No. 898,365. PATENTED SEPT. 8, 1908.

T. E. HOLMES.

HYDRAULIC PRESS.

APPLICATION FILED AUG. 22, 1907.

5 SHEETS—SHEET 1.

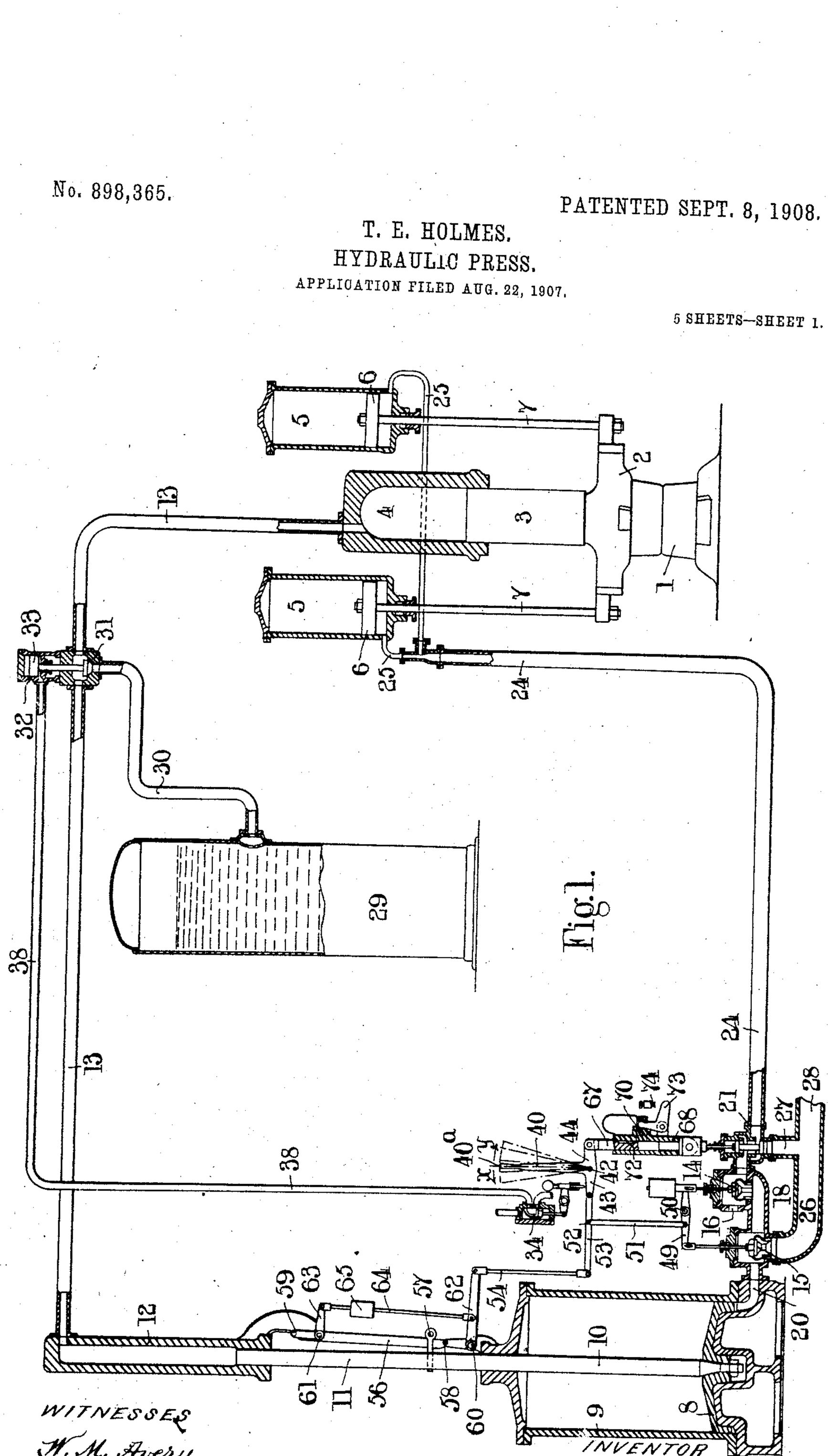

Fig. 1.

WITNESSES

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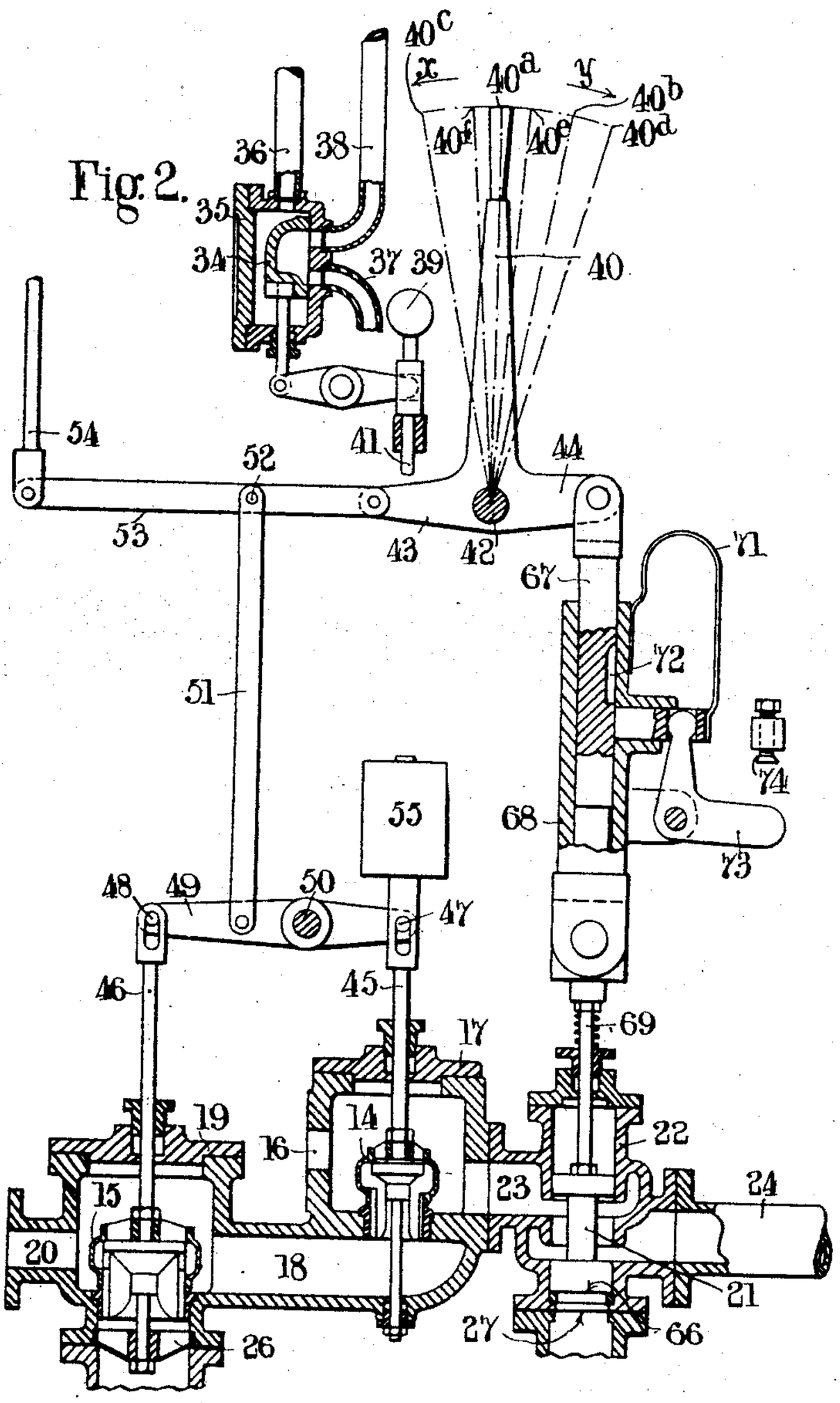
5 SHEETS—SHEET 2.

Fig. 2.



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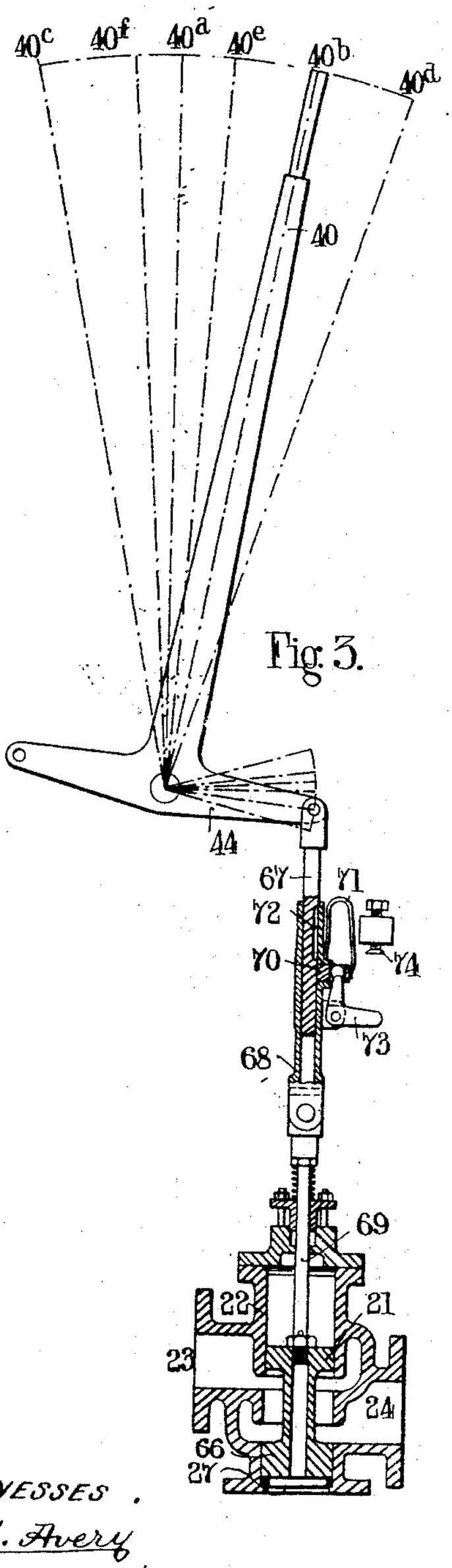

Fig. 3.

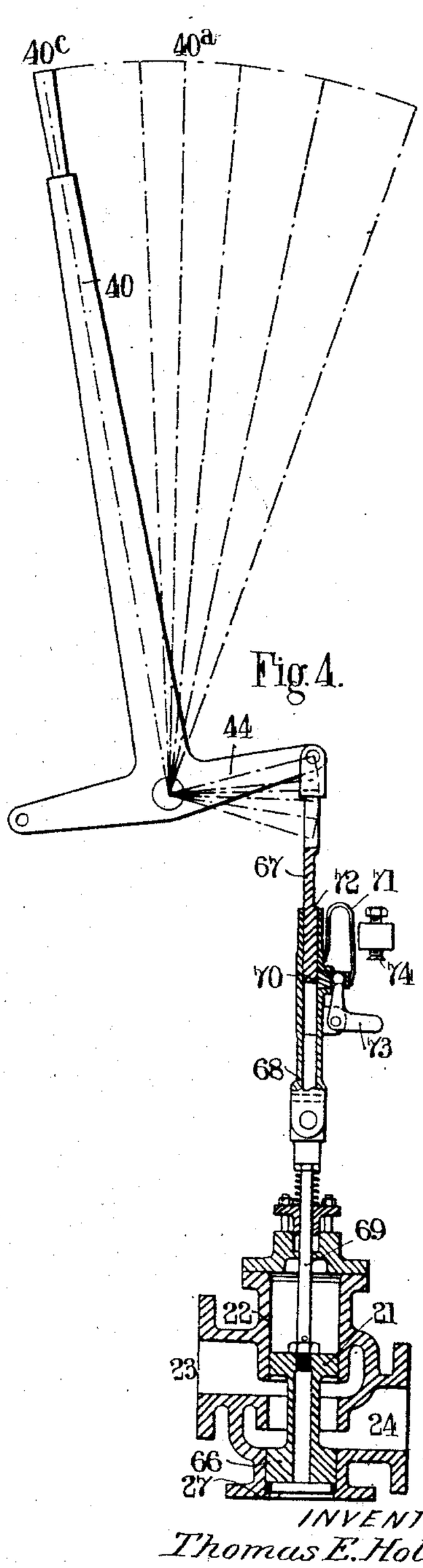

Fig. 4.

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5 SHEETS—SHEET 4.

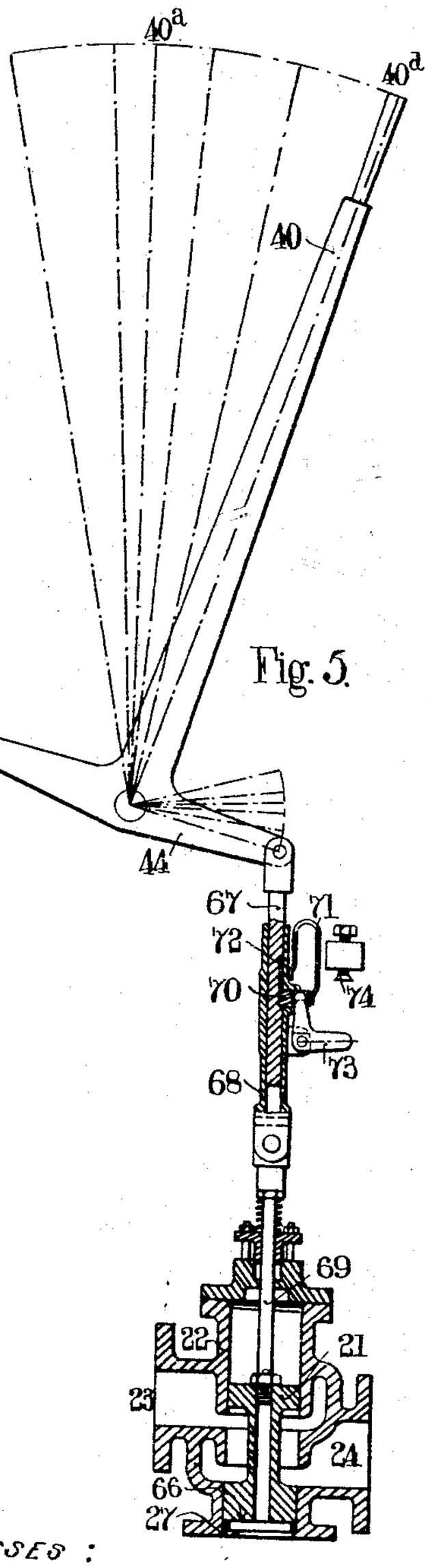

Fig. 5.

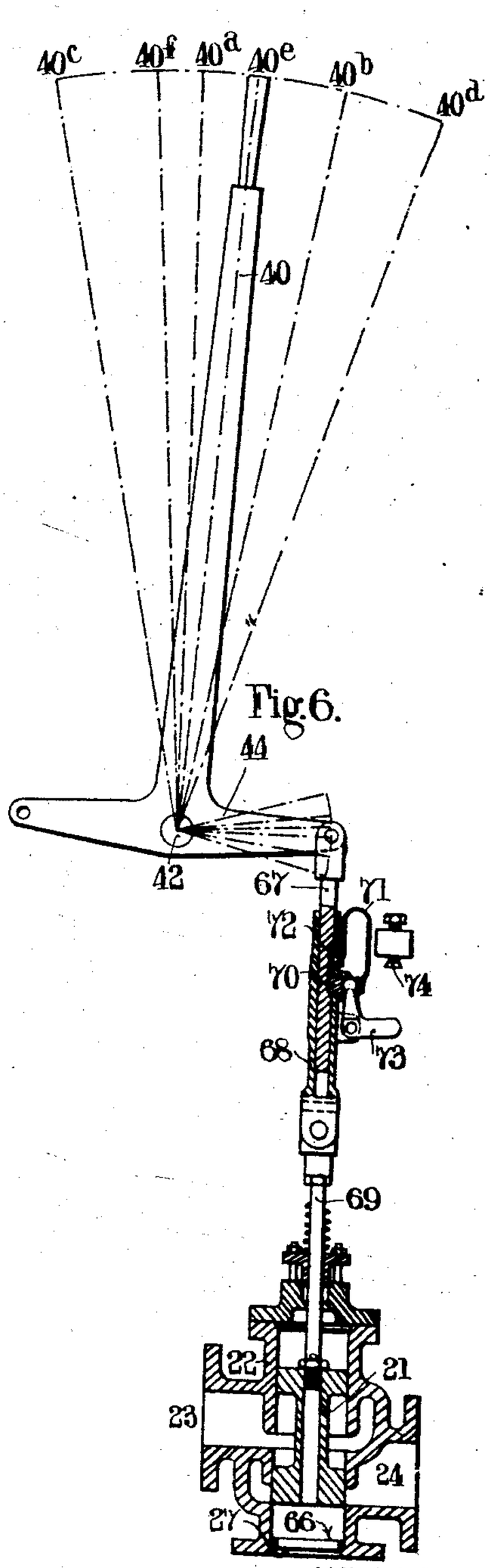

Fig. 6.

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5 SHEETS—SHEET 5.

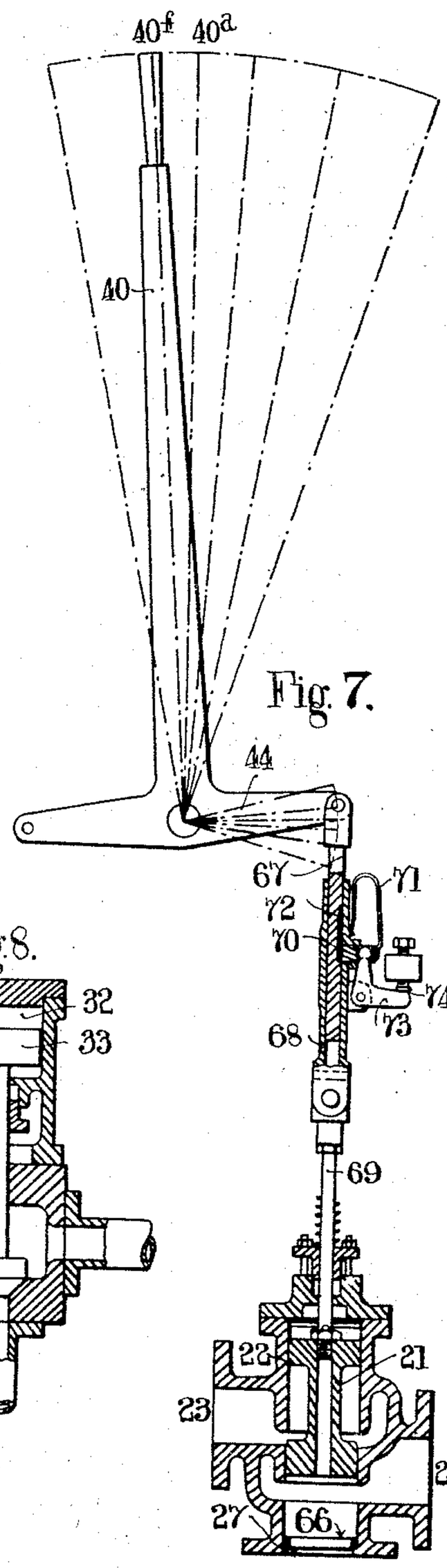
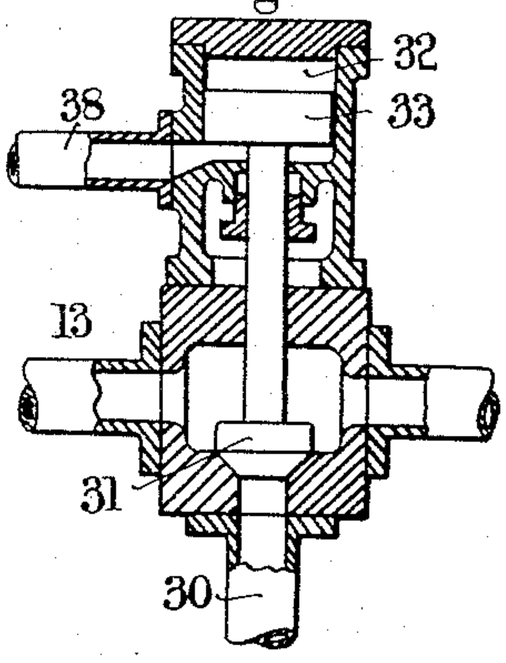


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE.

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HYDRAULIC PRESS.

No. 898,365. Specification of Letters Patent. Patented Sept. 8, 1908.

Application filed August 22, 1907. Serial No. 389,659.

To all whom it may concern:

Be it known that I, THOMAS EDMUND HOLMES, a subject of the King of Great Britain, and resident of 8 Oakdale road, Nether Edge, Sheffield, in the county of York, England, engineer and chief draftsman, have invented certain new and useful Improvements in Hydraulic Presses, of which the following is a specification.

This invention relates to hydraulic forging presses and the like worked by means of steam hydraulic intensifier apparatus, and wherein the valves for controlling the admission and exhaust of steam to and from the intensifier and lifting cylinders and for controlling the connections between the air vessel and the high pressure hydraulic system are all controlled by a single handing lever.

The invention has for its object to simplify and expedite the action of the press by enabling all its movements (whether the press be worked slowly with long strokes or rapidly with short strokes) to be controlled by means of the single handing lever referred to, without the necessity (hitherto usual) of employing a separate and independently operated device for effecting such alteration in the steam connections to the lifting cylinders of the press as are required in order that the change from slow to rapid working, or vice versa, may be made.

In the apparatus of the present invention, the steam connections appertaining respectively to the intensifier cylinder and to the lifting cylinders are controlled by independent valves, the steam supply and exhaust to and from the intensifier cylinder being preferably controlled by separate drop valves actuated by means of automatically acting hunting gear adapted both to prevent excessive movement of the intensifier steam piston and also to cause steam to be cut off from the intensifier cylinder at a point in the stroke of the piston corresponding to the position to which the handing lever has been set. While, however the valves appertaining to the intensifier cylinder are coupled to the handing lever permanently, the valve or valves controlling the steam supply and exhaust to and from the lifting cylinders is or are coupled to the same handing lever detachably through the medium of automatically acting trip mechanism, in such manner that steam is normally admitted to the lifting cylinders but is exhausted therefrom during the earlier part of the longer pressing strokes of the main ram, all the requisite opening and closing movements of the various valves, in either method of working, being produced simply by the oscillation of the single handing lever through different portions of its own maximum possible angular movement.

The invention will be described with reference to the accompanying drawings wherein Figure 1 is an elementary (or partly diagrammatic) elevation of a forging press with steam hydraulic intensifier apparatus adapted to be controlled by a single handing lever as above stated, the parts being in position of rest. Fig. 2 is a similar view of the handing lever the valves, and parts more immediately associated therewith drawn to a larger scale. Figs. 3, 4, 5, 6 and 7 are views of the handing lever, the valve for controlling admission and exhaust of steam to and from the lifting cylinders of the press, and the connections between said valve and levers, in various positions occupied during the working of the press. Fig. 8 is a detail view of another valve, drawn to a larger scale.

Similar reference numerals denote corresponding parts throughout the drawings.

1 is the anvil or bed-die; 2 the presshead; 3 the main hydraulic ram connected to the presshead; 4 the cylinder wherein the ram 3 works; 5, 5 are the lifting cylinders wherein work the pistons 6, 6 which are coupled to the presshead 2 by the rods 7, 7; 8 is the steam piston of the intensifier, this piston working in the cylinder 9 and having a piston rod 10 in one with the hydraulic ram 11 of the intensifier, and 12 is the cylinder wherein the ram 11 works, the cylinders 4 and 12 being connected by the hydraulic high pressure pipe 13.

In the example illustrated, the supply and exhaust of steam to and from the intensifier cylinder 9 are controlled respectively by double-beat drop valves 14 and 15, steam from the boiler being admitted as at 16 to the chamber 17 of the supply valve 14 and passing thence on the opening of said valve, by a passage 18 to the chamber 19 of the exhaust valve 15, which chamber 19 is in permanent communication through a passage 20 with the lower end of the cylinder 9.

The supply and exhaust of steam to and from the lifting cylinders 5 are controlled by means of a single piston valve 21 whose chamber 22 is in communication on the one

hand through the passage 23 with the intensifier steam supply valve chamber 17 and therefore with the main steam inlet 16 and on the other hand through the pipe 24 and branch pipes 25 with the lower ends of the respective lifting cylinders 5.

26 and 27 are respectively the exhaust steam pipes leading from the valve chambers 19 and 22 to the main exhaust pipe 28.

29 is the air vessel, which communicates with the hydraulic high pressure pipe 13 through the branch pipe 30. This pipe (in example illustrated) is controlled by a valve 31, (see Fig. 8) which is normally held closed by the pressure in the pipe 13 but is adapted to open automatically under the pressure in the air vessel 29, so as to allow the pipe 13 and cylinders 4 and 12 to become filled with water when the rams 3 and 11 descend by their own weight and thus create a partial vacuum in the hydraulic high pressure system. When this system is full of water and the ram 3 is to be raised preparatory to making a working stroke, the valve 31 is opened positively so as to allow water to be returned to the air vessel. This may be effected by means of fluid pressure admitted to a cylinder 32 wherein works a piston 33 coupled to the valve 31, the admission and exhaust of motive fluid to and from the cylinder 32 being controlled by means of a slide valve 34 working in a chamber 35 constantly supplied as at 36 with said fluid. Normally the valve 34 maintains communication between its exhaust pipe 37 and the pipe 38 which connects the cylinder 32 and valve chamber 35, so that the valve 31 is permitted to remain on its seat, but when water is to be returned from the pipe 13 to the air vessel 29, the slide valve 34 is actuated to close the exhaust 37 and admit fluid pressure to the cylinder 32, such movement of the slide valve being effected at the proper time (in opposition to a weight 39 tending to maintain the valve in the normal position shown in Figs. 1 and 2) by means of the handing lever 40 which is then brought into position to actuate a tappet 41 connected to the slide valve.

In small presses the valve 31 may be opened, to allow the return of water from the pipe 13 to the air vessel, not by fluid pressure admitted beneath a piston 33 under the control of the handing lever 40 as above described, but by manual power transmitted from the handing lever to the valve through the medium of lever and link mechanism. The handing lever 40 is mounted to oscillate about a fixed fulcrum 42, and in the example illustrated has three arms whereof the shorter arms 43 and 44 are respectively coupled to the mechanisms for controlling the movement of the valves 14, 15 and 21 appertaining to the intensifer and lifting cylinders respectively. Preferably, as shown the intensifier steam valves 14, 15 are controlled through the medium of automatically acting "hunting gear" adapted both to prevent excessive movement of the intensifier steam piston 8 in the upward or active direction, and also to cause the supply of steam to the cylinder 9 to be cut off at any point in the stroke of the piston 8 corresponding to the angular position to which for the time being the handing lever 40 has been moved.

The form of "hunting gear" which it is preferred to employ, and which is illustrated in Fig. 1, is constructed as follows: The stems 45 and 46 of the valves 14 and 15 are respectively coupled through pin-and-slot connections as at 47 and 48 to a lever 49 mounted to oscillate about a fixed fulcrum 50, one arm of the lever 49 being coupled through a link 51 to an intermediate point 52 in the length of a "floating" lever 53 whereof one end is connected to the arm 43 of the handing lever while the other end is connected by a link 54 to the control mechanism of the "hunting gear." Since, in the arrangement illustrated, the pressure of the steam as it passes to the intensifier cylinder 9 will tend to hold open the steam supply valve 14, this valve is permanently loaded by a weight 55 sufficient to overcome the otherwise unbalanced steam pressure acting upon the cross-sectional area of the valve stem 45.

The control mechanism of the hunting gear comprises a bar 56 extending alongside of, but obliquely with reference to, the intensifier ram 11 so as to be progressively moved, in a direction transversely of the length of the bar, by the action of a roller 57 mounted upon the ram 11 and caused by the reciprocations of the latter to roll up and down in contact with the bar. The bar 56 is supported as at 58, 59 by one arm of each of a pair of bell-crank levers mounted to oscillate about fixed fulcrums 60, 61 the other arms 62, 63 of the respective levers being coupled by a link 64 which may also serve to carry a counterweight 65 tending to maintain the bar 56 in the normal position shown in Figs. 1 and 2. The arm 62 of one of the levers is coupled by the link 54, already mentioned, to the floating lever 53.

In the normal or resting position of the various parts, as indicated in Figs. 1 and 2, the handing lever 40 occupies a mid position 40^a, to the left-hand side of which are the various positions that may be assumed by the lever when the press-head 2 is performing a working stroke. If attention be confined for the moment to the hunting gear and parts controlled thereby, it will be seen that if the handing lever be moved towards the left (*i. e.* in the direction of the arrow *x*) to any particular angular distance from the mid position 40^a, and is held in such new position, thus opening to a corresponding extent the steam supply valve 14, it follows

that the piston 8, on performing so much of its full working stroke as corresponds to the same angular displacement of the handing lever, will be arrested in consequence of the hunting gear then causing the valve 14 to gradually close automatically. Hence also the piston 8 will be prevented from overrunning its full legitimate active stroke in consequence of the momentum acquired when the handing lever 40 is held over in the extreme left-hand position, since the action of the hunting-gear will have for effect to cause the steam supply valve 14 to close so gradually, before the piston has reached the end of its upward stroke, that the momentum of the piston will be gradually absorbed instead of being suddenly checked. The piston valve 21 is normally disconnected from the handing lever 40, and rests by gravity against a stop 66 in position to enable steam to gain access to the underside of the lifting pistons 6. From this position the valve 21 may be raised during a certain part of the stroke of the handing lever, so as to cut off the steam supply to the lifting cylinders 5 and open the latter to exhaust, by first moving the handing lever towards the right (*i. e.* in the direction of the arrow *y*) to a position wherein a plunger 67, permanently coupled to the arm 44, becomes automatically interlocked with a socket 68 wherein the plunger is fitted to slide, this socket being permanently coupled to the stem 69 of the valve 21. The result is that when the movement of the handing lever is reversed, the valve 21 will participate in the upward movement of the arm 44 until the plunger 67 and socket 68 become automatically disconnected, whereupon although the movement of the handing lever towards the left may continue, the valve 21 will fall back to its normal position.

The trip mechanism whereby the plunger 67 and socket 68 are thus automatically engaged with and disengaged from one another, comprises a latch-bolt 70 fitted to slide transversely through an aperture in the wall of the socket 68 and constantly pressed inwards by a spring 71 so as to tend to become interlocked with a notch 72 in the side of the plunger 67 when the latter has entered a certain distance into the socket, and a bell-crank lever 73 fulcrumed to the socket 68 and engaging by one of its arms with the latch bolt 70 so that, when the socket 68 has been raised so as to cause the other arm of the lever 73 to encounter a fixed stop 74, this lever will be actuated, the latch-bolt 70 will be withdrawn from the notch 72, and the socket 68 will be free to fall so as to allow the valve 21 to return to resting position on its seat 66.

It will be observed that so long as the various parts are in the position shown in Fig. 1, with the handing lever in its mid or neutral position 40^a and both the intensifier and main hydraulic rams 11 and 3 resting at the bottom of their respective strokes, the hydraulic cylinders 12 and 4 and their connecting pipe 13 will be full of water and consequently (the valve 31 being closed) no upward movement of the ram 3 can result from the steam pressure on the pistons 5. If, now, it be desired to set the press in operation water must first be let out of the pipe 13 so as to enable the pistons 5 to raise the main ram 3 and presshead 2 sufficiently to accommodate the work on the anvil 1. For this purpose the slide valve 34 must be actuated in the manner already described for opening the valve 31, and this is done by moving the handing lever from the neutral position 40^a towards the right (*i. e.* in the direction of the arrow *y*) until on reaching the position 40^b (see Fig. 3) the arm 43 of the lever lifts the tappet 41 and so causes motive fluid to be admitted beneath the piston 33, the consequent opening of the valve 31 removing the obstruction to the upward movement of the ram 3 and pistons 6. The handing lever being now at the position 40^a (or a little to the right thereof) the nature of its further movements will depend upon whether it is desired to work the press with long or short and rapid strokes. In the latter case a permanent elastic cushion of live steam is required beneath the pistons 6, and exhaustion of the cylinder 5 being therefore unnecessary, the handing lever may be moved directly back from 40^b to any position at the left of its neutral position 40^b between which and the extreme left-hand position 40^c (see Fig. 4) corresponding to the full opening of the valve 14, the handing lever may then be oscillated so as to cause the ram 3 to be driven down repeatedly and rapidly in opposition to the steam pressure on the pistons 6 whereby it is promptly raised at each reverse movement of the handing lever. If, however, it be desired to work the press with long (and relatively slow-) strokes, it is necessary to exhaust the lifting cylinders 5 so as to allow the presshead 2 to drop, and also to keep these cylinders exhausted during the earlier portion of the working stroke of the press (or until the steam inlet valve 14 of the intensifier has been slightly opened) so as to prevent the press-head rising until the working or pressing stroke has commenced. It is also desirable to again admit steam to the lifting cylinders 5 during the pressing stroke, or when the steam inlet valve 14 is opened, so as, without sensibly checking the force with which the ram 3 descends, to provide an elastic cushion of live steam beneath the pistons 6 in readiness (the moment reversal of the stroke of the presshead 2 is required) to cause the ram 3 to be properly raised in preparation for another working stroke. In this case the handing lever must be moved beyond the position 40^b towards the right until, on the lever reaching the ex-

treme right-hand position 40^d (see Fig. 5) the latch-bolt 70 engages the notch 72. On the handing lever passing the position 40^b, the valve 31 will as before be opened and the ram 3 will rise. After the engagement of the plunger 67 with the socket 68, reversal of the handing lever will cause the valve 21 to rise until, on the handing lever reaching the position 40^e (see Fig. 6) steam will be cut off from the lifting cylinders 5 which will also then begin to be opened to the exhaust with the result that the presshead 2, having by this time been raised to the desired extent, will be allowed to descend by gravity on to the work, meanwhile drawing water from the air vessel 29 into the pipe 13 so as to fill up the hydraulic high pressure system. The continuance of the movement of the handing lever towards the left will open the valve 21 fully to exhaust and will so retain it during the idle descent of the presshead and during that first portion of the pressing stroke of the ram 3 which commences on the handing lever passing its neutral position 40^a and beginning to open the steam valve 14. When however, the handing lever reaches the position 40^f (see Fig. 7) whereat the bell-crank lever 73 encounters the stop 74, the latch-bolt 70 will be tripped and the valve 21 will fall, closing the lifting cylinders 5 to the exhaust and again admitting steam under the pistons 6, so that the remainder of the working stroke of the ram 3 (during which the handing lever may be moved from 40^f to 40^c) will be performed against a cushion of live steam in the cylinders 5. On the completion of a long working stroke, the handing lever is returned towards the right-hand side of its neutral position 40^a, thus opening the intensifier steam exhaust valve 15, while, before another long stroke is begun the handing lever is moved to the extreme right-hand position 40^d, the entire cycle of operations already described being thereafter gone through.

If at any time while the press is being worked with short strokes it should be found that the presshead 2 is too high, the handing lever must be moved to the position 40^d so as, by causing the valve 21 to be opened to exhaust on the reversal of the handing lever, to enable the presshead to descend on to the work (or as far as may be required) before proceeding with the short strokes.

When it is desired to bring the parts to the position of rest shown in Fig. 1, the handing lever must first be moved to the position 40^d and then brought to and let in the neutral position 40^a.

It will be observed that by the use of the present invention the loss of time hitherto involved in changing from the long-stroke to the short-stroke method of working and vice versa is saved, which is important as the number of such changes and consequent waste of valuable time in forging each piece is often considerable. The operator also finds it to his own advantage to work on the short-stroke method, since this requires much less labor than is involved in moving the handing lever through its full travel, as required for long strokes. Hence the tendency will always be to work the press with short and rapid strokes, which will secure a further economy both in time and in steam consumption. Time will be saved inasmuch as when working with long strokes the presshead is liable to be lifted unnecessarily high, and steam will be economized because the steam pressure being constantly admitted to the lifting cylinders, condensation in the latter will be reduced.

A further advantage is to be found in the ease and simplicity of the working of the press, the operator being able to use both hands for moving the handing lever. Moreover, if hunting-gear (such for example as above described) be used for controlling the intensifier steam valves 14 and 15, there is no idle movement of the handing lever in working these valves, so that the travel of the handing lever in actuating said valves is relatively much less than in presses of the usual type.

I claim:

1. The combination of a hydraulic press, steam hydraulic intensifier apparatus for operating the same, an air vessel, valves for controlling the admission and exhaust of steam to and from the intensifier and the lifting cylinders of the press and for controlling the connection between the high pressure hydraulic system and the air vessel, a single hand lever for operating all of said valves, connections between said lever and the several valves, and trip mechanism interposed in the connection between the lever and the valve appertaining to the lifting cylinders and adapted to automatically couple and uncouple said valve to and from the lever in such manner that steam will be normally admitted to the lifting cylinders but will be exhausted therefrom during the earlier part of the working strokes of the press when working with long strokes.

2. The combination with a hydraulic press and a steam hydraulic intensifier apparatus for operating the same, and valves for controlling the admission and exhaust of steam to and from the intensifier and the lifting cylinders of the press, of a single lever for operating said valves and trip mechanism interposed between the lever and the valve of the lifting cylinders for coupling and uncoupling said valve to and from the lever at predetermined intervals, whereby to permit the steam to exhaust from the lifting cylinders during the early part of the stroke when the press is working on long strokes.

3. The combination with a hydraulic press

and a steam hydraulic intensifier apparatus for operating the same, and valves for controlling the admission and exhaust of steam to and from the intensifier and the lifting cylinders of the press and for controlling the connection between the air vessel and the high pressure hydraulic system, of a single lever for operating all of said valves, and trip mechanism interposed between the lever and the valve of the lifting cylinders for coupling and uncoupling said valve to and from the lever at predetermined intervals, whereby to permit the steam to exhaust from the lifting cylinders during the early part of the stroke when the press is working on long strokes.

4. The combination of a hydraulic press, steam hydraulic intensifier apparatus for operating the same, an air vessel, valves for controlling the admission and exhaust of steam to and from the intensifier and the lifting cylinders of the press and for controlling the connection between the high pressure hydraulic system and the air vessel, a single lever for operating all of said valves, hunting gear comprising a lever tending to maintain a predetermined angular position and cam mechanism operated by the piston of the intensifier for displacing said lever to an angular extent corresponding to the advance of said piston, a floating lever connected to said hunting gear lever, to the handing lever, and to the valves for controlling the admission and exhaust of steam to and from the intensifier, connections between the hand lever and the valve for controlling the connection between the high pressure hydraulic system and the air vessel and between the hand lever and the valve for controlling the admission and exhaust of steam to and from the lifting cylinders, and trip mechanism interposed in the last mentioned connection and adapted to automatically couple and uncouple to and from the hand lever the valve controlled by said connection in such manner that steam will be normally admitted to the lifting cylinders but will be exhausted therefrom during the earlier part of the working strokes of the press when working with long strokes.

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