(No Model.) 3 Sheets—Sheet 1.

A. LANGERFELD.

HYDRAULIC EMBOSSING MACHINE.

No. 453,410. Patented June 2, 1891.

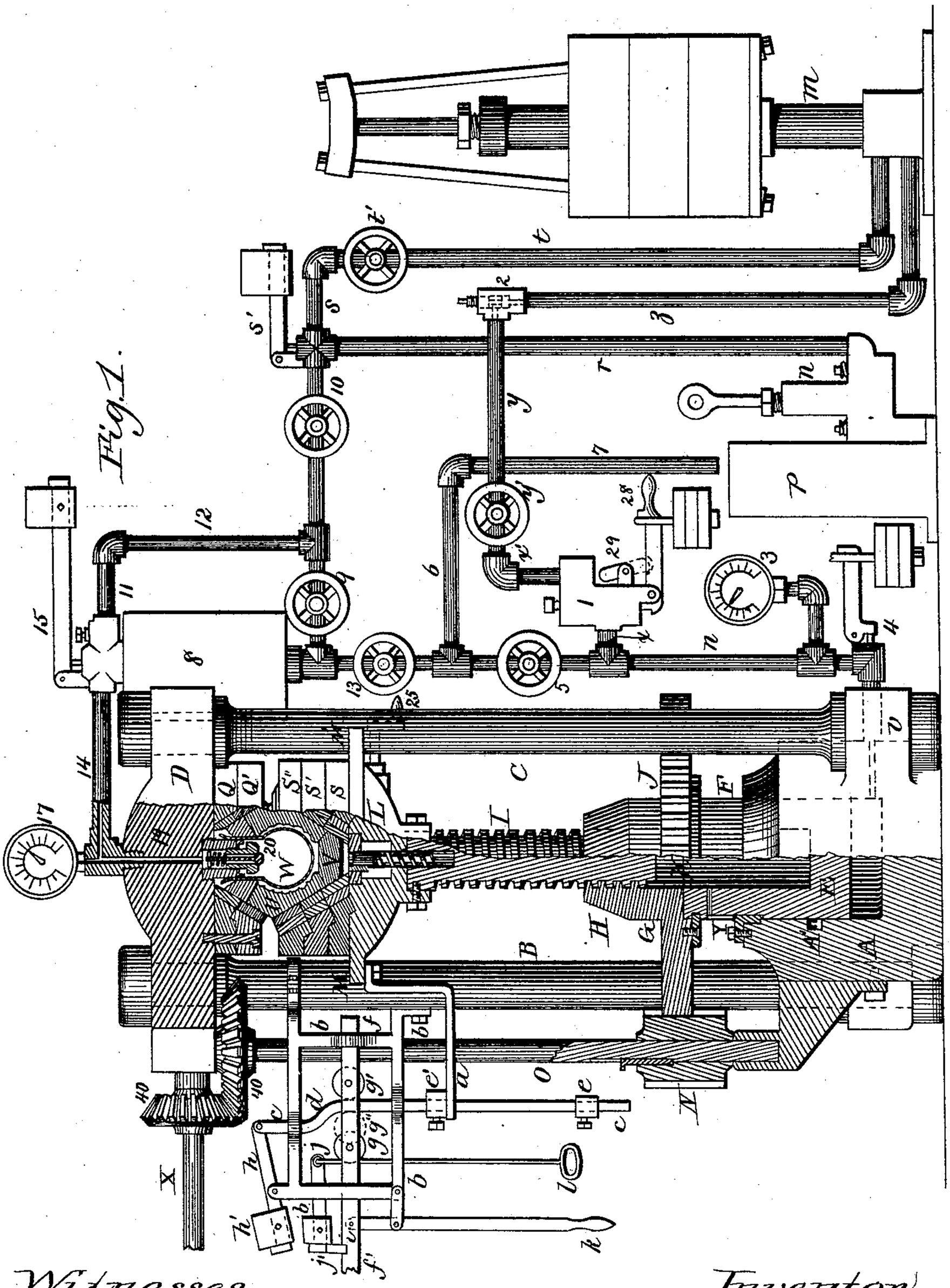

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

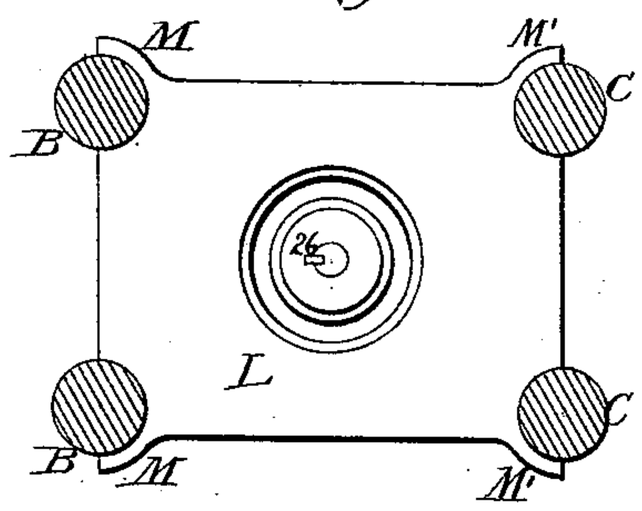


Fig. 3

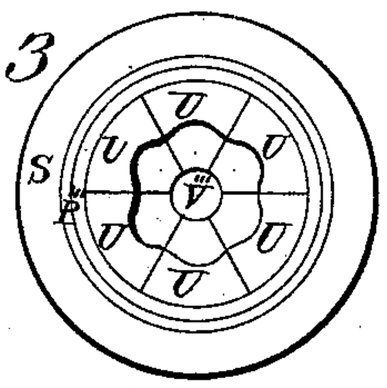
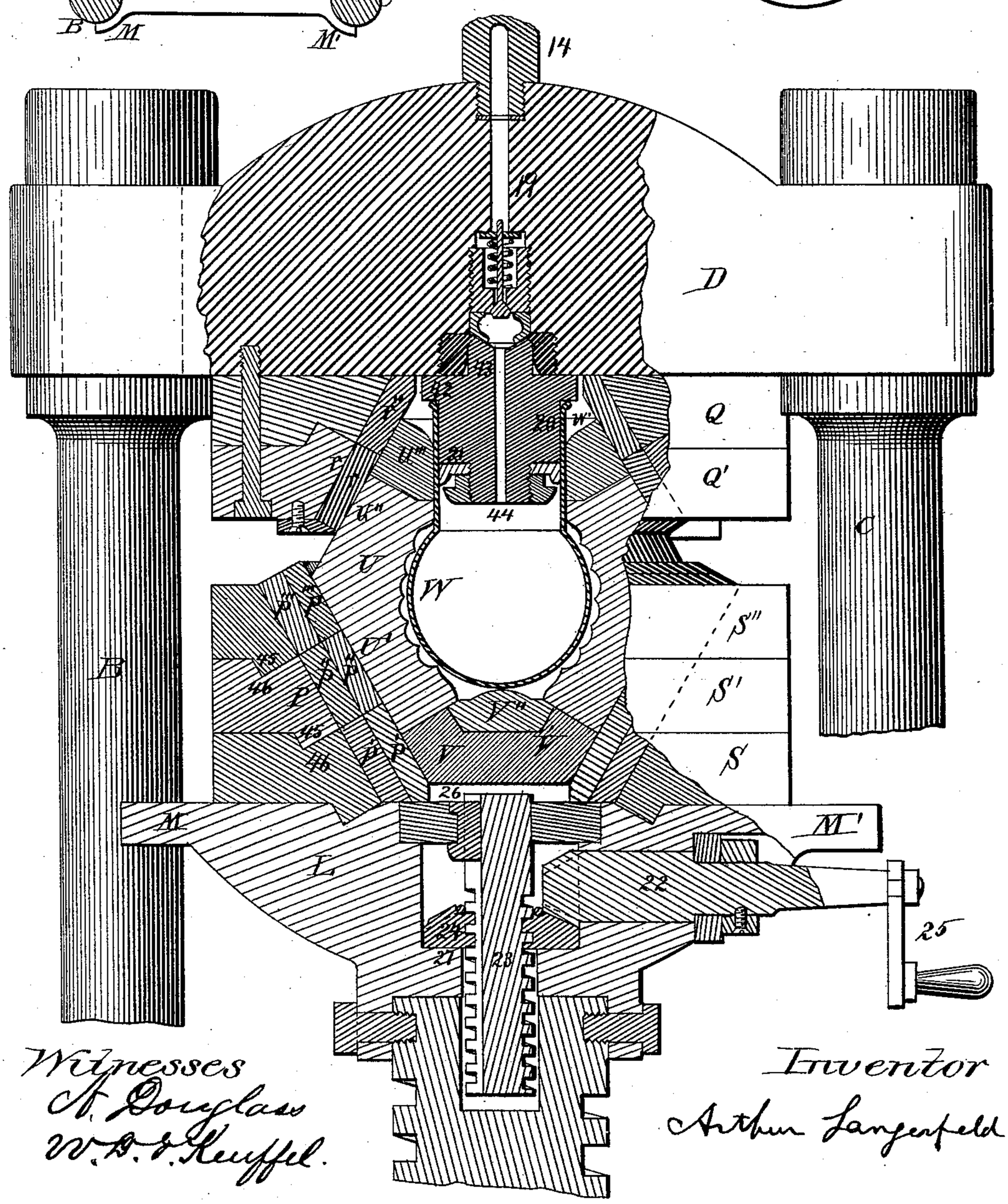


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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HYDRAULIC EMBOSSING MACHINE.

No. 453,410. Patented June 2, 1891.

Fig. 8.

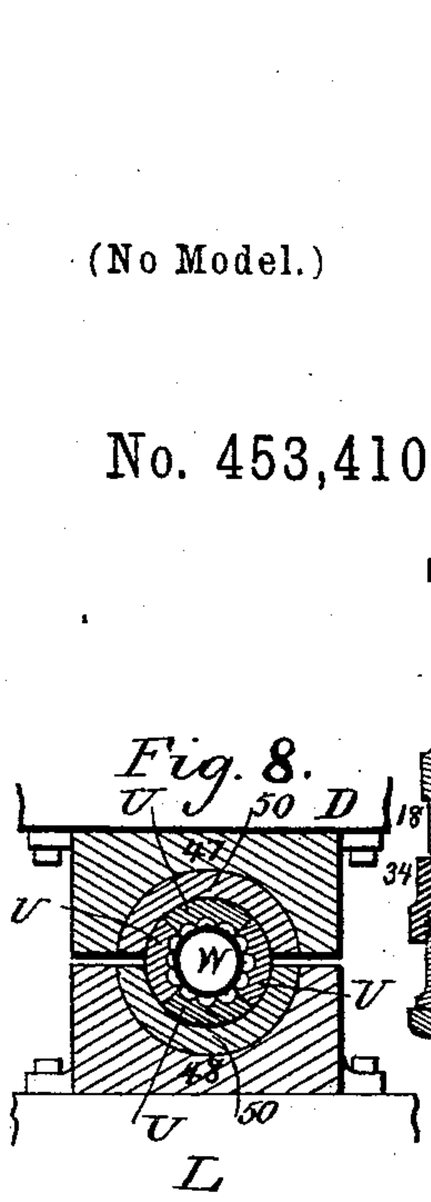


Fig. 5.

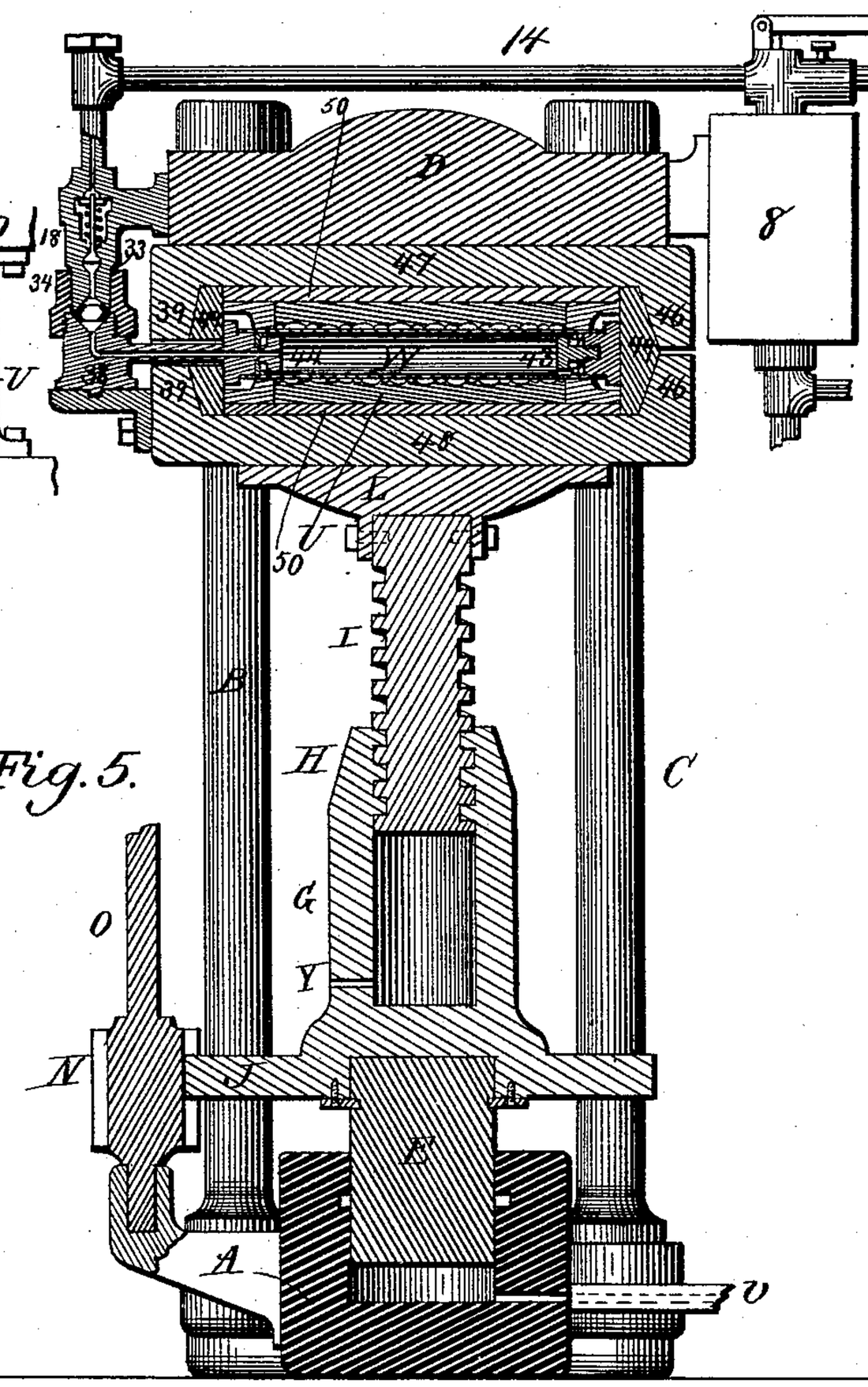


Fig. 6

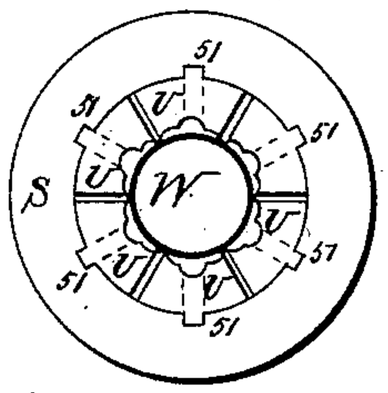
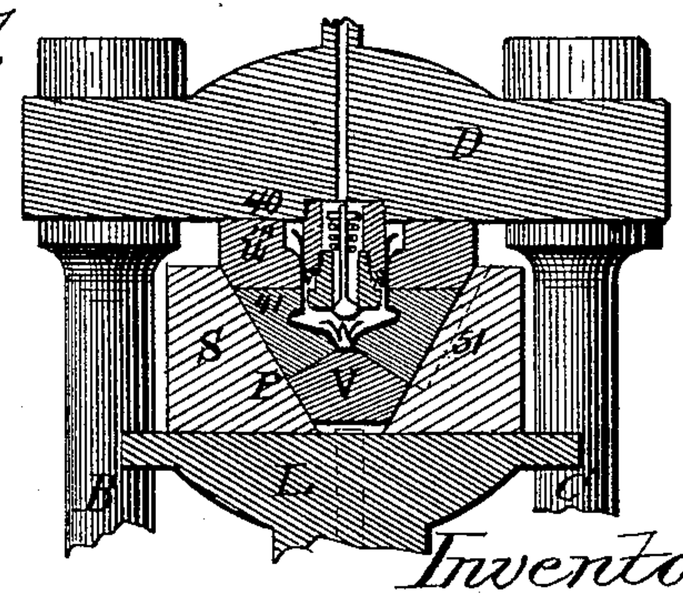


Fig. 7.



Witnesses
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Inventor
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UNITED STATES PATENT OFFICE.

ARTHUR LANGERFELD, OF NEW YORK, N. Y.

HYDRAULIC EMBOSSING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 453,410, dated June 2, 1891.

Application filed February 10, 1890. Serial No. 339,961. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR LANGERFELD, a citizen of the United States, residing in the city, county, and State of New York, have invented a new and useful Hydraulic Embossing-Machine, of which the following is a specification.

My invention relates to improvements in machines for embossing, forming, or pressing sheet-metal shells and tubes by the direct pressure of water or other fluids, and several of the new features of this machine are also useful for other purposes.

The objects of my invention are, first, to provide a water-tight connection between the shell or tube to be embossed and the water-supply, so constructed that the rim or neck of the shell or tube will not be firmly held or clamped, as is the case in machines of this kind now used, but so that the neck of the shell or tube can slide and be sufficiently drawn into the die to supply metal for filling out the cavities in the die without stretching and weakening the metal as much as it is when firmly held at the edge; second, to provide a die-holding press having a long and quick motion to open and close, so that work can be put in and taken out quickly; third, to provide a mechanism by which the die can be opened enough to take the finished work out and put a blank in without taking the whole die apart or out of the die-holder; fourth, to provide die-holders so constructed that they will compress the sections of the die concentrically, so as to firmly close the seams between the sections; fifth, to provide die-holders so arranged that dies of different lengths and sizes can be put in; sixth, to provide means and connections for bringing different pressures to bear both on the dies by means of a press and on the work in the dies to suit different sizes, kinds, and thicknesses of metal. I attain these objects by the mechanisms and means illustrated in the accompanying drawings, in which—

Figure 1 is a general view of the machine, partly shown in section. Fig. 2 is a plan showing a section above the platen of the press. Fig. 3 is a plan of the die-holders and dies. Fig. 4 is an enlarged vertical section of the die-holders, dies, plug with connection, and mechanism for opening the die. Fig. 5 shows the die-holders, dies and connections for long tubes, and arrangement of screw when the ram is too small to be bored out to receive the screw. Fig. 6 shows the sections of the die provided with guides in the die-holder. Fig. 7 shows a die in a single die-holder in section. Fig. 8 is a central cross-section of the tube-dies and tube-die holders shown in Fig. 5.

A B C D E, Fig. 1, is an ordinary hydraulic press, A being the cylinder, B and C columns or rods, D the head, and E the ram.

F is an extension of the ram E outside of the cylinder A.

G is a sleeve or support resting on the top of the ram E on a bearing K, so that the sleeve G can revolve.

Y is a key and slot to keep the ram E from being revolved, so as not to wear the packing A′ unnecessarily. There is also a vent-hole at Y to the bore in the ram E to allow the air to escape when the screw I descends.

On the sleeve G is a nut H.

I is a screw fitting into the nut H, and is fastened under the platen L.

M and M′ are guides attached to the platen L and sliding against the columns B C or other guides, as shown in Fig. 2, so that the platen L and screw I cannot be revolved, but will be moved up or down when the nut H is revolved to the right or left, respectively.

The ram E, as shown in Fig. 1, is so proportioned as to be large enough to admit of being bored out, so that the screw I can enter it when descending. This arrangement is desirable because it makes the press shorter, but it is not necessary that the ram E should be hollow. When the ram E is so proportioned as to be too small to be bored out large enough to admit the screw I, then the sleeve or support G is made as much longer or higher as is necessary to give the screw I room to descend without entering the ram E, as is shown in Fig. 7, or the part F of the ram may be made long enough to receive the screw; but it is generally preferable to lengthen G. The objects of the screw I are to impart a quick and sufficient travel to the platen L to make room between the head D and platen L, so that the blank shell W can be put into the die U or taken out when fin-

ished and the die quickly raised up to the head D after the blank shell W has been put in without using the slow-moving ram E.

J is a gear-wheel to drive the nut H.

N is a pinion to drive the gear-wheel J. The face of the pinion N is made wide enough to give the gear J room to move up and down as much as the ram E without becoming disengaged.

Motion is imparted to the pinion N by the shaft O, onto which it is fastened. This shaft O is provided with suitable means for being driven by bevel-gears 40, as shown, or by a pulley direct, as may be most convenient.

The counter-shaft X must be provided with means for being driven to the right or left or stopped. As any of the means commonly used for this purpose will answer, they are not shown in the drawings.

The screw I is stopped when nearly all the way up or down by the mechanism carried by the rigid immovable frame *b b b b*, Fig. 1, and consisting of the following parts: *a a* is a stiff arm attached to the platen L or head of the screw I. *c c* is a rod sliding vertically in the frame *b b b b*, with a slanting step or bend *d* in it made to act as a cam. *e* and *e'* are collars adjustable on the rod *c c*. *h* is a lever with counter-weight *h'* in equilibrium with the rod *c c* and collars *e e'* so that this rod *c c* will move equally up or down and remain where left. *j* is a weighted lever or pawl with a tooth *j'* at its weighted end. The weights may be substituted by a spring. The tooth *j'* fits into the notch *i* in the slide *f f'*, *l* is a handle connected with *j*, so that the pawl *j'* can be raised up out of the notch *i* when *f f'* is to be shifted. The slide *f f'* is connected with the shifter of the above-mentioned means for driving or stopping the counter-shaft *x*, (not shown in the drawings,) so that when it is in a position to receive the pawl *j'* in the notch *i* the counter-shaft *x* will be stopped, and when shifted to *f* on *f'* by the lever *k* the counter-shaft *x* will be driven to the right or left, respectively, and thereby cause the nut H to revolve and raise or lower the screw I. When the screw I is running down, the roller *g* will be where indicated by the dotted circle *g''*, and when the arm *a a* has reached the collar *e* and moves the rod *c c* down *g''* will be pushed back to *g* and stop the screw I, as described. When the screw I is running up, it is stopped in a similar manner by means of the roller *g'*.

Other automatic stop mechanisms may be substituted for this one, but this one is especially adapted for this machine because it allows the heavy nut H, sleeve G, gear J, pinion N, and shafts O and X, to run after the power driving them has been stopped, until their momentum is exhausted, and any additional motion will not continue to shift the slide *f f'* because the rollers *g* or *g'* will have passed the bend *d* in the rod *c c*.

The platen L carries a die-holder S S' S'', and under the head D a similar die-holder Q Q' is fastened. Each die-holder has a conical bore P T, Fig. 4. The die-holders are made in sections S S' S'' and Q Q', or more, so that by using more or less sections dies of different lengths can be put into the press and the conical bores in the die-holders are provided with bushings P' P'' P''' and T' T'', so that different sizes of dies may be put into the same die-holders by inserting more or less bushings. Each section of the die-holders has a shoulder 45, fitting into a recess 46 in the next larger section, so that all sections remain flush or centered and the strain upon one is partly transferred to the next larger one and to the platen L by the largest one. The sections of the die U are made with two opposite conical external faces or bearings U' U'', corresponding to and fitting into the conical bores of the die-holders S S' S'' and Q Q', or into the bushings put into the die-holders. The object of these conical bearings is to cause the seams between the sections of the die to be tightly closed, so that they will not show in the work as much as they do when the dies are not so compressed.

When the shape of the die is such that the upper part cannot be conveniently provided with a sufficient conical bearing, I make the top of the die flat, as shown in Fig. 7, and provide a flat surface 40 under the head of the press D in place of a second die-holder for the top of the die to bear against, and thereby press the sections of the die into the conical bore P, so that the seams in the die will become firmly closed. The object of the separate bottom block V, Fig. 4, is to carry the pressure on the bottom of the work W without putting this strain onto the sections of the die U, which would be subjected to a tension or tearing strain if the bottom were made part of the sections. This arrangement is of special advantage when the dies are made of a metal or material which has a great crushing resistance—as, for instance, cast-iron—but a low adhesive strength or resistance to tearing and breaking. By providing this bottom block V with a plain recess V', as shown in Fig. 4, different bottom dies V'' can be put in, so that with the same dies for the sides different bottoms can be formed on the shells.

22 to 27, Fig. 4, is a mechanism in the platen L for raising and thereby opening the die W. It consists of the upright screw 23, nut 24, and crank-handle 25, geared to the nut 24. The screw 23 has a keyway 26 cut lengthwise, and is keyed to the platen, as shown in Fig. 2, so that the screw 23 cannot revolve, but will rise or descend when the nut 24 is turned to the right or left, respectively, by means of the crank-handle 25.

20, Fig. 4, is a plug fitting into the neck of the shell W. This plug 20 is provided with a hydraulic packing 21 at or near its end, and through the plug 20 is a water-passage 44, connecting the passage 19 with the inside of the shell W. The bottom edge of the plug 20

is rounded a little, so that the shell will slip over it without catching on the corner. It is desirable to give the top rim of the shell W a slight flare, as shown, so that in case it is a little out of shape or out of center it will center itself and slip onto the plug 20 without striking it on the edge. This plug 20 may either be fixed under the head of the press D, as shown in Fig. 1, so that the shell W will slip onto it, or it may be put into the neck of the shell W and raised up against the head D, together with the shell W. In this case the plug is provided with a shoulder 42, Fig. 4, resting upon the top of the shell W; or if the shell is not strong enough on part of the die U the plug is also provided with a connection 43 to form a tight joint between the passage 19 and the passage 44 through the plug. For small accurate work the former is preferable; but for large irregular or rough work it is generally safer to put the plug into the neck of the shell W, instead of fastening it to the head D. The end of the water-passage into the shell W is closed by a light spring-valve 18 to keep the water from emptying out of the passage 19 and tube 14 when the shell W has been withdrawn from the plug 20.

The blank shell W is made with a cylindrical or parallelopiped prolongation of its upper end or neck W′, and the die U has a smooth cylindrical or parallelopiped collar U‴ at or near its top end closely fitting around the neck W′, which is made long enough to allow for being drawn down into the die when the shell W is being embossed. I prefer to make the collar U‴ separate of hard steel, the dies being made of a cheaper metal or material; but the collar may also be made part of the dies at or near the top ends of the sections, the parts being pressed together into a whole when the dies are pressed together. The plug 20 must be made of such a length that the hydraulic packing 21 will come just inside of the collar U‴, so that the neck W′ of the shell can slide down between the collar U‴ and packing 21 without becoming expanded or distorted. The packing will then remain tight while the shell is being drawn into the die to supply metal to fill out the cavities in the die without overstraining the shell W and causing it to tear or become too thin in places.

m is an ordinary weighted accumulator.

n is a hydraulic force-pump, (shown only in part,) and *p* is the supply-tank for this pump. The pump *n* is connected with the accumulator *m* by the pipes *r s t*.

s′ is a safety-valve for the pump *n* as a precaution.

The cylinder A of the press is connected with the accumulator by the pipes *v w x x′ y z*.

1 is a pressure-regulator and 2 is a check-valve inserted to provide against any pressure backing out of the cylinder A in case the accumulator *m* should be emptied while a shell is being embossed.

3 is a pressure-gage to indicate the pressure in the cylinder A.

4 is a safety-valve connected with the cylinder A as a precaution.

5 6 7 is an outlet-pipe connecting the cylinder A with the tank *p*.

8 is a pressure-multiplier connected with the accumulator *m* by the pipes 9 10 *s t* and 11 12 10 *s t*, also to the pump by the pipe *r*. The pipe 14 and passage 19 connect the pressure-multiplier 8 with the shell W in the dies *u*, as shown, and the outlet-pipe 13 6 7 connects the pressure-multiplier with the tank *p*.

15 is a safety-valve placed between the shell W and the pressure-multiplier 8 as a precaution.

17 is a pressure-gage to indicate the pressure in the shell W.

When the machine is to be used for only one kind and size of work or only for certain work for which either the pressure-multiplier or pressure-regulator, or both, are not required, these parts or either of them may be omitted and the die-holders made in one piece instead of sections. The machine can also be operated without any accumulator by using a pump with several plungers working so as to give a nearly steady pressure; but the accumulator is much steadier and quicker.

When the press is to be used for straight or plain drawing, forming or embossing dies, the die-holders, with conic bores S and Q, are removed and the water-supply through passage 19 used or not used, as may be required.

When a tube is to be embossed, a solid plug provided with a hydraulic packing and resting on the bottom block V is put into the lower end of the tube and a collar provided closely fitting the outside of the tube and placed opposite the packing, all similar to plug 20. The upper end of the tube is closed by a plug the same as 20.

When a tube is too long to be conveniently placed in the press in an upright position, I put it in crosswise, as shown in Fig. 5. A solid plug 43 is put into one end and a plug with water-passage 44 into the other end, both plugs and surroundings being made similar to plug 20, but held in place by the cap-pieces 39 and 46 on the ends of the die holders 47 and 48. The connection with the passage in plug 44 is formed automatically by the hollow plunger 33, connected with pipe 14, and fitting and sliding into the cylinder 34, provided with a hydraulic packing and attached to the plug 44, and connected with plug 44 by the passage 38. The water-passage in the plunger 33 is closed by a light spring-valve the same as plug 20, and for the same purpose.

The machine is operated in the following manner: The screw I is lowered, as described, all the way down or far enough to give room for opening the die U and putting in a shell

W. The die U is then opened by turning the crank 25, and a blank shell W is put into the die. The die U is then lowered into the die-holder S S′ S″ by turning the crank 25 around in the opposite direction, as before, until the bottom block V no longer rests on the top of the screw 23. By dropping into the conic bore of the die-holder the die closes around the shell W. The shell W is now poured nearly full of water, space being allowed for the plug 20. The pump is now run steadily to fill the accumulator *m*, valve *t′* being opened and valve 10 closed. Next the screw I is run up all the way, or nearly so, and then valve *y′* is opened, valve 5 being closed. The pressure in the cylinder A will now rise as high as the regulator 1 will permit. This pressure should be sufficient to firmly compress the die, so as to close the seams without overstraining it. Valve 10 is now opened, (valve 9 being closed.) The water will then enter the shell W through pipes 12 11 14 and passages 19 and 44. The regulating-valve 1 is now thrown out of operation by pushing down the lever 28 and turning down the pawl 29, as indicated on Fig. 1 by dotted lines. Then the pressure in the shell W is increased to what is required by closing valve 13 and bringing the pressure-multiplier 8 into operation by slowly opening valve 9 until the gage 17 indicates the pressure necessary to emboss the shell W. If the pressure does not rise high enough by supplying the multiplier from the accumulator, valve *t′* is closed in addition to valve 13, valves 10 and 9 remaining open. The full force of the pump *n* will now act in conjunction with the multiplier 8, and the pressure will rise to the highest point obtainable unless valve 9 is closed sooner. Before valve *t′* is closed the accumulator should be well filled to keep up the pressure in the cylinder A, and just before valve 9 is closed valve A′ must be opened or the pump stopped. Now valve 10 is closed and 13 opened a little. This will slowly let the pressure out of the shell W and multiplier 8. At the same time valve *y′* is closed and valve 5 is opened enough to let the pressure out of the cylinder A at the same rate as out of the shell W. When the pressures have both been all let out, the screw I is lowered, the die U opened by turning crank 25, and the work is taken out. The ram E must be of such a size that it gives more pressure than is exerted on the largest internal horizontal cross-section of the work in the press, so that the die always remains compressed.

The screw I, nut H, sleeve G, and the entire mechanism for driving the nut H may be substituted by other mechanisms or means to move the platen up and down; but the screw I, nut H, and driving-gears are an improvement answering the requirements of this particular purpose of the press.

By providing the sections of the die U with guides 51, Fig. 7, so as to keep the sections equally divided, and placing into the open die a blank shell or tube which is somewhat too large, the blank W will be pressed into the cavities of the die to some extent and save the metal from being stretched or strained as much in circumference as it otherwise would be. I also provide the tube die-holders, Fig. 5, with bushings 50, so that tubes of different diameters or dies of different thicknesses can be put into the same die-holders, and I provide blank blocks 49, to be used when the tubes are not as long as the die-holders. When the press is large enough, a number of tube die-holders may be placed in the press together side by side, and similarly several shells W can be embossed simultaneously in a large press.

The pressure-multiplier 8 and pressure-regulator 1, I have made the subjects of separate applications for patents.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a hydraulic embossing-machine, the means for connecting the shell or tube to be embossed with a water-supply, consisting of a plug provided with a hydraulic packing fitting into a cylindrical or parallelopiped neck on the shell or into the end of the tube, the plug having a water-passage provided with a separable connection with the water-supply, substantially as described.

2. In a hydraulic embossing-machine, the combination of a straight or flared neck or parallelopiped prolongation on the upper end of the shell to be embossed, a plug fastened under the head of the press and fitting into this neck on the shell, a water-passage through the plug connected with a water-supply, a die containing the shell, a collar resting on or made a part of the die and fitting around the neck of the shell, means for holding, raising, and lowering the die, and guides causing the die with shell to move centrally in line with the plug, for the purpose set forth.

3. In a hydraulic embossing-machine, a cylindrical or parallelopiped prolongation of the blank shell or tube extending outside of the sunk part of the die, in combination with a plug having a water-passage through it arranged to connect the inside of the blank tube or shell with a water-supply, the plug also having a hydraulic packing at or near its end fitting into the prolongation of the shell or tube, a collar having a smooth inside face closely fitting around the prolongation of the shell or tube and placed opposite the packing of the plug, and means for holding the plug and collar in their place together with the die, for the purpose set forth.

4. In a hydraulic embossing-machine, in combination with a die for embossing shells or tubes open at both ends, the means for closing one end, consisting of a cylindrical or parallelopiped prolongation of the shell or tube extending outside of the sunk part of the die, a solid plug having a hydraulic packing at or near its end fitting into the prolongation

of the shell or tube, a collar fitting around the prolongation of the shell or tube and placed opposite the hydraulic packing of the plug, and means for holding the plug and collar in their place together with the die.

5. In a hydraulic embossing-machine, the combination of a plug fitting into the neck or end of the shell or tube to be embossed, an automatic connection consisting of a hollow plunger fitting into a cylinder with a hydraulic packing, and a water-passage from the inside of the shell or tube to be embossed through the plug to the hollow plunger and cylinder and from there to the water-supply, substantially as described.

6. In combination with a hydraulic embossing-machine, the light spring-valve 18 at or near the end of the water-passage into the shell or tube to be embossed, for the purpose set forth.

7. In combination with a press, two opposite die-holders with conical bores or cavities, and sectional dies with opposite conical faces fitting into the conical bores or cavities of the die-holders, substantially as described.

8. In combination with a press, a die-holder carried by the platen of the press and having a conical bore or cavity, a sectional die with conical sides fitting into the conical bore in the die-holder, and a flat top surface on the die arranged to bear against the head of the press, for the purpose set forth.

9. The sectional die-holders consisting of rings or frames resting upon each other and provided with shoulders fitting into recesses or other means for keeping them in position, each section having a conical bore or cavity flush with the bore of the other sections.

10. In combination with die-holders having a conical bore or cavity, the bushings P T, fitting into the conical bores of the die-holders and having similar or dissimilar conical bores or cavities, so that dies of other shapes or sizes can be put into the same die-holders, substantially as described.

11. The combination of a conical bore or cavity in a die-holder containing a sectional die and a mechanism under the conical bore or cavity arranged to raise or lower the die, for the purpose set forth.

12. In combination with a die-holder having a conical bore or cavity, the mechanism for raising and lowering the sectional die in the die-holder, consisting of the screw 23, fitting into the nut 24, geared to a crank 25 with a handle, the nut revolving on a bearing 27, and the screw being kept from revolving by a fixed key 26, fitting into a keyway cut lengthwise into the screw, substantially as described.

13. In combination with a hydraulic embossing-machine, die-holders for long-tube dies, consisting of opposite blocks having semi-cylindrical or semi-parallelopiped channels closed at each end by cap-pieces, substantially as described.

14. In combination with a hydraulic press, the means for quickly raising and lowering the platen, consisting of the guides M M′ on the platen L, the screw I, fastened under the platen L, the nut H, fitting and holding the screw I, the sleeve or support G, resting on a bearing K on top of the ram E and carrying the nut H, and means for driving the nut H, substantially as described.

15. In a combined hydraulic and screw press, the means for driving the nut H, carrying the screw I of the press, consisting of a gear-wheel J on the nut H or on the sleeve G, carrying the nut H, a pinion N, in gear with the wheel J, the face of one of these two wheels being as much wider than the face of the other one as the ram E of the press has travel, and the shaft of the pinion N being provided with means for being driven to the right or left or stopped.

16. The automatic mechanism for stopping the screw I of the press, consisting of the rigid frame *b b b b*, carrying an upright rod *c c*, having a bend *d* in it arranged to act as a cam and also having two adjustable collars or projecting parts *e* and *e′*, a stiff arm *a a*, extending from the platen L, fastened to the top of the screw I and reaching to the collars *e e′*, a horizontal slide *f f′*, also carried by the frame *b b b b* and provided with two lugs or anti-friction rollers *g g′*, so placed that the bend *d* in the rod *c c* will strike them and move the slide *f f′* when the arm *a a* moves the rod *c c* by striking one of the collars *e* or *e′*, the slide *f f′* being connected with the shifter of the belts, or other means by which the nut H of the screw I is driven, all substantially as described.

17. The automatic lock of the shifter *f f′*, consisting of the lever *j*, arranged to stop and hold the shifter *f f′* by means of a notch and tooth, in combination with means for automatically moving the slide *f f′*, substantially as described, and a lever *k* and connection *l*, by which the slide *f f′* can be unlocked and shifted voluntarily, substantially as shown and described.

18. In a hydraulic embossing-machine, the combination of a ram arranged to carry or compress a die, and an accumulator connected to supply pressure for forcing up and steadily maintaining the pressure of the ram, substantially as described.

19. In a hydraulic embossing-machine, the combination of a pressure-regulator 1, a ram arranged to compress the die, and a connection from a pump or other water-supply through the pressure-regulator to the ram, substantially as shown and described.

20. In a hydraulic embossing-machine, the combination of a pressure-regulator, an accumulator, a ram arranged to carry or compress the die, and a connection from the accumulator through the pressure-regulator to the ram, substantially as shown and described.

21. In a hydraulic embossing-machine, the

combination of a pressure-multiplier 8, a connection from a pump or other water-supply to the pressure-multiplier, and a connection from the pressure-multiplier to the shell or tube to be embossed in the die, substantially as shown and described.

22. In a hydraulic embossing-machine, the combination of a pressure-multiplier 8, an accumulator, a connection from the pressure-multiplier to the shell or tube in the die, and a connection from the accumulator to the pressure-multiplier, substantially as shown and described.

23. In a hydraulic embossing-machine, the combination of a pump, an accumulator, a pressure-multiplier, a connection from the pump to the accumulator, a connection from the pump to the pressure-multiplier, and valves in these connections, so that the pump can be brought into connection with the accumulator only or with the pressure-multiplier only, the pump being made to give a higher pressure than that required to fill the accumulator, substantially as described, and for the purpose set forth.

24. In combination with a hydraulic embossing-machine, a water-supply connected to the ram E, arranged to carry or compress the die, and a separate or separated water-supply connected with the shell or tube W in the die, so that the pressures of these two water-supplies are independent of each other.

25. In combination with a hydraulic embossing-machine, an accumulator, a connection from the accumulator to the cylinder A of the press, and a connection from the accumulator to the shell or tube W in the die, substantially as described.

26. In a hydraulic embossing-machine, the combination of an accumulator, a pump, a connection from the pump to the accumulator, a connection from the pump to the shell or tube in the die, and a connection from the accumulator to a ram arranged to carry or compress the die, the connections being provided with valves, so that the pump can be brought into connection with the accumulator only or with the shell or tube in the die only, or with both, substantially as described.

27. In a hydraulic embossing-machine, the combination of a pressure-regulator, a pressure-multiplier, a connection from the pressure-regulator to a ram arranged to carry or compress the die, a connection from the pressure-multiplier to the shell or tube in the die, connections from the pressure-regulator and pressure-multiplier to a water-supply or to separate water-supplies, and valves in these connections, substantially as described.

28. In a hydraulic embossing-machine, the combination of an accumulator, a pressure-regulator, a pressure-multiplier, a connection from the accumulator to the pressure-regulator, a connection from the pressure-regulator to a ram arranged to carry or compress the die, a connection from the accumulator to the pressure-multiplier, a connection from the pressure-multiplier to the shell or tube in the die, and valves in these connections, substantially as shown and described.

29. In combination with a sectional die, a separate block or part forming the bottom and having a bearing of its own independent of the other sections of the die, substantially as described, and for the purpose set forth.

30. In combination with a sectional die, a block under the sectional die provided with a recess into which differently-formed or different sizes of bottom dies can be placed, substantially as described.

31. The combination of a die-holder with a conic bore or cavity, a sectional die, and concentric guides between the sections of the die and the die-holder, keeping the sections equally divided or apart when raised or lowered, substantially as described, and for the purpose set forth.

32. In combination with channeled die-holders for tube-dies, sectional bushings fitting into the channels in the die-holders and having channels similar or dissimilar to the channels in the die-holders, for the purpose set forth.

33. In combination with channeled die-holders for tube-dies, blocks fitting into the channel and arranged to fill up the remaining space when the tube-dies are shorter than the channels in the die-holders, so that dies for tubes of different lengths can be put into the same die-holders, substantially as described.

ARTHUR LANGERFELD.

Witnesses:
ISON LUETKE,
WILLIAM H. ILGES.