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PLATEN CONTROL MECHANISM FOR WELDING

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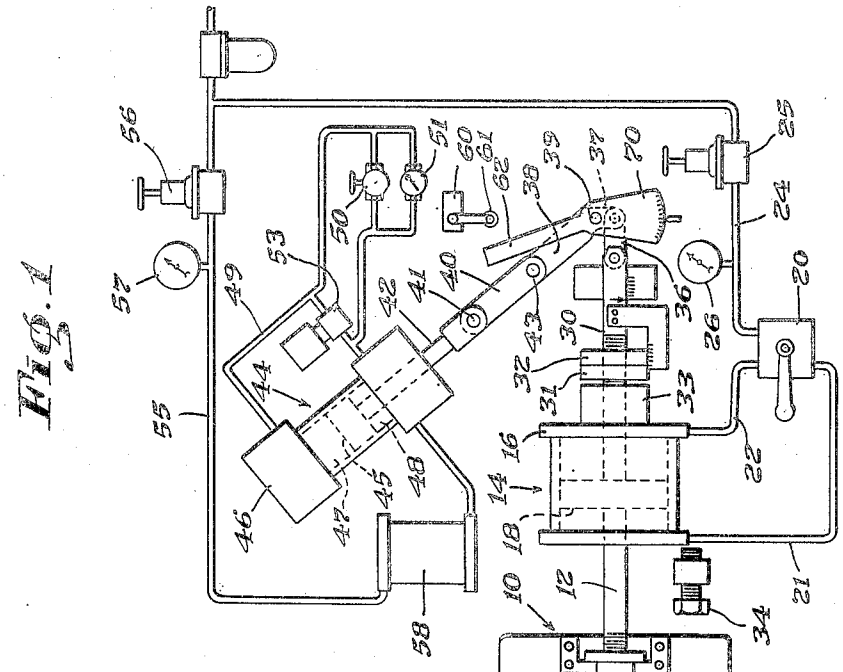

Fig. 1

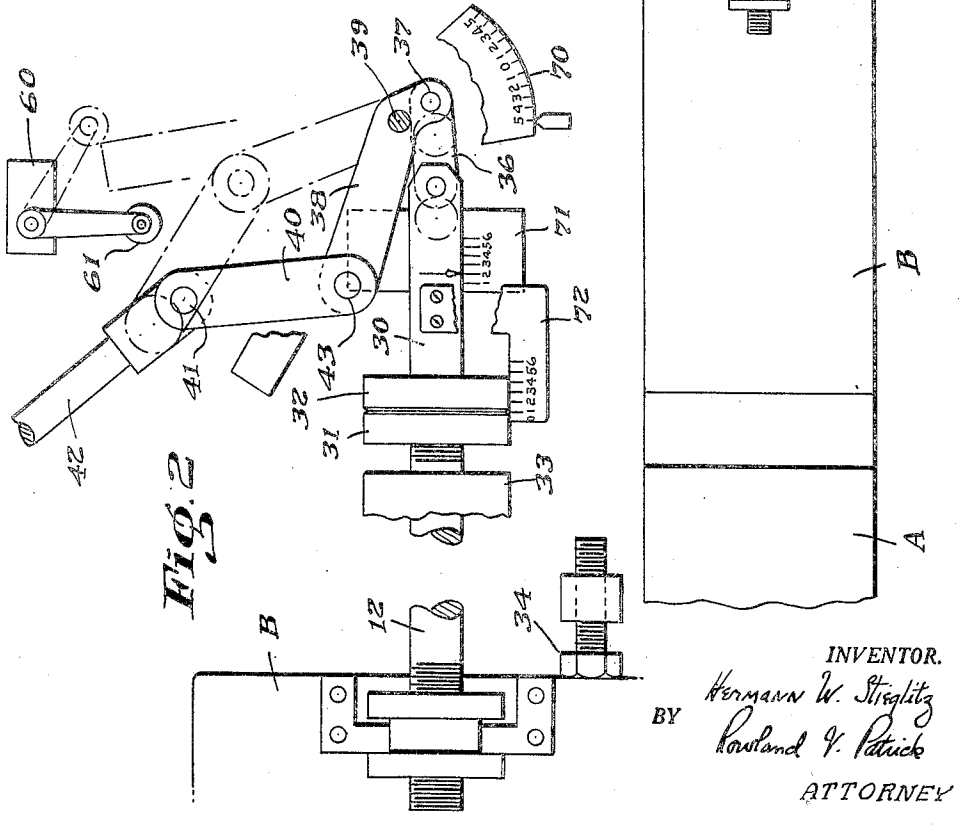

Fig. 2

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PLATEN CONTROL MECHANISM FOR WELDING

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This invention relates to welding and specifically to new and improved mechanism for controlling the relative movement of the platens of a flash-butt-welding machine.

Flash-butt-welding operations include a so-called flash off operation followed by an upset. To accomplish these operations successfully, the platens which hold the work to be welded are moved slowly towards each other during the initial flash off period and are then abruptly brought together to upset the work by a relatively quick push-up.

In early days of flash-butt-welding this type of movement was imparted to the platens by skilled operators who manually controlled the platen movement. Their skill permitted them to produce the correct flash-off motion through the manual control handle and to perform the upsetting operation at the right instant. Since automatic flash butt-welding was introduced to supersede the labor and skill concomitant to manual control, welding manufacturers have constantly sought to provide an automatic motion which would reliably produce perfect flash butt welds. For example, when the platens are hydraulically operated, some arrangement for transition from the slow flash motion to the rapid upset motion has been incorporated. One such arrangement includes a dump valve interposed in the hydraulic lines so that the hydraulic platen motor may be suddenly flooded with fluid after an initial relatively slow metering of fluid to the motor.

I have discovered that a power operation of a flash butt-welding machine may be carried out with remarkably good welding results by imparting to one of two relatively movable platens a motion having an acceleration conforming to the accelerated motion of the toggle joint of a toggle mechanism, the terminal pivots of which linearly separate at a constant rate. Such a motion conforms to a parabolic curve on a time-motion graph, found to be ideal for the production of a flashing motion in a flash butt-welding machine.

In a specific embodiment of the invention I produce a constant rate of linear separation of the terminal pivots of a toggle by interposing the toggle between a power operated platen and a snubbing device which contains a supply of fluid which is metered out, against the drive of the motor operating the platen, at a constant rate regardless of the pressure exerted against the snubbing device by the platen motor drive.

Such a mechanism is shown in the accompanying drawings wherein—

Fig. 1 is a diagrammatic plan view of the operating parts of a mechanism of my invention; and

Fig. 2 is an enlarged detail, with parts broken away, of certain of the mechanism shown in Fig.

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1 at different positions from those shown in Fig. 1 and indicating by dot-and-dash lines further positions of the parts.

In the drawings, A and B represent a conventional fixed and movable platen respectively of a flash-butt-welding machine. The platen B is connected through a lost motion connection, generally indicated at 10, to a piston rod 12 of a fluid operated motor 14, comprising a housing 16 and enclosed piston 18.

The motor 14 may be a hydraulic or pneumatic motor operated by a four-way valve 20 through connecting lines 21 and 22 communicating with the front and rear chambers respectively of the motor 14. Lines 21 and 22 also communicate through the four-way valve 20 with a supply line 24, which includes a pressure regulator 25 and indicator 26.

An extension rod 30, connected to piston 18, extends outwardly through the rear of housing 16 and carries a threaded adjustable stop collar 31 and adjacent locking nut 32. Such stop collar 31 is positioned to engage a stop 33 jutting out from motor housing 16 to limit the forward motion of the platen B. An adjustable stop 34 is provided on the frame of the machine to limit the rearward movement of the platen B. By operation of the four-way valve 20, platen B may thus (in the absence of work on the platens) be moved forwardly and rearwardly to the limits permitted by collar 31 and stop 34. However, assuming a constant pressure in the pressure regulated supply line the forward motion would be at a substantially uniform rate, and could not provide either increasing acceleration during the flash or any quick final upset motion.

Accordingly, in order to impart the ideal parabolic motion to platen B, I snub its forward motion by linking the rear end of rod 30 to a link 36 pivotally connected to the short leg 37 of a bell-crank lever 38 pivoted on a fixed axis 39 and the other leg of which constitutes one link of a toggle mechanism, the companion link of which 40 is pivotally connected at 41 to the piston rod 42 of a snubbing cylinder generally indicated at 44. The snubbing cylinder includes a piston 45 and housing 46 forming rear chamber 47 and forward chamber 48 which are connected by a line 49 having interposed therein a metering valve 50 operative to permit flow of oil or other fluid contained in the rear chamber 47 to the forward chamber 48 at a predetermined maximum rate determined by the setting of the valve 50. The valve 50 is by-passed by a line and check valve 51 to permit free return flow of oil or other fluid in the opposite direction, that is from the forward to the rear chamber, and both of valves 50 and 51 are by-passed by a line and a normally closed valve 53 which may be manually or automatically opened to permit unimpeded fast re-

turn of the oil or other fluid from the chamber 48 to the rear chamber 47.

The fluid in the snubbing system is maintained at a proper pressure level from a source line 55 through a regulating valve 56, pressure indicator 57 and accumulator 58.

As will be seen in the position of the parts in Fig. 1, the toggle is on dead center and the two terminal pivots 39 and 41 thereof are in their position of maximum separation. This is an intermediate position in the full path of travel of platen B. Fig. 2 illustrates in full lines the position of the toggle mechanism when platen B is at the limit of its rearward movement; and in dot-and-dash lines the position of the toggle when the platen B is at the limit of its forward movement. It will thus be seen that the toggle is broken in one direction at the beginning of the platen cycle and is pulled with ever-increasing acceleration towards dead center by the motor 14 against the snubbing resistance of the cylinder 44. Since, in the dead center position of the toggle as shown in Fig. 1, the stop collar 31 has not as yet abutted its cooperating fixed stop 33, the pressure of the motor 14 will snap the toggle across dead center and immediately upon the toggle being across dead center the resistance of the snubbing cylinder 44 is completely released except for the slight resistance offered by the freely flowing return of oil through line 49 and check valve 51. The parts therefore move very rapidly from dead center to the dot-and-dash line position representing their limit of movements as controlled by the collar 31 and stop 33 or by the interposition of work between the two platens.

The drawings also show a micrometric switch 60, the operating arm of which 61 is interposed in the path of an arm 62 adjustably connected to the lever 38. The switch 60 is an off switch for the welding current and the arm 62 may be so set as to break the welding circuit when the toggle reaches a predetermined position before, at, or beyond dead center.

Also illustrated are calibrated gauges 70, 71, and 72 for setting the cut-off switch operation and for indicating the amount of flash off and upset movements of the platen, respectively.

The purpose of the lost motion connection 10 is to insure that, when the four-way valve 20 is opened to admit fluid to the rear chamber of motor 14, the initial jump of the connected parts resulting from take-up and fluid compression will not be transmitted to the platen B and that the motion of the platen B will commence only after its motion is the exact counterpart of the accelerated motion of the intermediate toggle pivot 43 from its full line position of Fig. 2 to its dead center position of Fig. 1.

In operation therefore assuming the parts to be in the full line position of Fig. 2 with the toggle broken to the extent permitted by the stop 34 under the influence of pressure of fluid contained in the forward chamber of motor 14, the four-way valve 20 is operated to exhaust the forward chamber of motor 14 and place its rear chamber in communication with the pressure regulated supply of fluid from line 24. Immediately any slack or take-up will move the drive rod 12 forward to take up the lost motion connection between the rod 12 and platen B. Movement of the rod 12 in a forward direction will then continue subject to the resistance imparted by the body of fluid in the rear chamber 47 of the snubbing cylinder 44 as it is slowly, and at a constant maximum rate, metered through the line 49 and metering valve 50 into the forward chamber 48 of the cylinder 44. While the terminal pivot 41 therefore separates linearly from the terminal pivot 39 at a constant maximum rate, regardless of the pressure in motor 14, the intermediate toggle pivot 43 approaches its dead center position at a rate conforming to the parabolic time-motion curve and this motion with its characteristic acceleration is translated through the connections 37 and 36 into a corresponding accelerated motion of the platen B. Immediately upon the toggle reaching dead center, the motor 14 takes over, unsnubbed by cylinder 44, with the piston 45 returning forwardly against substantially no resistance from the body of fluid in the forward chamber 48 of cylinder 44, which fluid may pass freely through check valve 51 to the rear chamber 47. The motion of platen B just before, while and after the pivot 43 passes its dead center position is very rapid, compared with the initial movement of pivot 43. As soon as arm 62 strikes the set operating point of arm 61 of switch 60, the welding current is interrupted and the toggle will continue its motion until the work interposed between the platens offers final resistance or until the collar 31 abuts stop 33. This completes the weld.

The parts are then rapidly returned to initial position by switching valve 20 to exhaust the rear chamber and flood the forward chamber of motor 14 and by opening the normally closed valve 53 so that fluid in the forward chamber 48 of cylinder 44 may rapidly return to the rear chamber 47. The valve 53 must be closed before the cycle is repeated. Its operation as well as the welding current relay may be controlled either from the handle of valve 20 or otherwise.

While the motor 14 has been shown interposed in a straight line connection, it will be understood that the motor may be directed against the toggle mechanism with equal success.

The welding results accomplished with this simplified mechanism have been most gratifying and use of the mechanism offers a highly reliable automatic motion for flash-butt-welding platens.

I claim:

1. Platen control mechanism for a flash-butt-welding machine comprising a fluid motor for moving one platen towards and away from the other platen at a constant pressure in accordance with the fluid pressure supplied thereto, a snubbing device and a toggle mechanism connected between said snubbing device and said movable platen for cooperating with said snubbing device to resist the motion of said platen induced by said fluid motor during the first portion of the forward movement of the platen and thereafter to permit said motor to complete said forward motion substantially unresisted by said snubbing device.

2. Platen control mechanism for a flash-butt-welding machine comprising a motor for moving one platen towards and away from the other platen, a snubbing device operating at a predetermined maximum rate of movement against said motor during its forward drive and a toggle mechanism connected between said snubbing device and said movable platen for causing said predetermined rate of movement to effect accelerated motion of said platen during said forward drive.

3. Platen control mechanism as claimed in claim 2 wherein said snubbing device comprises a hydraulically operated cylinder and piston.

4. Platen control mechanism as claimed in claim 2 having a lost motion connection between said motor and said platen for taking up slack in said toggle mechanism and snubbing device at the commencement of forward drive of said motor before said movable platen is driven.

5. Platen control mechanism for a flash-butt-welding machine comprising a motor for moving one platen towards and away from the other platen, a snubbing device operating at a substantially constant rate of movement against said motor during its forward drive and a toggle mechanism connected between said snubbing device and said movable platen for causing said constant rate of movement to effect accelerated motion of said platen during said forward drive.

6. Platen control mechanism for a butt-welding machine comprising a motor for moving one platen towards and away from the other platen, a snubbing device operating against said motor during a portion of its forward drive to control the motion of said platen and a toggle mechanism connected between said snubbing device and said movable platen and adapted to be pulled by said driving motor from broken position to dead center position as said motor drives said platen over a portion of its forward movement, and thereafter to be pulled by said motor across dead center into opposite broken position unsnubbed by said snubbing device to permit said motor to complete the forward motion of said platen without snubbing resistance from said snubbing device.

7. Platen control mechanism for a butt-welding machine comprising a driving motor for moving one platen towards and away from the other platen, a snubbing device operating at a predetermined rate of movement against said motor during its forward drive and a toggle mechanism connected between said snubbing device and said movable platen and adapted to be pulled by said driving motor from broken position to dead center position against the snubbing resistance of the predetermined rate of movement of said snubbing device as said motor drives said platen over a portion of its forward movement for causing said predetermined rate of movement of said snubbing device to effect accelerated motion of said platen during that portion of its forward movement, and thereafter to be pulled by said motor across dead center into opposite broken position unsnubbed by said snubbing device, to permit said motor to complete the forward motion of said platen without snubbing resistance from said snubbing device.

8. Platen control mechanism for a butt-welding machine comprising a driving motor for moving one platen towards and away from the other platen, a snubbing device comprising relatively movable cylinder and piston elements providing chambers on both sides of said piston adapted to contain fluid, a fluid line connecting said chambers, a metering device in said line for maintaining a predetermined maximum rate of any fluid flow through said line towards one of said chambers, to permit only a predetermined rate of movement of one of said elements relative to the other in snubbing direction, and toggle mechanism connected between said one element and said movable platen and adapted to be pulled by said driving motor to dead center position against the snubbing resistance of the predetermined rate of movement of said one element as said motor drives said platen forward to cause said predetermined rate of movement of said one element to effect accelerated forward motion of said movable platen.

9. Platen control mechanism for a butt-welding machine comprising a driving motor for moving one platen towards and away from the other platen a snubbing device comprising relatively movable cylinder and piston elements providing chambers on both sides of said piston adapted to contain fluid, a fluid line connecting said chambers, a metering valve in said line for maintaining substantially constant the maximum rate of any fluid flow through said line from one of said chambers, to permit only substantially constant rate movement of one of said elements relative to the other in snubbing direction, and toggle mechanism connected between said one element and said movable platen and adapted to be pulled by said driving motor to dead center position against the snubbing resistance of the constant rate of movement of said one element as said motor drives said platen forward to cause said constant rate of movement of said one element to effect accelerated forward motion of said movable platen.

10. Platen control mechanism for a butt-welding machine comprising a driving motor for moving one platen towards and away from the other platen, a snubbing device comprising relatively movable cylinder and piston elements providing chambers on both sides of said piston adapted to contain fluid, a fluid line connecting said chambers, a metering valve in said line for maintaining substantially constant the maximum rate of any fluid flow through said line from one of said chambers, to permit only substantially constant rate movement of one of said elements relative to the other in snubbing direction, a by-pass for permitting flow of fluid through said line from the other of said chambers at a rate unrestricted by said valve, to permit faster unsnubbed return movement of said one element and toggle mechanism connected between said one element and said movable platen and adapted to be moved to broken position by said motor and pull said one element in unsnubbed return direction as said motor moves said platens to their limit of separation, and to be pulled by said motor to dead center position against the snubbing resistance of the constant rate of movement of said one element in snubbing direction as said motor drives said platens forward to cause said constant rate of movement of said one element to effect accelerated forward motion of said movable platen.

11. Platen control mechanism as claimed in claim 10 wherein said toggle mechanism is adapted additionally to be pulled by said motor across dead center to opposite broken position as said motor completes the forward movement of said platen to free said motor from the snubbing resistance of said one element.

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