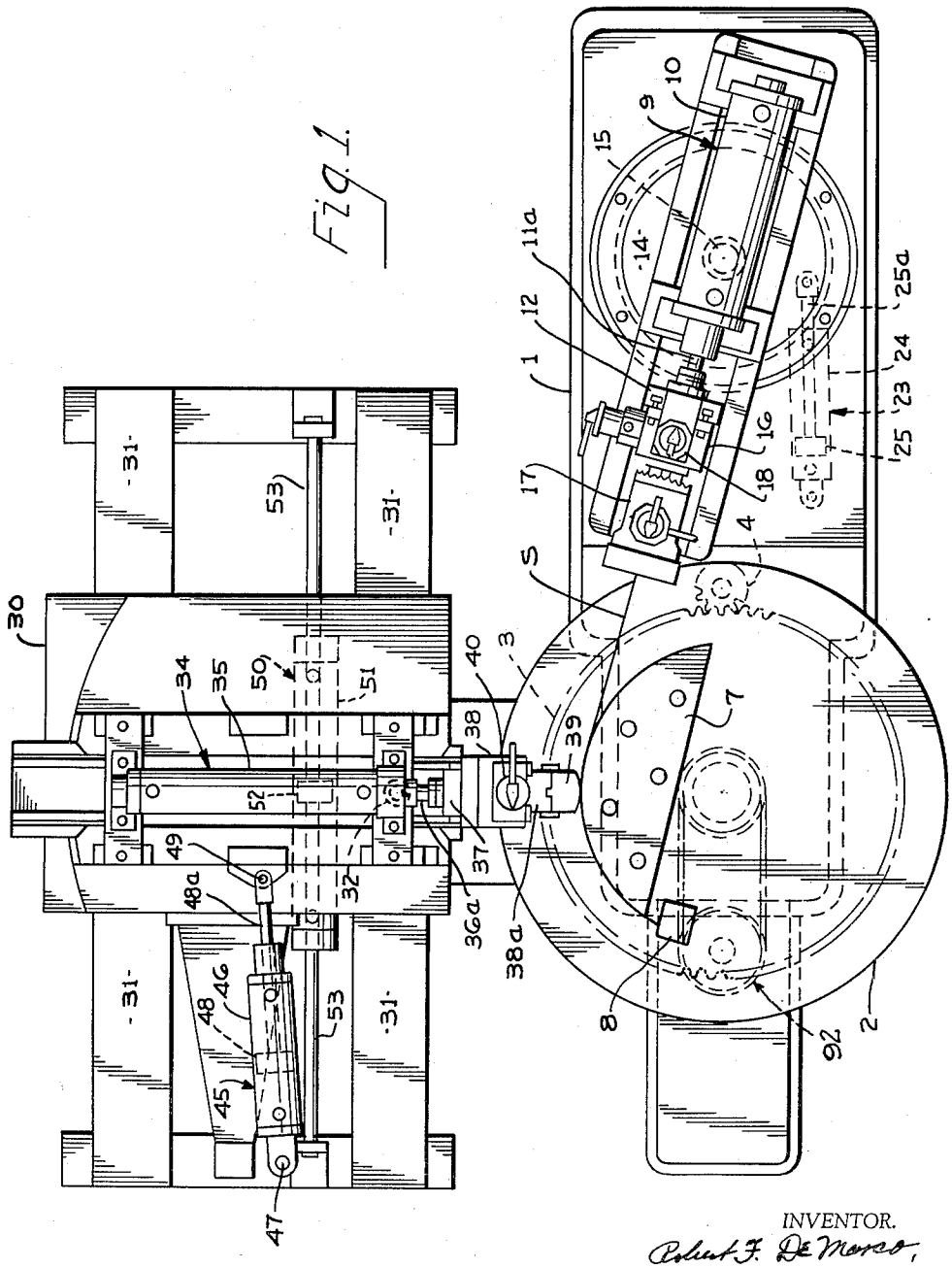
Jan. 16, 1962 R. F. DE MARCO 3,016,882

METAL FORMING MACHINE AND REVERSIBLE HYDRAULIC CONTROL THEREFOR

Filed Jan. 8, 1959 4 Sheets-Sheet 1

Fig. 1.



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METAL FORMING MACHINE AND REVERSIBLE HYDRAULIC CONTROL THEREFOR

Filed Jan. 8, 1959 4 Sheets-Sheet 2

Fig. 2.

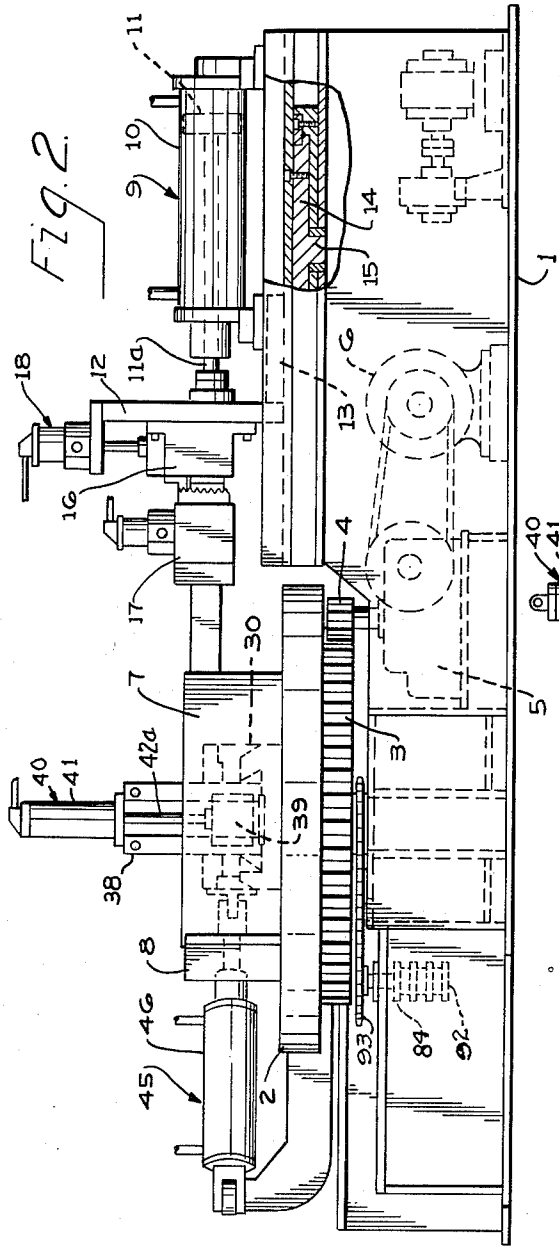
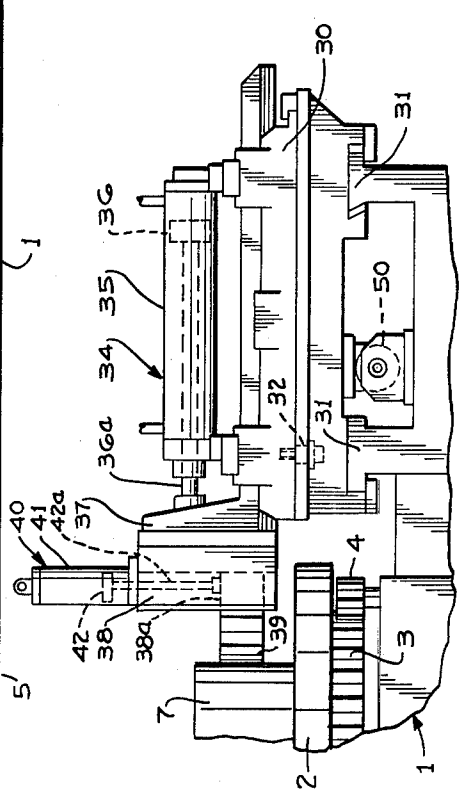


Fig. 3.



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METAL FORMING MACHINE AND REVERSIBLE HYDRAULIC CONTROL THEREFOR

Filed Jan. 8, 1959 4 Sheets-Sheet 3

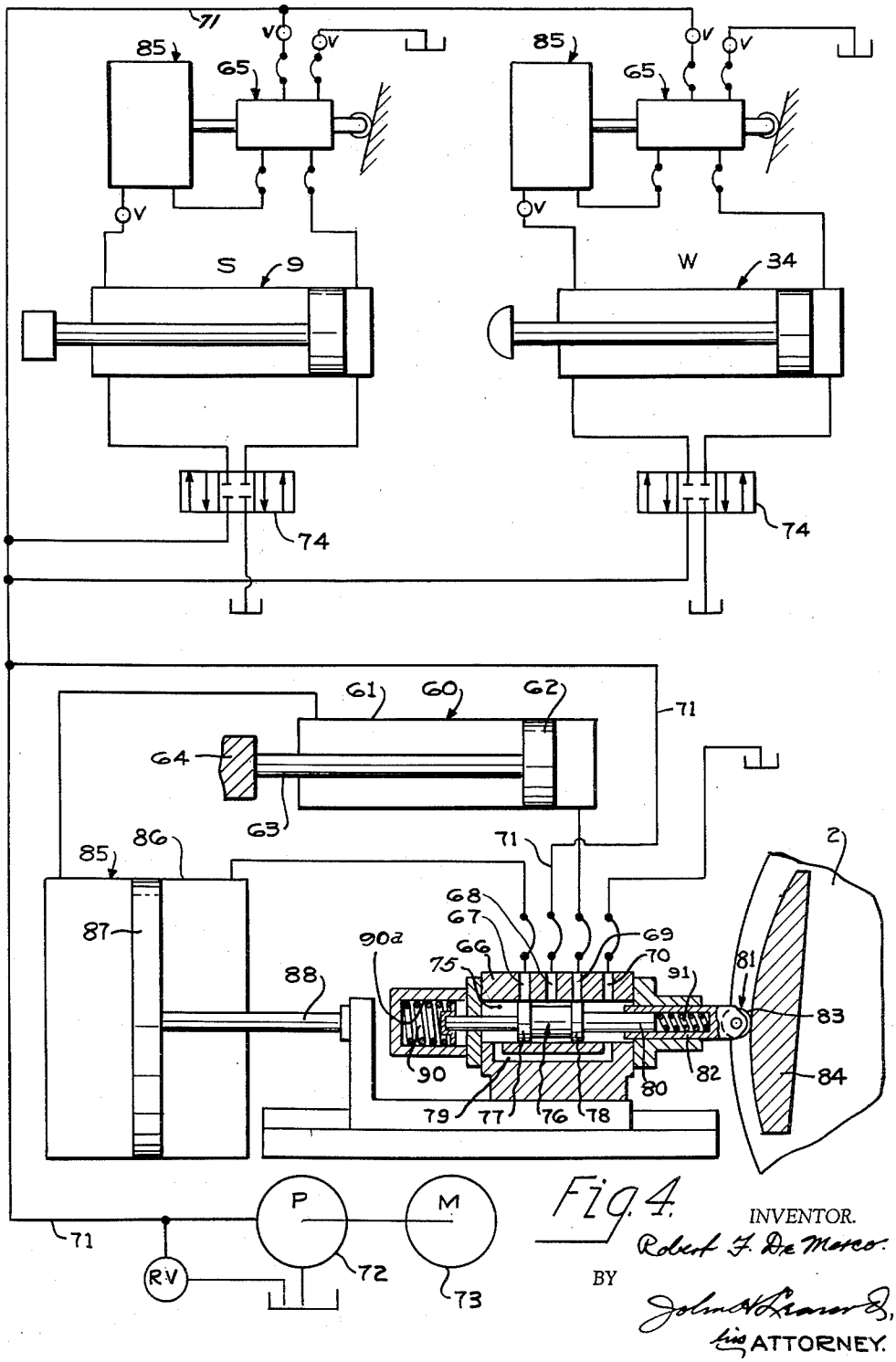


Fig. 4.

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METAL FORMING MACHINE AND REVERSIBLE HYDRAULIC CONTROL THEREFOR

Filed Jan. 8, 1959 4 Sheets-Sheet 4

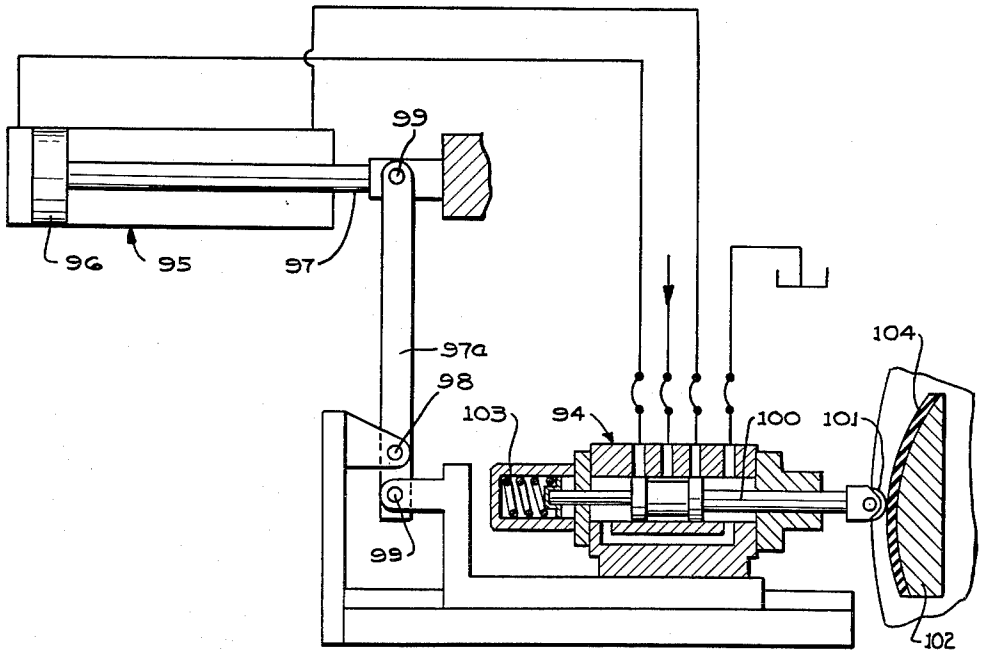


Fig 5.

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United States Patent Office 3,016,882 Patented Jan. 16, 1962

3,016,882

METAL FORMING MACHINE AND REVERSIBLE HYDRAULIC CONTROL THEREFOR

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Filed Jan. 8, 1959, Ser. No. 785,666
3 Claims. (Cl. 121—41)

This invention relates to stretch forming and wipe forming machines and controls therefor, and particularly to controls for hydraulic motors, such, for example, as reversible hydraulic piston and cylinder assemblages of stretch and wipe forming machines.

For purposes of illustration, the invention is disclosed herein in combination with a combined stretch and wipe forming machine, its specific advantages in such a machine as well as its uses and advantages generally for controlling operations of reversible hydraulic motors of other types of machines being readily apparent from the illustrative example.

Heretofore, in the control of hydraulic motors operated by hydraulic fluid under pressure for moving various parts of machines in preselected sequences, a follow-up valve connected to the motor for controlling the admission of pressure fluid thereto, and operatively connected in some manner to a driven control element and to the motor for movement in accordance with the operation of the motor and element, has been employed.

However, the valving parts of valves of this character tend to override or overrun each other when moved to preselected positions by the motor and element, thereby causing the part controlled thereby to overrun or override the preselected position into which it was meant to have been moved. This overrunning causes "hunting" of the part to and fro throughout a relatively wide range of oscillation of gradually decrescent amplitude before it finally reaches and stops at the preselected position.

However, if the preselected positions to which the part to be controlled is to be moved are changed frequently in succession, then the "hunting" is continuous and the part to be moved does not remain in each preselected position for any appreciable interval but, as to each preselected position, merely passes through it repeatedly as the part overruns the position successively in opposite directions.

In accordance with the present invention, a follow-up valve has been combined with the part to be controlled in such a manner that the follow-up valve does not itself overrun and hunt but moves immediately into, and remains in, each preselected control position until a new position has been selected, wherefore the part controlled thereby does not overrun and hunt. This makes possible the accurate control of some of the extremely heavy parts of combined stretch forming and wipe forming machines and, consequently, of the stresses and strains imposed on the stock by the machine parts, all as more fully disclosed hereinafter.

The object of the present invention is to provide more rapid and accurate control of reversible hydraulic motors by more rapid and accurate control of the admission and discharge of pressure fluid thereinto and therefrom.

Another object is to control moving parts of stretch forming and wipe forming machines so that the forces applied to the stock being formed on such machines are controlled more effectively and within safe allowable limits.

Various other objects and advantages will become apparent from the following description wherein reference is made to the drawings, wherein:

FIGS. 1 and 2 are a top plan view and front elevation, respectively, of a combined stretch forming and wipe

forming machine embodying the principles and control of the present invention;

FIG. 3 is a fragmentary right end elevation of the wipe forming structure of the machine illustrated in FIG. 1;

FIG. 4 is a diagrammatic illustration showing the control mechanism and improved follow-up valve of the present invention and its relation to the parts to be controlled; and

FIG. 5 is a view similar to FIG. 4, showing a modified form of the invention.

The combined wipe and stretch forming machine in which the present invention is embodied is one such as more fully described in U. S. Letters Patent No. 2,810,421, issued October 22, 1957, to Dolney et al., its specific advantages therein, as well as its use with other hydraulic motors and equipment, being readily apparent from the illustrative example.

As therein more fully disclosed, the combined wipe and stretch forming machine comprises a frame **1** on which a turntable **2** is rotatably mounted. The turntable is driven through a ring gear **3**, pinion gear **4**, and transmission **5**, by a suitable reversible motor **6**.

The turntable **2** carries a side face die **7** about which stock S to be formed is wrapped while held under tension by a stretch forming assemblage and while pressed against the die by a wipe forming assemblage.

Mounted on the table is a suitable clamp **8** adapted to engage one end of the length of stock S for holding it in fixed position relative to the die during the stretch and wipe forming operations. The stretch forming force is derived from a piston and cylinder assemblage **9** including a cylinder **10** and a piston **11** reciprocable therein and having a rod **11***a*. The rod **11***a*, in turn, is connected to an upright pedestal **12** of a suitable slide **13** which is movable endwise parallel to the axis of the assemblage **9** toward and away from the side face die **7**. The pedestal **12** and slide **13** provide an elongated head support for a stretch head. The assemblage **9** and slide **13** are mounted on a suitable support **14** which is connected to the frame **1** by a pivot **15** for swivelling about a pivotal axis parallel to the axis of rotation of the table **2**.

Mounted on the pedestal **12** is a vertically slidable carrier **16** on which is carried a stretch forming head **17** which is adapted for clamping engagement with the opposite end of the stock S for imparting tension thereto when hydraulic fluid is admitted to the rod end of the cylinder **10**.

The pedestal **12** and slide **13** thus provide an elongated stretch head support for supporting the stretch head **17** so that the head and the support are movable endwise generally toward and away from the table **2** in a plane normal to the axis of rotation of the table.

In forming some shapes, the side face of the die is curvilinear in a direction upwardly and downwardly toward the top of the table **2**, and the stretch forming head **17** must be raised and lowered to maintain the instantaneous line of contact between the stock S and die **7** in proper position.

To effect this upward and downward movement of the head **17**, a hydraulic piston and cylinder assemblage **18** is mounted on the pedestal **12**, and includes a cylinder **19** and a piston **20** reciprocable therein and having a rod **20***a* which is connected to the carrier **16**. Thus, the carrier **16** can be lifted and lowered by admitting and discharging pressure fluid from the rod end of the cylinder **18**, and this operation can be performed during the stretch forming operation.

In some instances, the die **7** about which the stock is to be formed or wrapped has a non-circular or non-cylindrical side face, or the die, though having a circular

side face, may have its axis offset from the axis of rotation of the table. In such cases, the instantaneous line of contact between the stock S and die 7 moves inwardly and outwardly radially relative to the axis of the table. In order to maintain the axis of the stretch forming assemblage 9 tangent to the side face of the die 7 at the instantaneous line of contact of the stock and die, the piston and cylinder assemblage 9 must be swung to the different positions about the pivot 15. In small machines, this swinging of the assemblage 9 was effected by the stock itself, inasmuch as the strength of the stock was relatively large in proportion to the weight of the assemblage. However, as tougher metals are developed and greater power is required for stretch forming and, at the same time, a more accurate control is required, the stretch forming assemblages have become so heavy that, in many instances, the force required to effect the swinging of the assemblages about their pivotal axis into such a tangential relation imposes undue stresses on the stock. Furthermore, once the assemblage has started to move, there is a tendency for its momentum to swing it beyond the position necessary for tangency. Therefore, it has become necessary to provide, for swinging the head support provided by the pedestal 12 and slide 13, about the axis 15, by a power means which can be controlled accurately and which responds promptly to its control without the well known "hunting" effects. The swinging by the power means or motor driving device must be such that the head support is driven substantially to, and maintained substantially and continuously in, positions wherein a line defined by the axis of the pivot 15 and the gripping portion of the head 17 is maintained substantially tangential to the side face of the die at the instantaneous line of contact or tangency of the stock and side face of the die.

For this purpose, there is mounted on the frame 1 a piston and cylinder assemblage 23 which is controlled accurately and rapidly and comprises a cylinder 24 pivotally connected at one end to the frame 1, and having reciprocable therein a piston 25 with a rod 25*a* which is pivotally connected to the support 14. Thus, by admitting controlled pressure fluid to the cylinder at opposite sides of the piston, selectively, the assemblage 23 can be operated to swing the support 14 about its pivot to positions in which the axis of the assemblage 9 is, and is maintained, tangent to the side face of the die 7 at the instantaneous line of contact of the stock and die.

Again, in machines of this character, wipe forming assemblages are provided and these generally must be traversed along the side face of the die by hydraulic means. In the form illustrated, a wipe forming assemblage is mounted on a platform 30 which can be moved along guideways 31 on the frame 1. Mounted on the platform for swinging about a pivot 32, parallel to the axis of rotation of the table 2, is a carriage 33 on which is mounted a wipe forming piston and cylinder assemblage 34 comprising a cylinder 35 and a piston 36 having a rod 36*a*. The rod 36*a* is connected to a pedestal 37 of a suitable slide 38 which is slidable on the carriage 33 parallel to the axis of the assemblage 34.

Mounted on the pedestal 37 is a vertically reciprocable support 38*a* which supports a wipe shoe 39. Again, due to the rise and fall in the side face of the die that is sometimes used for particular pieces, it is desirable that the wipe shoe be lifted and lowered so as to maintain the proper relation with respect to the side face of the die. For this purpose, a piston and cylinder assemblage 40 is mounted on the pedestal 37. The assemblage 40 includes a cylinder 41 and a piston 42 having a rod 42*a* connected to the support 38*a*. Thus, the wipe forming shoe 39 can be lifted and lowered, as required, for maintaining proper co-relation with the side face of the die, by the control of the admission of pressure fluid to the assemblage 40.

It is desirable not only that the entire wipe forming assemblage 34 be moved endwise of the side face of the die but, also, that it be rocked to different positions about an axis parallel to the axis of rotation of the table 2. For the purpose of rocking the assemblage about the axis 32, a piston and cylinder assemblage 45 is provided. The assemblage 45 comprises a cylinder 46 pivotally connected at one end, as indicated at 47, to the platform 30, and having a piston 48 with a rod 48*a* pivotally connected, as indicated at 49, to the carriage 33. Thus, by admitting pressure fluid to opposite ends of the assemblage 45, the carriage 33 can be oscillated about the axis of the pivot 32.

For moving the platform 30 along the guideways 31, a suitable double-end piston and cylinder assemblage 50 is provided. This assemblage comprises a cylinder 51 fixedly connected to the platform 30 and with its axis extending parallel to the guideways 31. Within this cylinder 51 is a piston 52 having rods 53 at opposite ends, which rods are fixedly connected to the frame at opposite ends of the guideways 31, respectively. Thus, by admitting fluid to opposite ends of the cylinder 51, selectively, the platform 30 can be caused to reciprocate along the guideways.

As mentioned, control of the hydraulic parts of a combined wipe and stretch forming machine must be such that the response is rapid and accurate, and free from hunting. It is necessary to provide substantially instantaneous response and accurate and prompt starting and stopping of these various piston and cylinder assemblages. They must be started and stopped without any appreciable hunting effect, the optimum being an instantaneous stop and start with no hunting whatsoever.

As further examples of the piston and cylinder assemblages which must be controlled very accurately, there is the assemblage 18 for changing the elevation of the stretch forming head 17, the assemblage 24 for rotating the stretch forming piston and cylinder assemblage support 14 so as to dispose and maintain the longtiudinal axis of the assemblage 9 in the proper tangential relation with the side face of the die, the assemblage 45 for swivelling the carriage 30 to position the axis of the wipe forming assemblage 34 in the proper direction relative to the side face of the die, the assemblage 50 for positioning the platform 30 at the proper distance along the guideways 31, and the assemblage 40 for moving the wipe forming shoe 39 to the proper vertical position.

In some instances, too, the stretch forming head is rocked about an axis, in which case the reversible assemblage 55 is connected to the head and is capable of oscillating the head about a horizontal axis extending toward and away from the side face of the die so that the stock may be twisted if required by the contour of the side face of the die.

All such fluid pressure operated motors as the piston and cylinder assemblages described above are to be operated accurately and with a minimum of hunting.

For this purpose, a well known type of follow-up valve is employed, the valve being modified so that its response is greatly improved and rendered proper for the present purposes, and having its spool and body connected in a desirable manner to the particular assemblage or hydraulic motor to be controlled and to a control element.

For example, as illustrated in FIG. 4, a piston and cylinder assemblage, indicated generally at 60, is shown and it is assumed that it can be any one of the operating piston and cylinder assemblages hereinbefore described. This assemblage comprises a cylinder 61 with a piston 62 reciprocable therein and having a piston rod 63 which is connected to a part 64 operated by the assemblage 60. The part 64 may be the vertically movable support 38, or the swivelling support 14, or the traversing platform 30, or any of the hydraulically operated devices mentioned above.

The follow-up valve, indicated at 65, is one which is known in the trade and comprises a body device 66 hav-

ing a plurality of ports therein. For cooperation with the particular reversible piston and cylinder assemblages herein illustrated, four ports are provided, these comprising in order from left to right in FIG. 4, a cylinder port 67, an inlet port 68, a cylinder port 69, and a discharge port 70, the latter of which is connected to a suitable sump. Pressure fluid is supplied to the port 68 through a manifold 71 to which pressure is supplied from a pump 72 driven by a motor 73.

The extension and retraction of the stretch forming piston and cylinder assemblage 9 and the wipe forming piston and cylinder assemblage 34 may be controlled manually, if desired, by suitable valves such as indicated at 74, respectively. The valves 74 may be operated hydraulically by hydraulic piston and cylinder assemblages controlled by smaller control valves similar to the valves 74, but, in turn, operated remotey by solenoids.

The follow-up valve 65 comprises a body device 66 provided with a bore 75 in which a valving spool 76 is reciprocable axially, the spool having lands 77 and 78 arranged for valving cooperation with the ports of the body device in a well known manner. The body device also is provided with a duct 79 which connects the opposite ends of the body device together, and thus to the sump through the port 70.

The spool lands and ports are so related that in the extreme left-hand position of the spool, in FIG. 4, the cylinder port 67 and inlet port 68 are connected together and the cylinder port 69 is connected to the sump through the port 70. In the next intermediate position to the right, both cylinder ports 67 and 69 are blocked and the inlet port 68 is disconnected from the port 70 and from the cylinder ports. In the right-hand position, the inlet port 68 is connected to cylinder port 69 and the cylinder port 67 is vented through the duct 79 and port 70 to the sump.

The spool is provided with a movable operating device, in the form of a coaxial stem 80, for moving it relative to the valve body device. Extraneous driving means adapted to be moved to different positions for moving the spool is also provided. One of the devices is arranged to be moved in accordance with the movements effected by the hydraulic piston and cylinder assemblage 60, and the other of the devices is arranged to be moved by the extraneous driving means which is operated in a predetermined relation to the operations desired by the assemblage 60.

In the form illustrated in FIG. 4, the extraneous driving means, indicated generally at 81, comprises a sleeve 82 having at one end a roller 83, and a cam 84 on, and driven by, the table 2 for obtaining a predetermined operation of the assemblage 60 in relation to table position.

On the other hand, in the illustrative example, the body device 66 is driven in a fixed relation to the operation of either the piston member or cylinder member of the assemblage 60.

To form an operating connection between the assemblage 60 and the body device 66 so that the body device is moved in a fixed relation to the assemblage, an auxiliary piston and cylinder assemblage 85 is provided. The assemblage 85 comprises a cylinder 86 having therein a piston 87 with a piston rod 88 which is connected to the body device 66 for movement of the body device thereby. The rod end of the cylinder 86 is connected to the port 67 of the body device 66, and the head end of the cylinder 86 is connected to the rod end of the cylinder 61 of the assemblage 60. The head end of the cylinder 61 is connected to the cylinder port 69 of the body device. The assemblage 85 is of very large diameter and short stroke such that its movement in each direction is slight relative to the movement of the piston 62 in each direction for the purpose of reducing the distance of travel of the body device relative to the distance of travel of the piston 62 in opposite directions.

Thus, upon relative axial movement of the body device 66 and the spool 76, pressure fluid is fed selectively to either end of the assemblage 60 and the opposite end is vented concurrently.

The pressure fluid supplied through the auxiliary assemblage 85 is, in operating effect, pressure fluid supplied by the pump.

The movement of the piston 87 is in fixed relation to the extension and retraction of the assemblage 60, and, being connected to the body device 66, forms an operative connection between the body and the part 64 to be controlled, any relative movement of the cylinder 61 and piston 62 being reflected by a proportional movement of the body device 66. On the other hand, the movable operative device 80 is connected to an extraneous driving means 81, such as the sleeve 82, roller 83, and cam 84, which moves with the table, and, therefore, can be arranged so as to predetermine the setting of the spool 76 in relation to the operation desired by the assemblage 60.

Obviously, if desired, the device or stem 80 could be connected to the piston rod 88 and the body device 66 connected to the extraneous driving means, and the valving ports and lands arranged so as to obtain essentially the same operation as that heretofore described.

The valve thus far described is essentially the same as those heretofore used, except that in those heretofore used, the usual cam roller, corresponding to the roller 83 in FIG. 4, is mounted in fixed position on, and axially of, the stem 80.

As in the prior valves, a spring 90 is interposed between a cap 90*a* on the body device and the end of the spool opposite from the stem 80, and yieldably urges the body device and spool to move axially relative to each other in a direction such that the spool moves stem end foremost, and thus toward extended position. This causes pressure fluid to be supplied through the ports 68 and 69 to the head end of the cylinder 61, and, through the assemblage 85, port 67, duct 79 and port 70, to be vented from the rod end of the cylinder 61. Thereupon, the piston 87 drives the body device 66 to the right in FIG. 4.

Due to the heavy inertia of the part 64 and elements of the assemblage 60, there is a tendency for the body device 66 to be driven to the right in FIG. 4, during the operation above described, beyond the position desired and selected by the extraneous operating means, including the cam 84, roller 83 and sleeve 82. Consequently, the spool and body device overrun the selected point at which the admission of pressure fluid is stopped to a point at which they reverse the connection. This connects the head end of the assemblage 60 to the sump and the rod end of the assemblage 60 to the source of pressure fluid. A prompt response of the assemblage 60 follows, whereupon the body device is pulled to the left in FIG. 4. This re-establishes the first connection.

Valves of this character are extremely sensitive, operating on a .001 of an inch of relative movement of the body device and spool axially. Consequently, there is a tendency to overrun not only when the assemblage 60 is moving to its newly selected position, but to overrun also in the opposite direction as it reverses to correct the first overrun. This "hunting" or overrunning effect in opposite directions is gradually decrescent until the assemblage 60 finds the preselected position. However, as mentioned, if the position is to change frequently due to the work required, then by the time the assemblage has settled down to a selected position, the position is changed and the hunting again starts, so that the assemblage 60 continuously hunts and never quite reaches and remains in its preselected positions.

In order to overcome this hunting effect, a spring 91 is interposed between the end of the movable operating device or stem 80 and one end of the sleeve 82 so that the roller 83 is yieldably urged in the direction away from the stem 80 and is held resiliently against the operating face of the cam 84. Thus, a resilient means is interposed between the movable operating device 80 and the extraneous driving means 81.

Springs **90** and **91** are such that in a preselected relative axial position of the spool and body device, they balance each other and, in the absence of any extraneous movement of the body device **66** or the operating means **81**, the spool and body device remain in a preselected axial position. However, the rates of the springs **90** and **91** are different.

By "rate" is meant the rate of increase in resistance to deflection in relation to an increase in load. Thus, of two springs, under the same gradually increasing load, the one having the faster rate builds up its resistance to deflection at a greater rate than the other. In the form illustrated in which the body device is to be moved in response to the hydraulic motor or assemblage **60**, the spring **91** has a greater rate than the spring **90**.

Due to the spring **91** having a strength which can balance the spring **90** in the proper starting position, but having a faster rate than the spring **90**, as the roller **83** is permitted to move to the right in FIG. 4 by the cam **84**, the body device **66** begins following the roller, being driven by the piston **87**, the spring **90** becoming compressed and, in turn, transmitting some of its force through the spool to the spring **91**. However, the spring **91**, having a faster rate, acts more nearly as a solid connection between the roller **83** and spool stem **80** until the spring **90** has been compressed a substantial amount. When the movement of the roller to the right in FIG. 4 is arrested by the cam **84**, therefore, the inertial forces on the body device continue to urge the body device to the right, compressing the spring **90** somewhat so that its force is great enough to compress the spring **91**. When this build-up is reached, the body device and spool travel together to the right, the springs **90** and **91** being in balance for an instant. Hence, the body device does not overrun with respect to the valving position even though it overruns its theoretical absolute position. Because of the faster rate of the spring **91**, the resistance of the spring **91** soon tends to become equal to, and then greater than, that of the compressed spring **90** and further travel of the spool to the right is arrested. By this time, however, the valving has overcome the inertial forces urging the body device to the right.

If the roller is then moved to the left, the spring **91** acts almost as a solid stem so that the operation of the valve body device in the right-hand direction is initially the same as though no spring **91** were provided. If then the roller stops moving to the left, the body continues moving, due to inertial forces, but as the resistance of the spring **90** decreases, the spring **91** re-expands and moves the spool to the left with the body for an instant, the two maintaining a fixed valving relation during this instant of concurrent movement, and this relation lasts long enough so that the inertial forces are overcome.

In this manner, the spring **91** acts as a solid stem except when the spring **90** is compressed to a substantial degree, giving the accuracy of control of a solid stem follow-up valve throughout most of the movements by permitting the body device and spool to move together for an instant as they reach their preselected valving position, thus retaining their preselected valving position fixed for a sufficient length of time to overcome the inertial forces which would cause hunting.

The cams, such as **84**, can be arranged on the table **2** itself. However, it is desirable to reduce their size and, for this purpose, a rotatable drum carrier **92** is mounted on the frame and is driven through a suitable chain and sprocket power transmission **93** from, or in predetermined relation to, the rotation of the table **2**, and the cam **84** and other cams for controlling other parts are carried on the drum **92** and extend about the periphery thereof.

Referring next to FIG. 5, the follow-up valve, indicated generally at **94**, is the same in all respects as that illustrated in FIG. 4, as shown, except for the arrangement of the resilient means between the spool and extraneous driving means, and for the drive of the body device. In FIG. 5 the operating assemblage **95**, corresponding to the assemblage **60**, is shown as the operating assemblage. This assemblage includes a piston **96** having a rod **97**. Instead of a hydraulic means for operatively connecting the follow-up valve body device to the assemblage, mechanical means are provided. Thus, instead of the assemblage **85** described in FIG. 4, the body device of the valve **94** is connected to one end of to rock lever **97***a* which is arranged to rock about a pivot **98** and of which the opposite end is connected, as indicated at **99**, to the piston rod **96**. The pivot **98** is nearer to the body device than to the piston rod so that a large movement of the piston rod **96** causes only a slight movement of the body device of the valve **94**. The operating device comprises a stem **100** and roller **101** connected to the stem in fixed position axially thereof. The extraneous driving means is a cam **102** movable with, or in fixed relation to, the die supporting turntable. A spring **103** is interposed between the body device and spool.

The resilient means may be in the form of a resilient strip of facing material **104** secured on the face of the cam **102**, and thus interposed between the operating device and the extraneous driving means.

The foregoing embodiments of the invention are illustrative only and various modifications may be made in the specific structures thereof without departing from the invention as defined in the accompanying claims.

Having thus described my invention, I claim:

1. Control means comprising a follow-up valve including a body having a central bore and an inlet port, an outlet port, and a pair of cylinder ports, all of said ports being connected with, and spaced from each other axially of, said bore, a spool coaxial with and slidable endwise in said bore and having axially spaced lands cooperable with the ports and operable upon movement of the spool in one direction for connecting one cylinder port to the inlet and the other cylinder port to the outlet port, and then progressively increasing the flow of fluid through said one cylinder port, and operable upon axial movement of the spool in the opposite direction successively to decrease gradually the flow through said one cylinder port, to disconnect said one cylinder port and the inlet port and to connect the other cylinder port to the inlet port and said one cylinder port to the sump, to increase gradually the flow of fluid through said other cylinder port, and upon axial movement of the spool back in said one direction from the position in which said other cylinder port is fully connected to the inlet port, successively to decrease gradually the flow of fluid through said other cylinder port, a first resilient means operatively interposed between the spool and body for yieldably urging the spool in one of said directions relative to the body, a movable operating element adapted to be driven by extraneous means to different positions, a second resilient means operatively interposed between the element and spool for yieldably transmitting force between the element and the spool, when the element is so moved, for yieldably urging the spool in the opposite of said directions relative to the body and for yieldably transmitting force from the first resilient means through the spool to the element for urging the element to move with the spool in said direction of movement of the spool, means adapted for operatively interconnecting the body to additional extraneous means for moving the body axially in opposite directions, respectively, upon operation of the additional extraneous means, independently of the movement of the spool by the two resilient means, the two resilient means being operable to apply balanced forces to opposite ends of the spool in one relative position of the body, spool, and element, and one of said resilient means having a predetermined rate, and the rate of one resilient means being different from, and in a preselected ratio to, the rate of the other resilient means.

2. A structure according to claim 1 wherein the sec-

ond resilient means is a resilient surface material on the movable operating device and forming the operating face thereof, and further including means on the spool and movable therewith to engage said operating face for transmitting force between said face and spool.

3. The structure according to claim 1 wherein the resilient means interposed between the spool and element has a faster rate than the resilient means interposed between the spool and the body.

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