

[54] **DEEP-DRAWING PRESS**

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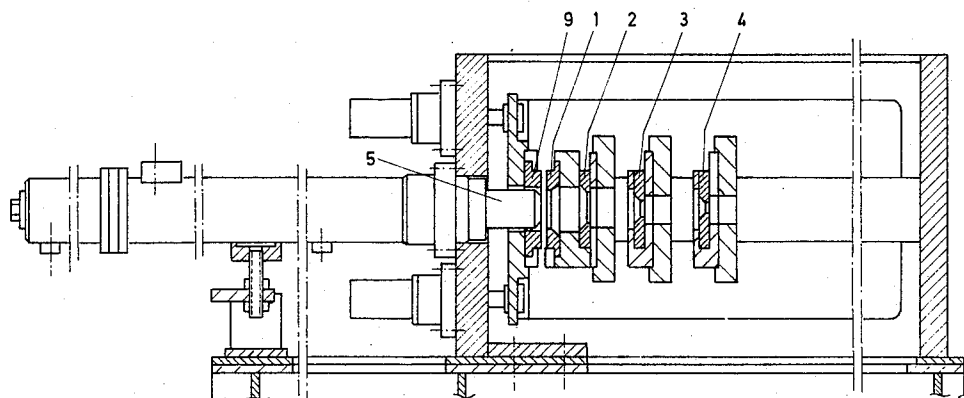
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[57] **ABSTRACT**

The invention relates to a deep-drawing press with a multi-stage die set comprising a plurality of dies arranged in sequence and punches moving telescopically inside each other, each of which, after a given length of travel, remains at an associated die which serves as a hold-down ring; the punches are powered by a plurality of coaxial annular pistons.

3 Claims, 7 Drawing Figures



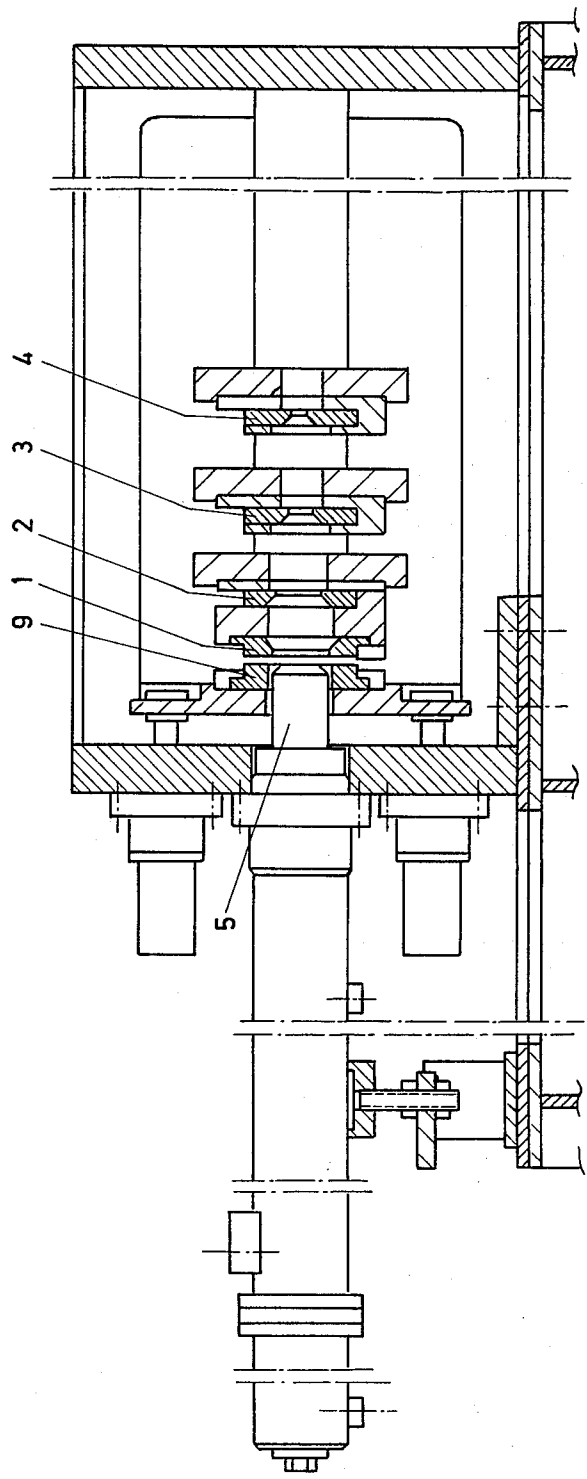


Fig. 1

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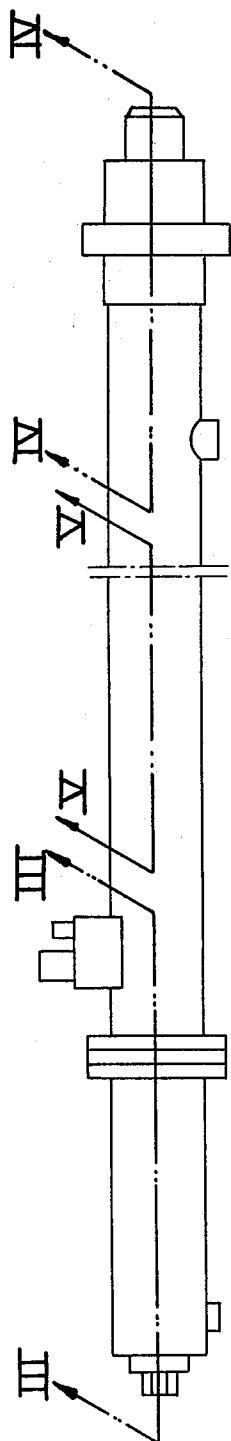


Fig. 2.

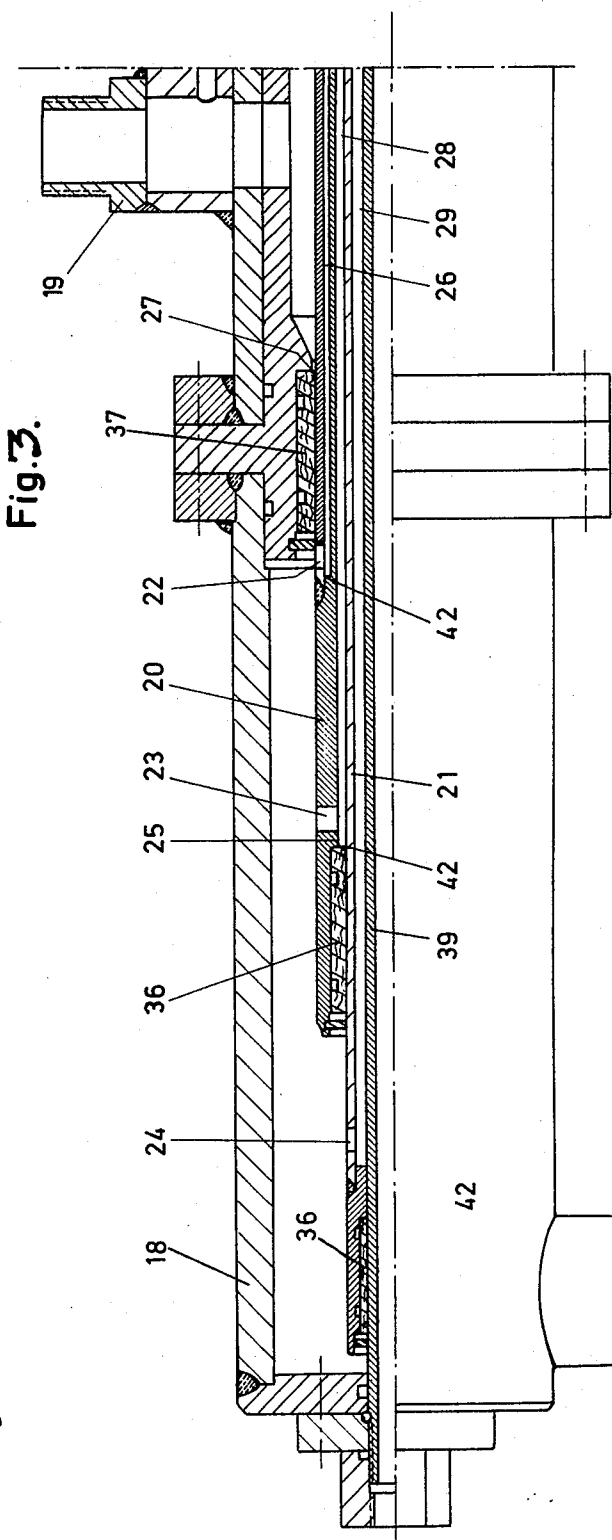
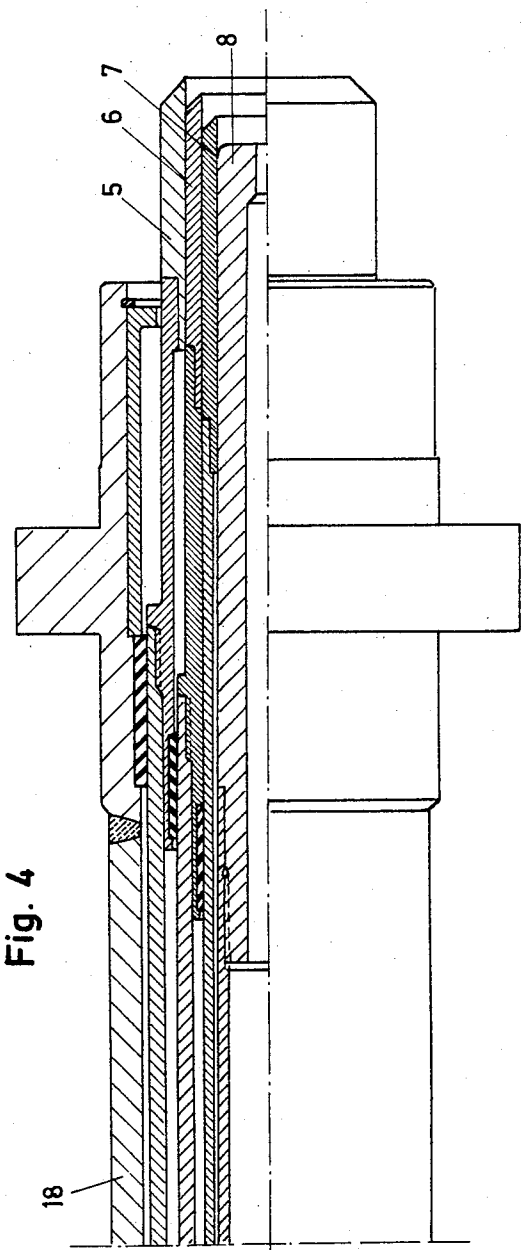
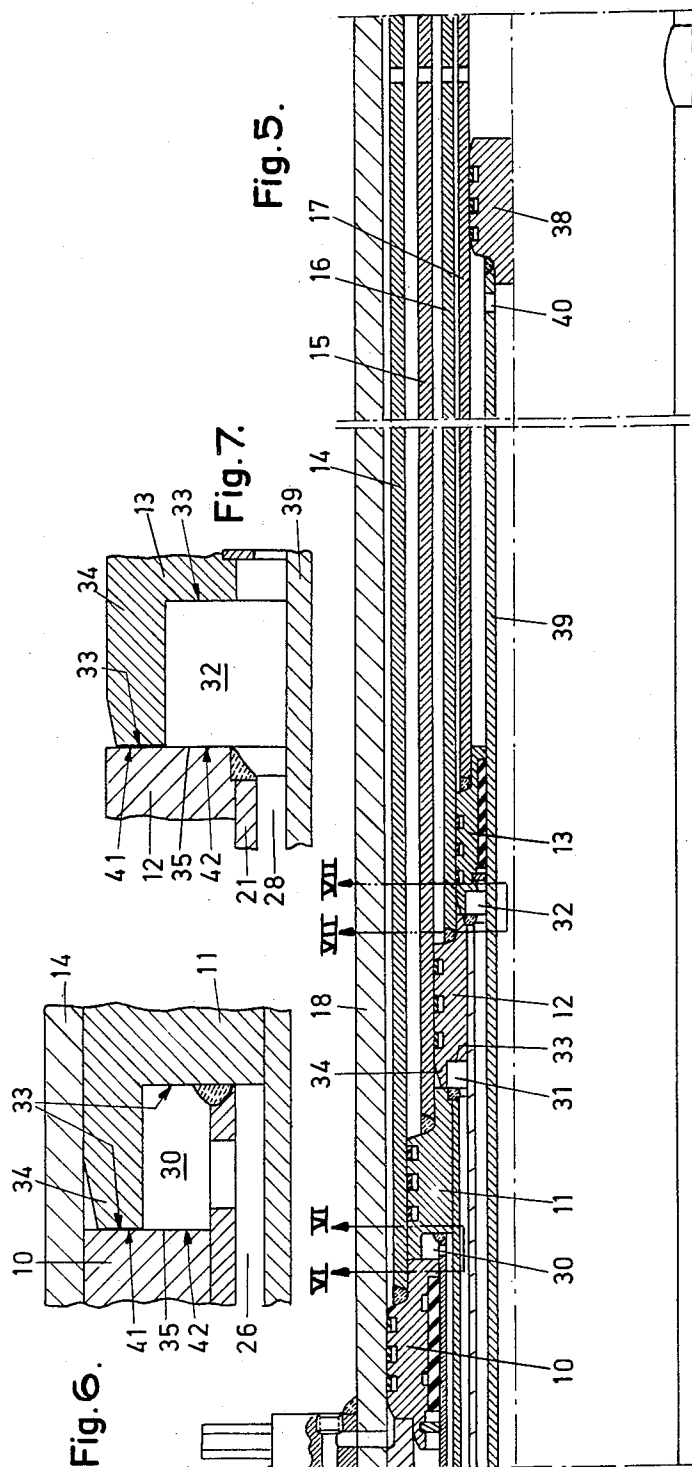


Fig. 3.





DEEP-DRAWING PRESS**BACKGROUND OF THE INVENTION**

With prior art deep-drawing presses of this type, the control means is generally a complicated unit, which is not part of the deep-drawing press and is separately installed outside the press. Irrespective of whether control takes place by a program or sequence control system, this prior art arrangement entails dead times that adversely affect the operational sequence and cycle times of the deep-drawing press. With a deep-drawing press of this type, if the punches, after a prescribed length of travel, are to remain effective at an associated die acting as hold-down ring, additional dead times are entailed, so that the control means is technically more complicated and more costly as well as being prone to trouble. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is, therefore, an outstanding object of the invention to provide a deep-drawing press having a simplified control means incorporated as an integral component. In so doing, unproductive times entailed with prior art versions are reduced, including the times for those control duties to ensure that the punches, after a prescribed length of travel, remain effective on an associated die as a hold-down ring.

Another object of this invention is the provision of a deep-drawing press that costs less to construct and constitutes an improvement with respect to operational sequence and cycle times.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

SUMMARY OF THE INVENTION

In general, the invention consists of a deep-drawing press having a control means comprising plunger-type valves, positively connected to all but the final annular piston, with control members for conducting the pressure medium to the piston end areas. The said plunger type valves act as a sequence control with members controlling in succession the flow of pressure medium to pressure chambers in front of the second to the final annular piston. At the backs of the first to the penultimate annular pistons, differential end areas are formed. After adjacent annular pistons are mutually supported by the stop rings in the inward position, the pressure medium on the one hand flows in front of the end areas of the operating pistons and, on the other hand, to the differential piston area of the first to the penultimate annular pistons, thereby determining the hold-down force, the differential force acting on the respective annular pistons.

BRIEF DESCRIPTION OF THE DRAWINGS

The character of the invention, however, may be best understood by reference to one of its structural forms, as illustrated by the accompanying drawings, in which:

FIG. 1 is a side view partly in section of a deep-drawing press incorporating the principles of the present invention,

FIG. 2 is a somewhat-enlarged view of a portion of the press,

FIG. 3 is a sectional view of the press taken on the line III—III of FIG. 2,

FIG. 4 is a sectional view of the press taken on the line IV—IV of FIG. 2,

FIG. 5 is a sectional view of the press taken on the line V—V of FIG. 2,

FIG. 6 is a sectional view taken on the line VI—VI of FIG. 5, and

FIG. 7 is a sectional view taken on the line VII—VII of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

According to a preferred embodiment of the invention, the control elements of the plunger type valves taken the form of holes, edges and, possibly, ducts in a cylindrical shell. Moreover, annular spaces are provided between adjacent plunger type valves to conduct the pressure medium to the associated annular pistons.

According to another embodiment, the differential piston areas are comprised of the supporting surfaces covered by the stop rings when the annular pistons are in the inward position, and of the piston end areas adjoining the pressure chambers.

It goes without saying, that the deep-drawing press, according to the invention, exhibits a housing acting as cylinder for the first annular piston and that a stub is provided for connection to the pressure medium supply. Said housing is also extended beyond the plunger type valves and provided with control elements in the form of edges that cooperate with the plunger type valve of the first annular piston. There is no need for a separate plunger type valve to be connected to the final annular piston, as said final piston is the last to receive the pressure medium and thus concludes the work cycle of said deep-drawing press.

In other branches of technology, actuators are employed that feature a plurality of coaxial annular pistons which automatic control themselves. So far, however, they have had no influence on the design of deep-drawing presses of the type conforming to the invention. In their case, there is, in fact, no problem of maintaining a given degree of pressure exerted by an annular piston in the outward position, for performing a given function — in the case of this invention, the holding down of the blank.

All spaces of the deep-drawing press, conforming to the invention, filled or to be filled with a pressure medium must be suitably sealed. For this purpose, the free end of the plunger type valve connected to the annular piston should be provided with packings flush with the control edges. Said packings together with the control edges seal off the annular spaces between adjacent plunger type valves. It goes without saying that there is also a packing between the plunger type valve of the second annular piston and the steel edge of the housing. The annular pistons of the deep-drawing press disclosed by the invention are provided with packings in a manner known per hold-down

The advantage afforded by the invention are, above all, that the control means of said deep-drawing press is incorporated as an integral component of the press and the possibility of controlling the travel of the individual annular pistons in relation to function, without complicated and costly mechanisms. At the same time,

dead times are obviated. Moreover, the design of the annular pistons with stop rings on the end areas and the provision of differential piston surfaces, itself a significant feature of the invention, ensures that the individual operations proceed in a definite sequence. This not only enables the individual annular pistons to perform their strokes but, at the end thereof, to exert a hold-down force.

The press disclosed by the invention is suitable not only for the deep drawing of plate and sheet, but for sizing deep-drawn components. When an article is sized subsequent to deep drawing, it is forced through a die to produce a given external dimension, the wall thickness being reduced by the action in cooperation with the mating punch.

The deep-drawing press depicted in the drawings has a multi-stage die set comprising four successive dies 1, 2, 3, and 4, and four telescopically-arranged punches 5, 6, 7, and 8 nesting within each other, the first three of said punches 5, 6, and 7 at the end of their predetermined stroke continuing to act as hold-downs in cooperation with an associated die. Punches 5, 6, 7, and 8 are surrounded by a main hold-down. Drive to these punches 5, 6, 7, and 8 is by four coaxially arranged annular pistons 10, 11, 12, and 13 attached to said punches and moved by a pressure medium. The four said annular pistons 10, 11, 12, and 13, with their four associated piston rods 14, 15, 16, and 17, are telescopically arranged within each other and accommodated in a housing 18 provided with a stub 19 for connecting the pressure medium supply line. Said housing 18 is designed as a cylinder for the first annular piston 10 and piston rod 14 of the first annular piston 10 serves as cylinder for the second annular piston 11, piston rod 15 of the second annular piston 11 acting as cylinder for the third annular piston 12, and piston rod 16 of the third annular piston 12 as cylinder for the fourth annular piston 13.

The deep-drawing press is provided with a control means which enables the annular pistons 10, 11, 12, and 13 to be moved outwards in sequence, starting with the outermost and ending with the innermost thereof. Attached to the second and third annular pistons 11 and 12 and coaxial therewith, the control means has plunger type valves 20 and 21 with control elements for directing the pressure medium to annular pistons 11, 12, and 13. Said plunger type valves 20 and 21 are operated successively in the manner of a sequence control, thereby controlling the flow of pressure medium to the second, third, and fourth annular pistons 11, 12, and 13. For control elements the plunger type valves 20 and 21 have ports 22, 23, and 24 and edge 25. Plunger type valve 20 connected to the second annular piston 11 is additionally provided with a control duct 26 in its cylindrical shell. Said duct communicates with port 22, thereby enabling the flow of pressure medium to the second and third annular pistons 11 and 12 to be controlled in sequence by said plunger type valve 20. Housing 18, extending beyond plunger type valves 20 and 21, also exhibits a control edge 27, which cooperates with the ports 22 and cooperates of plunger type valve 20 connected to the second annular piston 11. Annular spaces 28 and 29, between adjacent plunger type valves 20 and 21, are additionally provided to conduct pressure medium to annular pistons

11, 12, and 13. In front of annular pistons 11, 12, and 13, that is to say, at the end to which pressure medium must flow to effect outward displacement, are provided pressure chambers 30, 31, and 32 communicating with annular spaces 28 and 29 and control duct 26, respectively.

In the drawings of the deep-drawing press, the annular pistons 10, 11, 12, and 13 are shown in their inward position. Said annular pistons 10, 11, 12, and 13 are supported one against the other by stop rings 34, clear of pressure chambers 30, 31, and 32. During the outward stroke, the first annular piston 10 carries forward the second annular piston 11 by engaging the stop ring mounted on said second annular piston, and when the second annular piston 11 is displaced, it carries along the third and the third annular piston 12 carries along the fourth annular piston 13. Differential piston surfaces 35 are formed at the back of the four annular plungers 10, 11, 12, and 13. After the stop rings 34 have lifted, pressure medium flows both in front of the working faces 33 of the annular pistons and at the back of the differential faces 35 of annular pistons 10, 11, and 12, the differential force thereby generated being exerted by the respective annular pistons 10, 11, and 12 for holding down. The differential piston surfaces 35 are comprised of the support surfaces 41 covered by the stop rings 34 when the annular pistons 10, 11, 12, and 13 are in the inward position, pressure chambers 30, 31, and 32 and annular spaces 28 and 29 or the piston areas 42 flanking the control duct 26. (FIGS. 3a and 3b).

All spaces of the illustrated deep-drawing press that are filled or to be filled with pressure medium are sealed in a manner known per se. Plunger type valves 20 and 21 connected to annular pistons 11 and 12 are provided on the inside of their free end with packings 36. Said packings 36 seal off the annular spaces 28 and 29 between the adjacent plunger type valves 20 and 21. A packing 37 is also fitted at the control edge 27 of housing 18 between said housing and the plunger type valve 20 of the second annular piston 11.

On the deep-drawing press disclosed by the invention a receiving piston 38 of fixed arrangement cooperates with the fourth annular piston 13 and is coaxial with the other annular pistons 10, 11, and 12. Connected to said receiving piston 38 is a piston rod 39 provided with an orifice 40 for the pressure medium supply. Piston rod 17 of the fourth annular piston 13 serves as cylinder for receiving piston 38, said piston rod 17 enclosing the piston rod 39 of said receiving piston 38.

The mode of operation of the deep-drawing press disclosed by the invention is as follows:

Pressure medium flows to the first annular piston 10 through the stub connection 19 of housing 18. Said pressure medium causes the first annular piston 10 to move outward and through stop rings 34 the other annular pistons 11, 12, and 13 are entrained. Just before the first annular piston 10 completes its stroke, that is to say, immediately prior to the punch 5 attached to said first annular piston 10 making contact with its associated die 2, the first orifice 22 of the plunger type valve 20 connected to the second annular piston 11 is cleared by the control edge 27 on the extended housing 18, thereby permitting the pressure medium to flow through duct 26 in the cylindrical valve shell to pres-

sure space 30. Under the influence of the pressure medium, the second annular piston 11 starts its outward movement. As a result, the pressure medium flows up against the differential surface 35 of the first annular piston 10 thereby partly balancing out the force acting on said annular piston 10 and slowing down its outward movement, and after the punch 5 has made contact with its associated die 2 the differential force acts as a hold-down force upon the annular piston 10. When the second annular piston 11 has completed its drawing stroke, the control edge 27 on housing 18 clears the second orifice 23 in the plunger type valve 20 connected to the second annular piston 11, as a result of which the pressure medium flows into the pressure space 31 through the annular space 28 between the two plunger type valves 20 and 21 connected to the second and third annular pistons 11 and 12. The third annular piston 12 starts to move outwardly and carries along the fourth annular piston 13. After the outward movement of the second annular piston 11 has slowed down and the punch 6 is in contact with the die 3, the pressure acting on said piston 11 through the pressure medium ahead of the face end 33 and differential surface 35 serves as a hold-down force. Shortly before the third annular piston 12 completes its drawing movement, the orifice 24 of plunger type valve 21 connected to said third annular piston 12 is passed by the control edge 25 of the plunger type valve 20 connected to the second annular piston 11. As a result, the pressure medium is able to flow through orifice 24 and annular space 29 between the plunger type valve 21 connected to the third annular piston 12 and the piston rod 39 of receiving piston 38 to pressure chamber 32 ahead of the fourth annular piston. This causes the fourth annular piston 13 to start its outward movement and, at the same time, the hold-down force acts upon the annular piston 12.

When the deep-drawing operation is concluded, the return travel of the annular pistons 10, 11, 12, and 13 is effected by permitting the pressure medium to flow back into a reservoir, not illustrated, through a pipe connected with the stub 19 on housing 18. The pressure medium flows through the piston rod 39 of receiving piston 38 and port 40, thereby acting on the stationary receiving piston 38 and the fourth annular piston 13, which begins its inward movement, thereby initiating the return travel of the other annular pistons 12, 11, and 10 to their rest position. In so doing, annular pistons 13, 12, 11, and 10 support each other through their stop rings 34. The pressure medium thereby expelled flows through passages 22, 23, and 24 to the plunger type valves 20 and 21 and through port 19 to discharge into the reservoir. No difficulties will be encountered in that ports 22, 23, and 24 are covered by the associated control edges 25 and 27 only when there is no flow of pressure medium.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A deep-drawing press with a multi-state die set consisting of a plurality of successively arranged dies and punches moving telescopically within each other, after performing a predetermined drawing movement the punches exert pressure on an associated die acting as a hold-down ring, a drive consisting of the same number of coaxial annular pistons attached to said punches, the pistons being subjected to the influence of a pressure medium, and a control means that permits all of the said annular pistons to be moved axially in sequence, from the outside inward,

characterized by the fact that the control means comprises coaxial plunger type valves (20 and 21) integral with the first, second and penultimate annular pistons (10, 11 and 12), with elements for the flow of pressure medium to the end faces of said annular pistons, said plunger type valves (20 and 21) having elements acting in succession in the manner of a sequence control to control the flow of pressure medium to pressure chambers (30, 31 and 32) in front of the second and penultimate annular pistons, the backs of the first to penultimate annular pistons (10, 11 and 12) are provided with differential piston surfaces (35) so that, after the lifting of stop rings (34), through which adjacent annular pistons engage each other in the inward position, said pressure medium flows on the one hand to the working face and on the other hand to the differential piston surface (35) of the pistons, thereby determining the differential pressure exerted by the respective annular pistons.

2. A deep-drawing press as set forth in claim 1, characterized by the fact that the control elements of the plunger type valves (20 and 21) take the form of passages (22, 23 and 24) and edges (25) in the cylindrical valve shell and that annular spaces (28 and 29) are provided between adjacent plunger type valves (20 and 21) for directing the flow of pressure medium to the associated annular pistons (11, 12 and 13).

3. A deep-drawing press as set forth in claim 1, characterized by the fact that the differential piston surface (35) consists of the supporting surfaces (41) engaged by the stop rings (34) in the inward position of the annular pistons (10, 11, 12 and 13) and the piston areas (42) flanking the pressure chambers (30, 31 and 32).

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