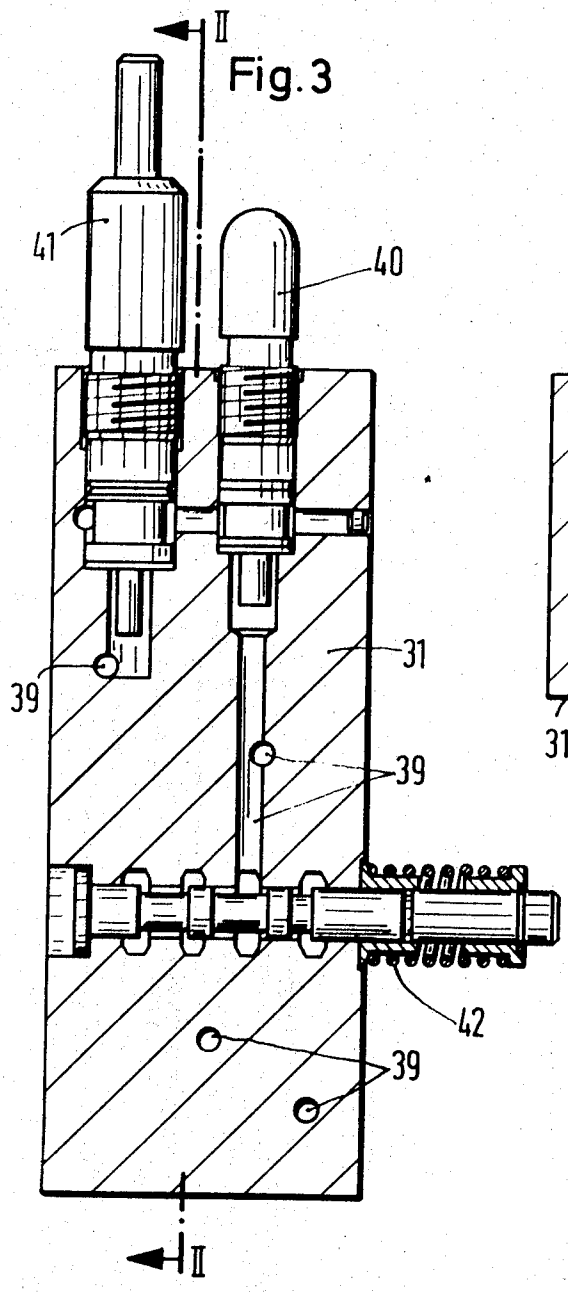
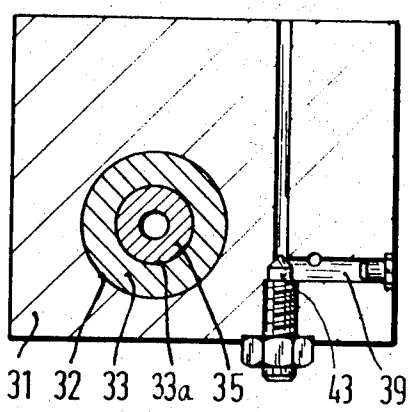


Fig.4



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CONTROLLABLE HYDRAULIC PRESS FOR PAPER CUTTING MACHINES OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to fluid-operated motion transmitting apparatus. More particularly, the invention relates to improvements in hydraulic apparatus which can be utilized to move one or more parts of paper cutting or like machines, for example, to actuate a hold-down device which is employed to clamp sheets of paper or the like prior to and during severing.

In presently known apparatus of the just outlined character, a motion transmitting piston can be displaced in response to a predetermined fluid pressure to move the hold-down device into engagement with a stack of sheets. The clamping or retaining force of the hold-down device should be raised once the sheets are properly adjusted with reference to the knife of the paper cutting machine. This is achieved by raising the fluid pressure so as to displace a spring-biased control member which then admits pressurized fluid against an auxiliary face of the piston whereby the latter causes the hold-down device to bear against the sheets with a requisite force. A drawback of such apparatus is that the fluid pressure which is required to maintain the control member in open position is quite high, *i.e.*, such fluid pressure must be high enough to counteract the bias of a strong closing spring which urges the control member toward closed position. This means that the force with which the piston acts upon the hold-down device cannot be reduced at the will of the operator.

SUMMARY OF THE INVENTION

It is an important object of the present invention to provide an improved fluid-operated motion transmitting apparatus of the above outlined general character and to construct and assemble the apparatus in such a way that the minimum fluid pressure required to maintain the control member in open position is practically independent of the bias to which the control member is subjected by one or more springs which tend to maintain it in closed position.

Another object of the invention is to provide a compact, rugged and reliable apparatus of the just outlined type and to provide a novel control member which can be used in such apparatus to determine the force with which the piston maintains a hold-down device or the like in operative position.

A further object of the invention is to provide a novel hydraulic system for use in the improved apparatus.

The improved apparatus may be utilized to move or to transmit motion to a hold-down device for stacked sheets in paper cutting machines or the like. It comprises a cylinder, a piston which is reciprocable in the cylinder and has a recess extending inwardly from an annular face at one end thereof, an insert which can form part of the cylinder and extends into the recess to define with the piston a working chamber, a control member installed in the insert and defining therewith a second chamber having an extension extending to the face of the piston, a first surface provided on the control member adjacent to an extension of the working chamber and a second surface of greater area provided on the control member in the second chamber, closing means for biasing the control member to the first of two positions in the first of which the closing member seals the working chamber from the second chamber and in the second of which the control member establishes communication between such chambers, and displacing means including a discrete conduit or a passage in the cylinder for admitting to the working chamber a fluid (preferably a liquid) at a first pressure to displace the piston with reference to the cylinder whereby the piston changes the position of a hold-down device or the like, and at a second pressure which suffices to move the control member to second position so as to admit fluid into the second chamber whereby the fluid exerts pressure against the annular face of the piston and also against the second surface of the control member. The pressure of fluid against the first surface of the control member to oppose the bias of the closing means. In this way, and by properly selecting the ratio of the areas of first and second surfaces, a relatively low fluid pressure suffices to maintain the control member in second position.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved motion transmitting itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a fragmentary schematic sectional view of an apparatus which embodies one form of the invention and is utilized to transmit motion to a portion of a paper cutting machine;

FIG. **2** is a central longitudinal sectional view of a second apparatus with the section taken in the direction of arrows as seen from the line II–II of FIG. **3**;

FIG. **3** is a sectional view as seen in the direction of arrows from the line III–III of FIG. **2**; and

FIG. **4** is a sectional view as seen in the direction of arrows from the line IV–IV of FIG. **2**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus of FIG. **1** comprises a cylinder **1** which accommodates a reciprocable working piston **2**. The upper or outer end of the piston **2** is operatively connected to one or more moving parts of a paper cutting machine, for example, to a schematically indicated hold-down device HD which can clamp a stack of sheets prior to and during cutting. The lower or inner end of the piston **2** is provided with an annular face **13** and with an axial blind bore or recess **2***a* which extends upwardly or inwardly from the annular face **13** and accommodates an insert **4** which is affixed to and can be said to constitute a portion of the cylinder **1**. The insert **4** defines with the piston **2** a working chamber **3** which occupies the innermost or uppermost part of the recess **2***a* and has an extension **5** formed by an axially extending bore of the insert **4**. The extension **5** communicates with a radial bore **6** which is in communication with a fluid-admitting conduit **20** forming part of a hydraulic displacing unit shown in the lower part of FIG. **1**.

The insert **4** accommodates an axially reciprocable control member or plunger CM which is biased upwardly by a closing spring **12** so that it tends to assume a first position which is shown in FIG. **1**. In such first position, the upper portion **7** of the control member CM seals the extension **5** (and hence the working chamber **3**) from a second chamber **16** which is defined by the insert **4** and control member CM. The upper portion **7** has a top surface **24** which is adjacent to the extension **5**, *i.e.*, it is subject to the pressure of fluid which is admitted by the conduit **20** and enters the extension **5** and working chamber **3** by way of the radial bore **6**. The second chamber **16** has an extension **15** (here shown as in inclined bore machined into the insert **4**) which extends all the way to the annular face **13** of the piston **2**. The control member CM further comprises a second or lower portion **8** which is integral with the portion **7** and has an annular surface **14** whose area exceeds that of the surface **24**. This surface **14** is accommodated in the second chamber **16** so that it can be acted upon by the pressure of fluid which is admitted via conduit **20** when the control member CM moves to a second position in which its lower portion **8** seals the chamber **16** from a tank T constituting a source of fluid and forming part of the aforementioned displacing unit. The conduit which connects the chamber **16** with the tank T in the first position of the control member CM is shown at **10**; the upper end of this conduit is connected to a nipple **11** of the insert **4**. When the control member CM assumes the illustrated first position, the conduit **10** communicates with the second chamber **16** by way of one

or more radial ports 9 machined into the lower portion 8. The upper portion 7 of the control member CM has an axially extending blind bore 23 and several radial bores 22 which establish communication between the extension 5 and chamber 16 when the control member CM is moved to second position.

The chamber 16 is in communication with a radial bore 17 of the insert 4, and this radial bore is in communication with a second conduit 18 having a branch 18*a* which accommodates an adjustable pressure regulating valve PV. The branch 18*a* discharges fluid into the tank T. The conduit 18 is connected to a four-way slide valve 19 which can be moved to three different positions including the position *a* which is shown in FIG. 1. The conduit 20 accommodates a fluid displacing pump 21 and has a branch 20*a* which is connected to the valve 19. The valve 19 can be connected with the tank T by three return conduits 19A, 19B, 19C. The conduit 19B contains a second adjustable pressure regulating valve S, and the conduit 19C accommodates an adjustable throttle valve or constriction D in parallel with the valve S. The valves 19, PV, S, D, the conduits 10, 18, 18*a* 19A—19C, 20, 20*a*, the pump 21 and the tank T together constitute the aforementioned displacing unit which can change the position of the working piston 2 and that of the control member CM. In the illustrated position *a* of the slide valve 19, the branch 20*a* of the fluid admitting conduit 20 is connected with the return conduit 19A so that the working chamber 3 is under minimal or no pressure and the piston 2 can dwell in the illustrated starting position. When the slide valve 19 is moved to the position *b* (for example, by hand), it connects the branch 20*a* with the return conduits 19B, 19C so that fluid pressure in conduit 20 depends on the setting of the pressure regulating valve S. Such pressure suffices to move the piston 2 upwardly and to thus displace the hold-down device HD into engagement with a stack of paper sheets but at a speed and with a force which cannot cause injury to a careless operator. This is achieved by proper dimensioning of the bottom face 2*b* in the recess 2*a* of the piston 2. The pressure determined by valve S does not suffice to move the control member CM from the illustrated first position, *i.e.*, the pressure of fluid acting on the surface 24 of the upper portion 7 of the control member cannot overcome the bias of the closing spring 12; therefore, the extension 5 (and hence and working chamber 3) remains sealed from the second chamber 16 and its extension 15. When the slide valve 19 is moved to the position *c* it seals the return conduits 19A—19C from the branch 20*a* so that the pressure in conduit 20 rises rapidly and overcomes the bias of the closing spring 12 to move the control member CM to second position and to thus seal the tank T from the chamber 16 by simultaneously establishing communication between the chambers 3, 16 so that the fluid can act on the annular face 13 and also on the surface 14. The slide valve 19 is moved to the position *c* when the sheets are properly adjusted with reference to the knife of the paper cutting machine.

In presently known apparatus, the fluid pressure required to move the control member to second position is often too high because the control member of a conventional apparatus does not have an equivalent of the second surface 14 so that, in order to maintain it in second position, the operator must select a fluid pressure which can oppose the bias of the closing spring by acting solely on that face 24 of the control member which is subjected to the pressure of fluid in the working chamber.

The parts of the displacing units are preferably mounted in and/or on a block-shaped support which is connected to the cylinder 1 by conduits 10, 18 and 20. Alternatively, the conduits can be omitted if the block-shaped support is mounted directly on the cylinder 1, for example, by resorting to screws, bolts or analogous fasteners. The mounting of the support on the cylinder is preferably such that its fluid conveying passages register accurately with passages in the cylinder.

The operation is as follows:

In the position *a* the valve 19 connects the branch 20*a* with the return conduit 19A and with the conduit 18. Therefore, the output of the pump 21 is caused to return into the tank T by way of the conduit 19A and the volume of the working chamber 3 remains unchanged, *i.e.*, the piston 2 dwells in the illustrated position.

If the valve 19 is moved to the position *b*, the branch 20*a* is connected with the return conduits 19B and 19C whereby the setting of the valve S determines the pressure which develops in the conduit 20. The fluid pressure in the working chamber 3 rises and the piston 2 is rapidly displaced upwardly to transmit motion to the hold down device HD. The speed at which the piston 2 leaves its starting position depends on adjustment of the throttle valve D in the return conduit 19C. As stated before, the force which the piston 2 transmits to the hold down device HD can be readily selected in such a way that the latter cannot cause injury to an operator. Such force depends on the setting of valves S, D and on the area of that face of the piston 2 which is adjacent to the upper end of the chamber 3. The fluid pressure which is selected by the valves S and D suffices to displace the piston 2 but is too weak to effect displacement of the control member CM from first position in response to pressure acting against the surface 24 of the upper portion. In other words, such pressure cannot overcome the bias of the closing spring 12 which urges the control member CM upwardly so that the portion 7 seals the chambers 3, 16 from each other and that the portion 8 establishes communication between the chamber 16 and tank T. However, when the slide valve 19 is moved to the position *c*, it seals the branch 20*a* from the return conduits 19A—19C so that the pressure of fluid in the conduit 20 is determined by the valve PV which is adjusted in such a way that pressure acting upon the surface 24 can overcome the bias of the closing spring 12 and the control member CM moves to its second position in which the bores 22, 23 admit fluid from the extension 5 into the chamber 16 and the insert 4 seals the outer ends of radial bores 9 to terminate the flow of fluid between the chamber 16 and tank T. The pressure which acts upon the annular face 13 of the piston 2 is the same pressure which is felt in the working chamber 3 and acts against the surfaces 14 and 24 of the control member CM. The area of the surface 14 exceeds that of the surface 24 and the fluid pressure upon these surfaces opposes the bias of the closing spring 12. The difference between the areas of surfaces 14, 24 determines the fluid pressure which is necessary to hold the closing member CM in the second position. Once the control member CM is moved to second position, a relatively low fluid pressure suffices to hold it in such second position of the differential between the surfaces 14, 24 is sufficiently large. Thus, it is necessary to temporarily raise the fluid pressure in the working chamber 3 so as to move the control member CM to the second position, and the pressure of fluid can be reduced thereafter without causing return movement of member CM to first position provided that the area of the surface 14 exceeds the area of the surface 24 to a predetermined extent. The surge in fluid pressure which is needed to move the control member CM to second position is not felt at the annular face 13 because this face is subjected to fluid pressure subsequent to establishment of communication between the chambers 3 and 16. In other words, the force transmitted by the piston 2 is substantially independent of the bias of the closing spring 12. The fluid pressure which acts simultaneously on the surfaces 14, 24 of the control member CM may be a small fraction of the maximum pressure which can be selected by the valve S; for example, the maximum pressure determined by valve S may be a whole multiple of the pressure required to maintain the control member CM in open or second position. The numeral 19D denotes a solenoid which can be employed to move the valve 19 to the position *c*.

FIGS. 2 to 4 illustrate a modified apparatus which comprises a cylinder 31 formed with a passage 32 for a working piston 33 having a blind bore or recess 33*a* receiving an insert 35 which defines therewith a working chamber 34 occupying the upper end portion of the recess 33*a*. The insert 35 is fix-

edly secured to the cylinder **31** by an annular connector **36** and can be said to form a part of the cylinder. The control member **37** is reciprocable in the insert **35** and cooperates therewith in the same way as described in connection with FIG. **1**. The extension of the second chamber (defined by the insert **35** and control member **37**) is shown at **38**; this extension terminates at an annular face provided at the lower end of the piston **33**.

The displacing unit of this apparatus comprises passages **39** which are formed directly in the cylinder **31** and serve to convey fluid to and from the chambers. The cylinder **31** further carries two adjustable pressure regulating valves **40, 41** which correspond to the valves PV and S of FIG. **1**, a four-way slide valve **42** which corresponds to valve **19** of FIG. **1**, and an adjustable throttle valve **43** shown in FIG. **4**. The bores **44** in the body of the cylinder **31** serve to permit passage of fasteners (*e.g.*, bolts or the like) by means of which the apparatus is secured to a paper cutting or other machine.

An advantage of the apparatus shown in FIGS. **2** to **4** is that all of its parts are assembled into a unitary compact structure. In other words, the conduits between the valves and the cylinder can be replaced by passages machined directly into the body of the cylinder. Each of the valves is preferably provided with threads so that it can be readily screwed into or removed from tapped bores provided therefor in the cylinder **31**. Such construction reduces the likelihood of leakage and contributes to longer useful life of the apparatus. The dimensions of the cylinder **31** are preferably selected in such a way that it can be used with working pistons of different sizes without necessitating a change in the distribution of passages **39**.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

I claim:

1. A controllable hydraulic press for paper cutting machines or the like comprising cylinder means; piston means reciprocable in said cylinder means having a recess extending inwardly from one end thereof and a face at said one end, said cylinder means having a portion extending into said recess and defining with said piston means a working chamber having a first extension; a control member installed in said portion of said cylinder means and defining therein a second chamber having an extension leading from said second chamber to said face, said control member being movable from a first position in which it connects said second chamber to a source of fluid so that fluid may flow from said second chamber to said source and in which a first portion of said control member seals said chambers from each other and a second position in which it establishes communication between said chambers and in which a second portion thereof prevents flow of fluid from said second chamber to said source, said control member having a first surface adjacent to said first extension and a second surface in said second chamber and having an area exceeding the area of said first surface; closing means for biasing said control member to said first position; and displacing means including means for admitting to and maintaining in said working chamber a fluid at a first pressure to displace said piston means with reference to said cylinder means and a second pressure which suffices to move said control member to said second position, said admitting and maintaining means including a first pressure-regulating valve, means to connect said first pressure-regulating valve to said working chamber and to disconnect it therefrom, and a second pressure-regulating valve communicating with said second chamber, whereby such fluid enters said second chamber to exert pressure against said face and said second surface so that the pressure of fluid exerted against said second surface assists the pressure of fluid against said first surface to cause the bias of said closing means.

2. A press as defined in claim **1**, wherein said recess is an axially extending blind bore and said face is an annular face surrounding the open end of said blind bore.

3. A press as defined in claim **1**, wherein each of said extensions is a bore in said portion of said cylinder means.

4. A press as defined in claim **1**, wherein said fluid admitting means are provided in said cylinder means.

5. A press as defined in claim **4**, wherein said fluid admitting means comprises passages provided in said cylinder means.

6. A press as defined in claim **5**, wherein the dimensions of said cylinder means are such that it can accommodate piston means of different sizes.