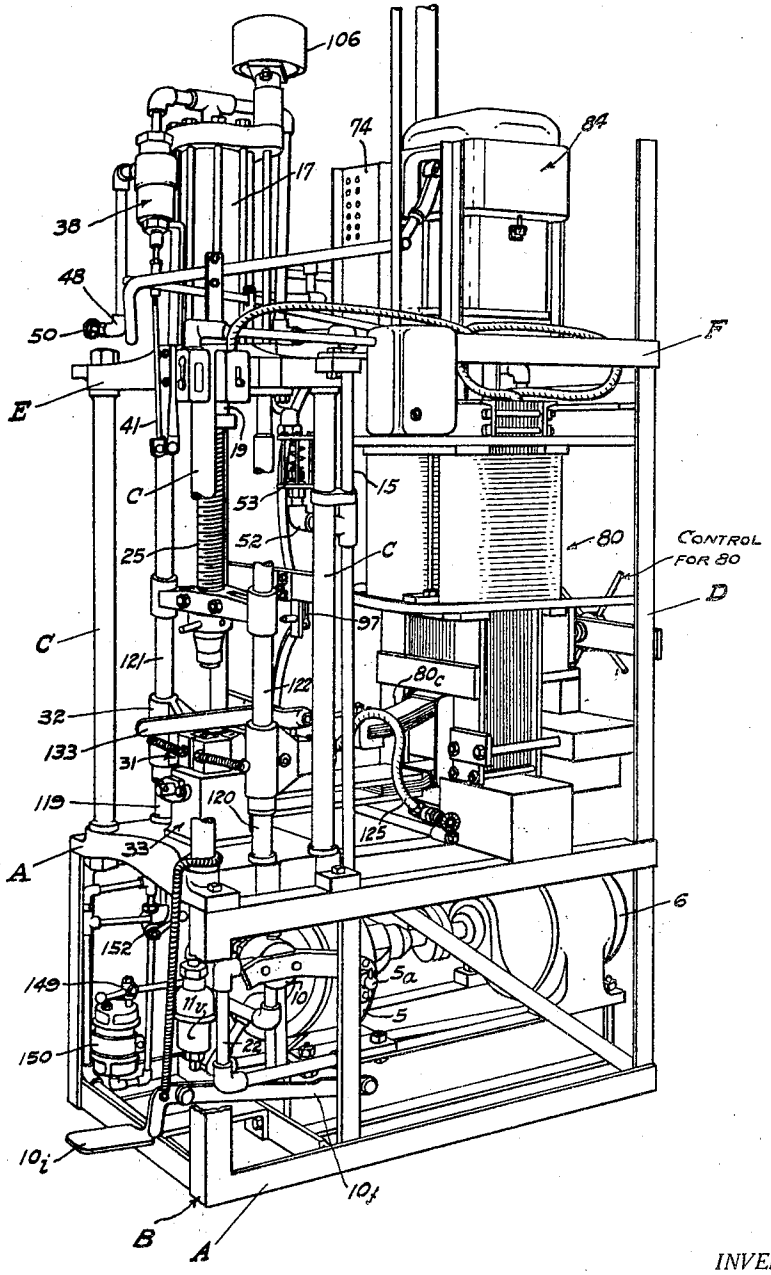
Aug. 9, 1932. L. P. DRAKE 1,870,987

APPARATUS FOR UPSETTING ARTICLES OF MANUFACTURE

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Fig. 1.



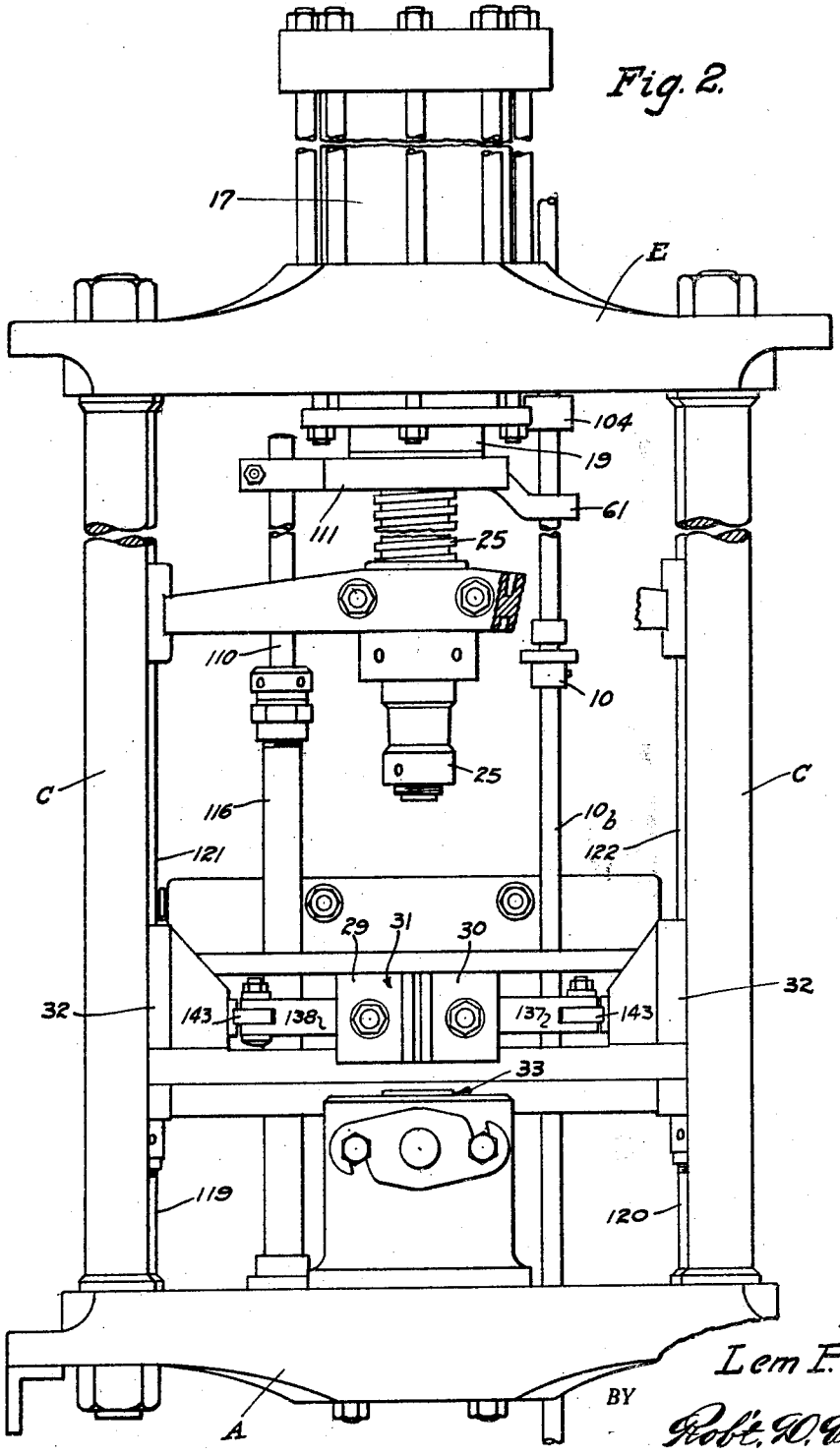
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APPARATUS FOR UPSETTING ARTICLES OF MANUFACTURE

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Fig. 2.



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APPARATUS FOR UPSETTING ARTICLES OF MANUFACTURE

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Fig. 3.

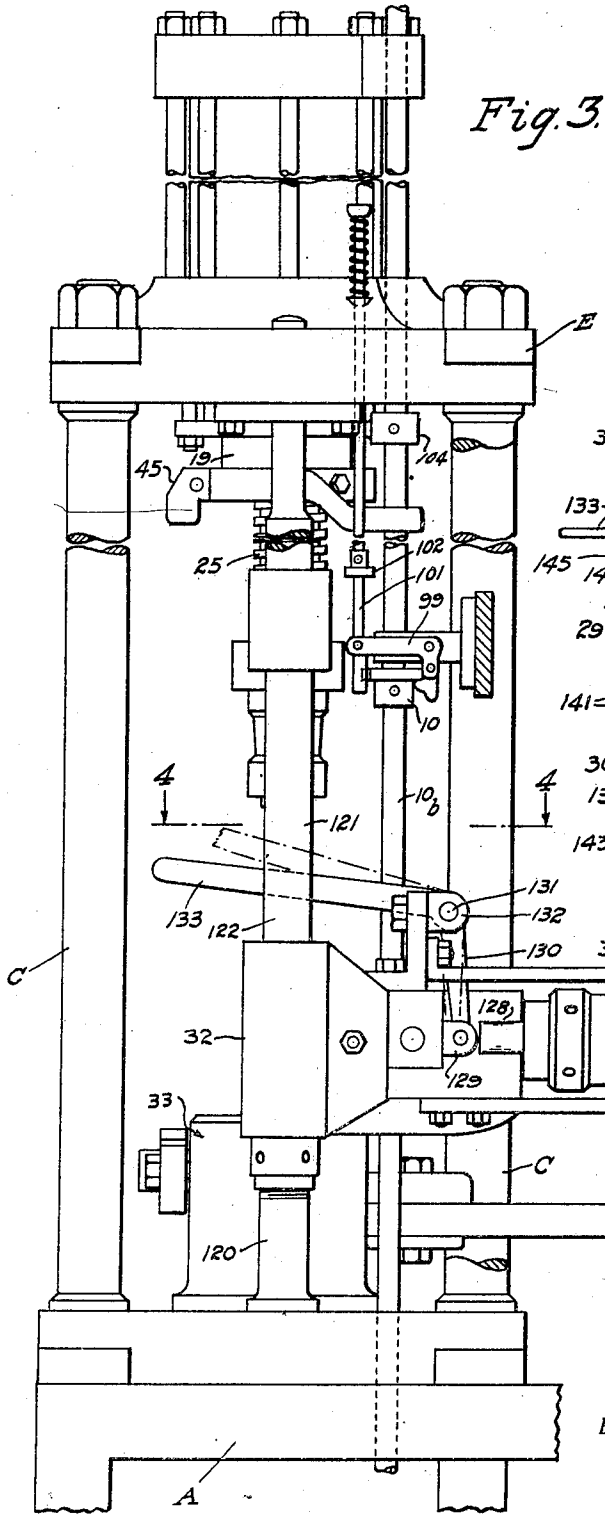
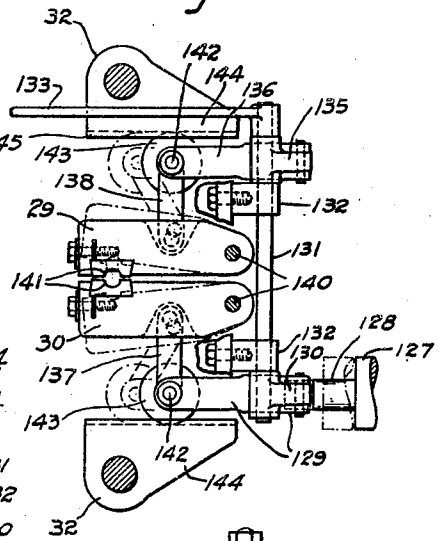


Fig. 4.



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APPARATUS FOR UPSETTING ARTICLES OF MANUFACTURE

Filed Oct. 16, 1929 4 Sheets-Sheet 4

Fig. 5.

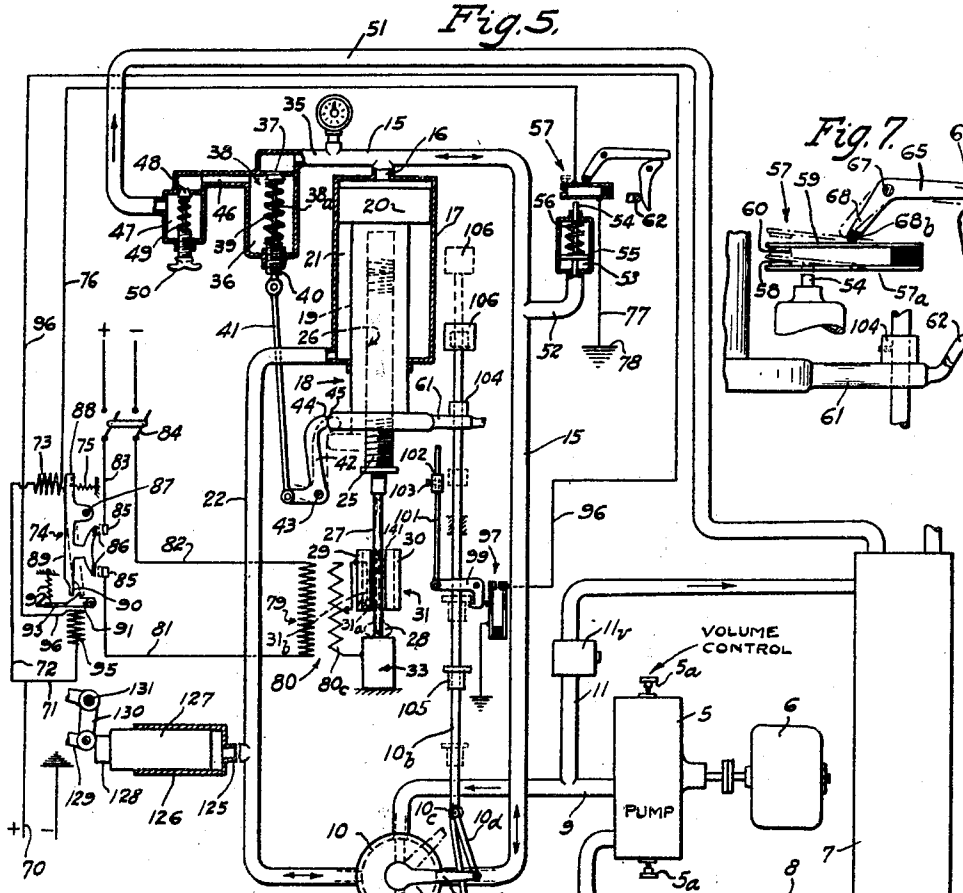


Fig. 7.

Fig. 8.

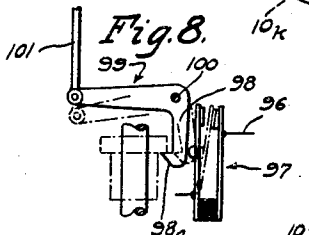


Fig. 9.

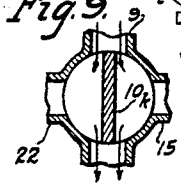


Fig. 10.

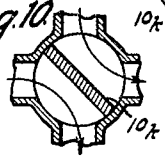


Fig. 11.

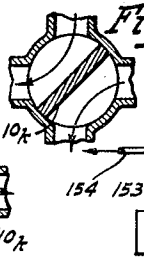
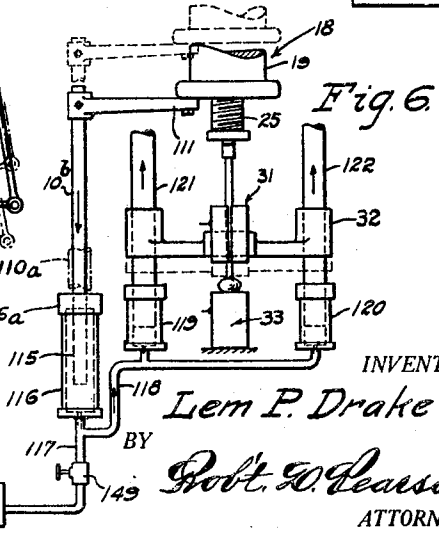


Fig. 6.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR UPSETTING ARTICLES OF MANUFACTURE

Application filed October 16, 1929. Serial No. 400,080.

This invention relates to a method and apparatus for forging, gathering and upsetting of metal rods.

An object of this invention is to provide an electrical apparatus for heating the metal which is to be operated upon in such a manner that, when the apparatus is used for upsetting metal rods such, for example, as are used for making poppet valves, progressive increase in the size of the electrically heated portions of the article is provided for in a more efficient manner than heretofore.

As the space occupied by the portion of the rod being enlarged or upset is filled with gathered or upset metal of larger cross-section than the rod, the space for the upset metal is increased to meet the mechanical and electrical requirements for forming the size of upset desired. The relation between the enlarged portions and the original size of the rod within the upset space is maintained within the limits of upset rather than of buckling or bending; and also in such a manner that the space is prevented from being entirely filled with upset metal of such large cross-section that the heating produced by the current would be lessened thereby, instead of remaining at the uniform temperature desired.

A further object of the invention is to provide an apparatus of the character stated wherein the mechanical and electrical operating features are arranged to cooperate with each other more efficiently, and wherein ample and dependable regulation is provided to meet the adjustment required for upset or for providing enlargements upon various sizes of rods, and with a view to obtaining the various amounts of upset and length desired in the various articles.

The invention pertains to an apparatus wherein electrically operated and controlled devices are combined with a system of hydraulic control whereby the automatic operation of the machine is secured, so that it performs in a more efficient manner without the necessity of any manual manipulation during the complete cycle of operations required in the production of the article being manufactured.

Other objects and advantages may hereinafter appear.

Referring to the accompanying drawings which illustrate what is at present deemed to be a preferred embodiment of the invention.

Fig. 1 is a perspective view showing the entire apparatus in a form as complete as is consistent with clearness of illustration. A few parts are broken away in this view in order to disclose more clearly underlying portions of the apparatus.

Fig. 2 is a front elevation of the apparatus showing only the main parts thereof, portions being broken away to contract the view.

Fig. 3 is a side elevation showing the principal parts of the apparatus, portions being broken away to contract the size of the view.

Fig. 4 is a transverse section on line 4—4 of Fig. 3.

Fig. 5 is a general hydraulic and electrical diagram showing as many of the operating parts as can be disclosed in one view without confusion.

Fig. 6 is a view showing somewhat diagrammatically an independent hydraulic feature which could not be illustrated conveniently in Fig. 5.

Fig. 7 is an elevational detail of an electric switch controlled by hydraulic pressure, the view including parts operatively related to said switch, portions of certain parts being broken away to contract the view.

Fig. 8 is an elevational detail of a switch to break the circuit which supplies the forging heat, together with the parts in immediate operative relation to said switch.

Figs. 9, 10 and 11 illustrate diagrammatically various positions of the master valve which controls the hydraulic supply for operating the ram.

Referring in detail to the drawings, and first more particularly to Figs. 5 and 6, the hydraulic pressure is supplied from a pump 5 operated by a motor 6, said pump being supplied from a tank 7 through a pipe 8. Said pump discharges through a pipe 9 which leads to the master control valve 10, said valve also having a by-pass branch 11 in communication with said tank 7, and having a

safety relief valve 11*v*. Pump 5 is provided with controls 5*a* to regulate the volume of liquid delivered.

From the master valve 10 leads the supply pipe 15 from which a passage 16 leads to the upper end of the piston cylinder 17 of the ram 18. Said ram 18 is provided with a body portion or plunger 19 to the upper end of which is secured the piston head 20 which has a working fit within cylinder 17, there being an annular space 21 between the plunger 19 and the wall of said cylinder 17. In order to operate the ram 18 in both directions pressure is also supplied to the annular space 21 through a pipe 22, flow through which is controlled by the master valve 10 with which the other end of said pipe 22 is connected.

The various working parts of the apparatus are shown as supported by a lower frame B upwardly from which extend the posts C and D which are united at or near their upper ends by the cross pieces E and F.

The ram 18 is provided at its lower end with an adjustable externally screw threaded extension 25 which screws into a bore 26 provided therefor within plunger 19. Said extension 25 is designed to advance the work as will presently be explained. In Fig. 5 the object being operated upon is a rod 27 the lower portion 28 of which is about to be subjected electrically to a forging or upsetting heat. Said rod is slidably held in place between the jaws 29 and 30 of a movable electrode 31 which is mounted upon a carriage 32 (see Fig. 3) to be by said carriage moved toward and from the stationary electrode 33. The construction and operation of these electrodes will be set forth later on.

Returning now to the hydraulic features of the invention, in addition to the pipes 15 and 22 which afford communication between the master valve 10 and the piston cylinder 17 of the ram 18, a pipe 35 which forms a continuation of pipe 15 communicates with a chamber 36 through a port 37 controlled by a valve 38 which is mechanically opened at times against the opposition of a spring 39. The amount of pressure requisite to open said valve is regulated by an externally threaded adjusting sleeve 40 through which the stem 38*a* of valve 38 slidably extends. The pressure of spring 39 must be sufficient to keep said valve closed at all times except when said valve is opened mechanically, as will be described. With said stem 38*a* is connected an operating rod 41 which, in turn, is pivoted to the short arm of a bell crank 42. Said bell crank 42 is mounted upon a fixed pivotal support 43 and the upper arm thereof is provided with a cam portion 44 with which cooperates a cam shoulder 45 formed on the lower end of the plunger 19 of the ram.

From the valve chamber 36 leads a passage 46 which communicates with another valve chamber 47 through an opening controlled by a valve 48. When said valve 48 opens it does so against the opposition of a compression spring 49 the opposition of which is regulated by a manually operable screw threaded member 50. From the valve chamber 47 a pipe 51 leads to the supply tank 7.

The pipe 15 which leads from the master valve 10 to the upper end of the ram piston cylinder 17 is provided with a branch 52 which communicates with a cylinder or chamber 53 within which is a pressure operated rod 54 which has fixed thereto a piston disc or head 55 and which is provided with a compression spring 56 which opposes the movement of the stem 54 when pressure is supplied to the chamber 53.

Referring to Fig. 7, said rod 54 is positioned to operate a spring switch arm 57*a* of a switch 57. Said arm 57*a* carries at its free end a contact 58. With said switch arm 57*a* cooperates a like spring arm 59 which carries at its free end a contact 60 arranged to cooperate with said contact 58, the latter switch arm being operated by a part carried by the ram 18. It will be seen that the contact-carrying arms of said switch 57 constitute circuit making and breaking elements which move from retracted or non-actuating positions to actuated positions, the circuit being completed only when both of said elements are in the actuated positions. A variety of devices may suggest themselves to the skilled workman, which may be substituted for the two-arm switch shown in Fig. 7, and yet such devices come within the scope of the invention as hereinafter claimed.

The lower end of the ram plunger 19 carries a laterally extending arm 61 which terminates in an operating finger 62. When the ram is in its retracted position, shown in Figs. 5 and 7, said finger 62 maintains a pendant arm 63 in the full line position shown in these views. Said arm 63 is mounted on a fixed pivot 64 and cooperates with a horizontally positioned arm 65 which is operatively related to the switch arm 59 of switch 57. The pendant arm 63 is provided with a cam surface upon which the finger 62 acts to deflect it from the dotted line position to the full line position of Fig. 7. Said arm 63 is provided with a heel portion 66 which underlies the arm 65 and said arm 65 is supported on a fixed pivot 67. Said arm 65 is provided with a downward extension 68 which operates to move downwardly the switch arm 59 when said extension 68 is moved from the dotted position to the full line position of Fig. 7. A layer of insulating material 68*b* is provided between the part 68 and the switch arm 59.

It will also be noted that the electrode 31 is provided with a spring actuated contact 31*a*, connected in circuit with the transformer

80 by the wire 31*b*. Said contact 31*a* and wire 31*b* are in turn insulated through the jaw 29, as shown in Fig. 5, and said contact 31*a* is formed to extend through the jaw 29 into the recess 141, to contact with the rod 27.

Switch 57 controls the electric circuit which operates the switch 74 controlling or supplying the forging or upsetting heat to the rod 27 or like article being operated upon. This electric circuit is supplied from the line wire 70 shown at the left side of Fig. 5. From said line wire 70 current passes through the branch wires 71 and 72, the latter wire leading to the pull-in-magnet 73 which closes the switch 74 against the opposition of the switch spring 75. From the pull-in-magnet 73 a wire 76 leads to the arm 59 of the switch 57 already described. When the switch 57 is completely closed, current passes through the conductors 70, 72, magnet 73, and conductor 76 through the switch 57 and thence through a ground wire 77 to the ground 78.

The switch 74 controls the transformer circuit which includes the primary coil 79 of the transformer 80, the secondary circuit 80*c* of which has one of its ends connected to electrode 30 and its other end to electrode 33, electrode 33 being insulated from the main part of the machine. The secondary current is controlled by means of a manually slidable armature operating within the core of the transformer serving to vary the magnetic flux within the core. The transformer circuit also includes the wires 81, 82, and 83, there being a manually operable double pole disconnect oil switch 84 for this circuit. This circuit also includes the terminals 85 between which the circuit is made and broken by the contacts 86 carried by switch 74. Said switch 74 is mounted on a fixed pivot 87, and has at one side of said pivot an arm 88 upon which the magnetic coil 73 operates and at the other side of its pivot a longer arm 89 which not only carries the spaced contacts 86 but extends beyond said contacts and is provided with a terminal finger 90 which is at times engaged by a dog 91 to hold said switch 74 in the contacting position. Said dog 91 is normally held in the position shown in Fig. 5 by means of a tension spring 92 attached to a finger 93 with which said dog is provided, but when the pull-in-magnet 73 is actuated said finger 90 moves across the bevelled tooth of said dog, whereupon the dog returns to its normal position wherein it retains switch 74 in the contacting position.

At times the dog 91 is operated to allow the spring 75 to open switch 74. For this purpose a dog-operating magnetic coil 95 is provided, said coil 95 having one end supplied by the wire 71 and the other end connected with a wire 96 which leads to a switch 97 shown in detail in Fig. 8, said switch 97 being normally open, but at times is closed by the short arm 98 of a bell crank lever 99 mounted on a fixed pivot 100. Said bell crank lever 99 is operated by a rod 101 on which is adjustably mounted a collar 102 changeably positioned by set screw 103. Said collar 102 is at times acted upon by reason of the arm 61 of the ram 19 coming in contact therewith, thus forcing the bell crank 99 to the position shown in dotted lines in Fig. 8 causing its arm 98 to close switch 97. The lower end of arm 98 is provided with a bevelled tooth 98*a* the function of which will later be described.

The coordinate operation of the various parts which have thus far been described is secured by the operation, both manual and automatic, of the master control valve 10 together with its foot operable rod 10*a* and its automatically operable rod 10*b*, these rods being pivotally secured to each other at 10*c* at which point is also attached a link 10*d* which is connected with the outer end of the valve operating arm 10*e*. The operating rod 10*b* has permanently fixed to it an upper collar 104, which cooperates with the ram arm 61, and also a lower collar 105 is secured to said rod, the latter collar cooperating with the beveled tooth 98*a* already mentioned as being a part of the dog or latch 99. A weight 106 is fixed to the upper end of this rod. To the lower end of the foot operable rod 10*a* is pivotally connected a foot lever 10*f* pivoted between its ends at 10*h* and having a treadle portion 10*i*. The master valve 10, as well shown in Figs. 9, 10 and 11, is provided internally with an adjustable valve proper or rotor 10*k* to which the valve arm 10*a* is fixed in order to adjust said member 10*k* to the various positions shown. This feature of the apparatus will readily be understood when the operation, is later on, described in detail.

An independent auxiliary hydraulic control system is illustrated in Fig. 6, this part of the apparatus being omitted from Fig. 5 to avoid crowding too much illustration into one view. In Fig. 6 the lower portion of the plunger 19 of the ram is shown in full lines in an advancing position wherein it is carrying with it a plunger rod 110 by reason of said rod 110 having an arm 111 by which it is secured to said plunger 19. As said rod 110 advances its plunger portion 115 moves farther into a plunger cylinder 116 which through pipes 117 and 118 delivers fluid pressure to the twin auxiliary plunger cylinders 119 and 120. Said auxiliary plunger cylinders 119 and 120 are respectively provided with the plunger 121 and 122 to each of which is fixed a yoke or carriage 32, the electrode 31 being mounted upon this carriage.

The same pressure which is at times supplied from the master valve through pipe 22 to move the ram to a retracted position, also supplies pressure through a branch pipe 125 to a plunger cylinder 126 within which

is a plunger 127. Said plunger 127 is diagrammatically shown in its general relation to the other parts in the left hand portion of Fig. 5, but the part of the apparatus with which it is operatively connected, is shown in detail in Fig. 4. Said plunger 127 does its work by means of an arm or reduced extension 128 which is positioned to act against the end of a link 129 adjacent its pivotal connection with the lower end of a pendant arm 130 fixed to a rock shaft 131. Said rock shaft 131 is mounted upon the fixed bearings 132 and has fixed to one of its ends a manually operable lever 133. At the inner end of rock shaft 131 opposite to the end thereof to which arm 130 is secured, a companion arm 135 is secured, and this arm is pivotally connected with one end of a link 136 which is a companion to the link 129 already mentioned. Said link 129 has its inner end pivotally connected to an inner link 137 at one end of said inner link, the other end of said inner link being pivotally connected with the jaw 30 of the adjustable electrode 31. Said link 136 has its inner end pivotally connected with one end of an inner link 138, the other end of said inner link being pivotally connected with the other electrode jaw 29.

Said electrode jaws 29 and 30 are mounted upon the pivots 140, each of said jaws being pivotally supported near one end, and near its other end being provided with a recess 141 to aid in gripping the rod or like article being operated upon.

Referring in further detail to the construction shown in Fig. 4 the pivotal connections between the inner links 137 and 138 and the links which operate them are made by means of pivot pins 142, and these pivot pins 142 each carry also an anti-friction roller 143, there being provided at each side of the device a guide member 144 having a track 145 on which said guide roller 143 travels.

The independent hydraulic control for the purpose of increasing the space between the electrodes proportionately as the work advances will now be described. Referring more particularly to Fig. 6, rod 10*b* is attached to the lower portion of ram 18, the lower end of said rod forming the plunger 115 operating in the cylinder 116. As this rod descends it displaces the oil from cylinder 116 into the two auxiliary cylinders 119 and 120 to raise their plungers 121 and 122 to which are firmly attached the carriage 32, which in turn supports the electrodes 31. Varying the sizes of plunger 115 changes the ratio of the two movements, thus causing the predetermined ratio of enlarged upsetting space between the two electrodes with respect to the amount of rod or other work upset.

In order to cause the carriage 32 to move at a greater or less relative speed as compared with the speed of the ram plunger 19, it is necessary to replace the plunger rod 115 with a larger or smaller rod and also to exchange the cylinder cap 116*a* of the cylinder 116 for a cap adapted to fit the different sized plunger rod used. In Fig. 6 110*a* designates a fragment of a larger plunger rod which might be substituted for the plunger rod 110.

Preliminary to the performance of the cycle of operations hereinafter described, the supply valve 149 from the oil tank 150 of Fig. 6 is opened until the proper amount of oil is supplied to the cylinder 116 of the main plunger, the oil being caused to flow due to independent air pressure being supplied to the tank 150 from line 155 through valve 152 and line 153. The increase in supply of oil will cause plungers 121 and 122 to raise carrying the carriage 32 to any desired starting position. Valve 149 will then be closed in order to confine the proper amount of oil in the independent system. When motion of carriage 32 is desired in reverse or lowered position, valve 152 is turned to exhaust position shutting supply line 155 and venting tank 150 through line 153 and 154. Then when valve 149 is opened oil from the cylinders 119 and 120 will be caused to flow back into the tank 150 due to the weight of the plungers and carriage 32 and when carriage 32 reaches the desired position valve 149 is closed.

Operation: Assuming the position of the parts to be that shown in Fig. 5 wherein the ram 18 is in the fully retracted position, the master or control valve 10 is in its neutral position as shown in full lines in Fig. 5 and as shown diagrammatically in Fig. 9 and the various hydraulic controls are such that a substantially equal pressure is supplied to each side of the piston head 20 of the hydraulic ram; also the various valves and switches and hydraulically and mechanically operated pressure control devices will be in the full line positions of Fig. 5, and the jaws of the contact 31 through which the work slides are in the open position. The cycle of operations is as follows:

The rod or like piece of work 27 is placed between the jaws of the combined guide and contact and said jaws are closed against the work by manually operating lever 133 (see Figs. 3 and 4) thus closing thereupon with sufficient tightness to hold it in place while at the same time permitting a sliding movement of the work with relation to said guide, the rod being at such time positioned with its lower end portion 28 as seen in Fig. 5 in contact with the abutment or fixed electrode 33. The foot lever 10*f* is next fully depressed thus raising the upright valve rod 10*b* to its uppermost position wherein it is releasably maintained by reason of the collar 105 engaging the tooth 98*a* (Fig. 8) of the spring controlled dog 99. This adjusts the master valve 10 to the position shown in Fig. 10, which permits an unimpeded flow of oil from pump 5 to the top of the piston

head of the ram 18. At the same time the liquid pressure passes through the mechanically controlled valve 37 which is open at this time. From said valve, pressure is conveyed to the adjustable relief valve 48 which is set to open at a pressure just sufficient to cause the ram to force the work to upset when the upset portion is at forging temperature. This setting of relief valve 48 must also be at a sufficiently low pressure to safeguard against buckling of the unsupported portion of the cold rod.

The pressure determined by the adjustment of said pressure relief valve 48 is also sufficient to operate the pressure switch plunger 55 against the opposition of its spring, thus causing said plunger to complete the closing of the already half closed mechanically operated switch 57. The closing of said switch 57 energizes the pull-in-magnet 73 thus operating switch 74 and closing the circuit which supplies the forging heat. Said switch 74 is maintained releasably in its closed position, by the dog 91 which cooperates therewith.

The operation of said switch 74 closes the primary circuit of the low voltage heating transformer 80. The heat current which passes through said transformer is regulated by a sliding shunt armature operating within the core of said transformer 80.

When the current is supplied as just stated, the portion of the work between the stationary electrode 33 and the guiding electrode 31 becomes heated to a forging temperature, allowing the ram 18, under the propelling hydraulic pressure supplied thereto as has been stated, to advance said rod, after opposition to the ram is lessened by the upset taking place under the action of the forging heat supplied.

While said ram is thus advancing owing to the fact that opposition thereto has been lessened by the heating of the metal to an upsetting temperature, the independent hydraulic system shown in Fig. 6 is actuated, thus supplying hydraulic pressure from the main cylinder 116 to the auxiliary cylinders 119 and 120 causing the plungers of the latter cylinders to move at a preadjusted rate in the reverse direction to the movement of the ram at this time, thereby progressively increasing the space between the fixed and movable electrodes to accommodate the increase in size of the upset portion of the metal. The volume and shape of the metal upset may be extended to the limits of the requirements of the art.

Furthermore when the rod 27 is placed between the jaws of the electrode holder 31, as shown in Fig. 5, the electric circuit will be permitted to pass from the transformer 80 through the wire 31*b* and 31*c* when the jaws 29 and 30 are closed, thus directing the current through the upsetting portion 28 and electrode 33 respectively, said jaws 29 and 30 and extension 25 being insulated from said electric circuit in the customary manner.

The ram advances under sufficient hydraulic pressure to perform the upsetting work, but not under a pressure so great as to buckle the cold portion of the rod. After the ram has thus advanced a short distance it disengages the surface of its cam shoulder 45 from the bell crank 42 which operates the mechanically operated valve 38, thus permitting said valve to close, thus causing the entire hydraulic supply to act upon the ram thereby imparting a constant speed of advance thereto, such advance speed being regulated by the adjustments 5*a* varying the output of the pump 5. This initial advance movement of the ram also carries down with it the arm 61 carried by the ram together with the operating finger 62 with which said arm terminates, said finger 62 releasing the pendant lever 63 which, in turn, releases the horizontal lever 65. The heel portion of the latter lever allows the upper spring arm of the switch 57 shown in Fig. 7 to spring out of contact or into the dotted position shown. This breaks the circuit which energizes the pull-in-magnet of the magnetic switch 74, but said switch is nevertheless still retained in its closed position by the dog 91. This cutting off of the current from the pull-in-magnet coil 73 prepares the switch 74 for being released when, as will later be described, its dog is withdrawn therefrom.

After the ram 18 is started it proceeds at a uniform speed under the impulse of the entire volume of liquid flow from the pump 5, the amount of the flow having been previously adjusted by the means 5*a* provided for regulating the output of the pump. This part of the operation will be properly performed by the apparatus as soon as sufficient test has been made to determine the rate at which the rod should be advanced and the various adjustments have been made accurately. For the same size rod or other work the adjustments when once determined would be worked out on a chart making the experiment unnecessary when similar work was repeated.

In order to set the machine for the desired length of rod to be upset, the collar 102 on the short upright rod 101 is so positioned as to be engaged by the ram arm 61 at the proper time for releasing the dog 99, thus allowing the upright valve rod 10*b* to fall by gravity to the lowest position thereof. This causes the master valve 10 to take the position shown diagrammatically in Fig. 11.

Releasing of the dog 99 causes the switch 97 to contact and thereby close the circuit of the dog release coil 95 of the magnetic switch 74 thereby releasing said magnetic switch and allowing it to come to its open position under the action of spring 75. The opening of this switch breaks the primary circuit of

the heating transformer 80, thus breaking the heating circuit through the work while there is still a full contact between the work and its electrodes. This insures that there will be no electric arcing produced when the ram begins its return movement. This position of master valve 10 (see Fig. 11) reverses the liquid flow to the ram causing the pressure to be applied to the lower side of the piston head thereof, thus moving said ram back to the retracted position. The same pressure which moves the ram back to its retracted position also operates the hydraulic plunger 127 which is thereby projected against the lower end of the pendant arms 130 which is fixed to the manual control lever shaft 131, (see Figs. 3 and 4) and therefore rocks said shaft. The rocking of said shaft moves the manually operable lever 133 back to its initial position opening the jaws of the work-holding electrodes. As the ram approaches its retracted position it engages the fixed collar 104 on the upright rod 107 thus bringing said rod back to its neutral position and also bringing the master valve to the neutral position as shown in Fig. 9.

I claim:

1. In an apparatus for expanding the cross-sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, an abutment positioned to be engaged by the end of said rod to form an upset thereon, said abutment being in spaced relation to said guiding means, means to electrically supply a forging temperature to the portion of said rod between said guiding means and said abutment, means to supply hydraulic pressure to said ram to advance it, a relief valve to limit the hydraulic pressure supplied to said ram during the initial portion of its advance movement, and means operated by the continued advance movement of said ram to automatically disconnect said relief valve from the hydraulic means in order that the full volume thereof may be supplied to the ram after the initial portion of its movement.

2. In an apparatus for expanding the cross-sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, an abutment positioned to be engaged by the end of said rod to form an upset thereon, said abutment being in spaced relation to said guiding means, means to electrically supply a forging temperature to the portion of said rod between said guiding means and said abutment, means to supply hydraulic pressure to said ram to advance it, means to limit the hydraulic pressure supplied to said ram during the initial portion of its advance movement adapted to increase the amount of hydraulic pressure supplied to said ram during farther advance movement thereof.

3. In an apparatus for expanding the cross sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means to heat to an upsetting temperature the portion of said rod to be upset, means stationed in the path of said rod to form an upset thereupon during the advance thereof by said ram, a system of piping to supply hydraulic pressure to said ram to advance and retract it, a hydraulic pressure supply for said piping to operate said ram, a master valve to control the flow of liquid through said piping to said ram to direct the movements of the latter, and means to control the speed of advance of said ram to suit the degree of heat supplied to said rod, said control means comprising a pressure relief valve in communication with the liquid supply to said ram to limit the amount of pressure supplied to said ram during its initial advance movement and means operated automatically by the advance movement of the ram to close the communication between said pressure relief valve and liquid supply to said ram.

4. In an apparatus for expanding the cross sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means stationed in the path of said rod to form an upet thereupon during the advance thereof by said ram, a hydraulic supply system to operate said ram, means operated by the advance of said ram automatically to supply pressure from said hydraulic system to the lower side of the piston of said ram as required to retract it, an electric circuit comprising a switch and conductors to supply electrically an upsetting temperature to the portion of said rod to be upset, means operated by the hydraulic pressure which advances the ram to close said switch, and means operated automatically by the final portion of the advance movement of said ram to open said switch.

5. In an apparatus for expanding the cross sectional area of rods and the like, in combination, a ram to advance the rod to be upset, said ram having a piston head, a piston chamber for said piston head, a motor driven pump, piping to supply liquid from said pump to said ram to operate the latter, a master valve to control the flow of liquid from said pump to said ram, a control rod operatively connected with said master valve, means manually to initially position said control rod and master valve to open communication through said piping between said pump and ram to impart an initial advance movement to the latter, latching means releasably to maintain said control rod in said initial position against the action of gravity,

and means actuated by the advance of said ram a predetermined distance to release said latching means thereby causing said control rod to gravitate to a lower position thus moving said master valve to a position wherein it directs the liquid flow to the opposite side of the piston head of the ram thus imparting a reverse movement to said ram.

6. In an apparatus for expanding the cross sectional area of rods and the like, in combination, a ram to advance the rod to be upset, said ram having a piston head, a piston chamber for said piston head, a tank, a pipe connecting the portion of said piston chamber on the outer side of said piston head with said tank, a pressure relief valve to control the flow through said pipe, a pump, a master valve, piping connecting said tank with said pump, connecting said pump with said master valve and said master valve with said piston chamber on both sides of said piston head, and automatic control devices in the path of travel of said ram to operate said master valve automatically to retract said ram and, at times, to cut off communication between said pressure relief valve and the portion of the piston chamber beyond said piston head in order that constant volume of liquid be supplied at such times to the outer side of said piston head.

7. In an apparatus for expanding the cross sectional area of rods and the like, in combination, a ram to advance the rod to be upset, said ram having a piston head, a piston chamber for said piston head, a tank, a pipe connecting the portion of said piston chamber on the outer side of said piston head with said tank, a pressure relief valve to control the flow through said pipe, a pump, a master valve, piping connecting said pump with said tank with said master valve and said master valve with said piston chamber on both sides of said piston head, and automatic control devices in the path of travel of said ram to operate said master valve automatically to retract said ram and, at times, to cut off communication between said pressure relief valve and the portion of the piston chamber beyond said piston head in order that constant volume of liquid be supplied at such times to the outer side of said piston head, said automatic control devices being operable by the final portion of the retractive movement of said ram to position said master valve to cause the inflow and outflow of said pump to circulate only through said tank.

8. In an apparatus for expanding the cross sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means stationed in the path of said rod to form an upset thereupon during the advance thereof by said ram, a hydraulic supply system automaticaly controlled by the advance of said ram to supply pressure to opposite sides of the piston of said ram as required to advance and retract it, an electric circuit comprising a switch and conductors to supply electrically an upsetting temperature to the portion of said rod to be upset, means operated by the hydraulic pressure which advances the ram to close said switch, a spring tending to open said switch, a dog to hold said switch closed against the opposition of its said spring, and means operated automatically by the final portion of the advance movement of said ram to withdraw said dog from said switch to permit the latter to be opened by its said spring.

9. In an apparatus for expanding the cross sectional area of rods and the like, guiding means, a ram to advance a rod longitudinally under the guidance of said guiding means, means in the path of said rod to form an upset thereupon during the advance thereof by said ram, a piston chamber for said piston head, a hydraulic system to supply pressure to the opposite sides of said piston head to advance and retract it, a master valve to control the flow of liquid through said hydraulic system, means in the path of movement of said ram to operate said valve to reverse the movement of said ram after it has been advanced to a predetermined distance, electric circuit means comprising a switch and conductors to supply electrically an upsetting temperature to the portion of said rod to be upset, a spring tending to hold said switch open, an auxiliary electric circuit comprising conductors and an auxiliary electric switch, means in the path of said ram to hold one arm of said auxiliary electric switch in the closed position for such arm, when said ram is fully retracted, a pressure device operable by the initial hydraulic pressure supplied to said ram to begin the advance thereof to move the other arm of said auxiliary switch into contact with the first mentioned arm thereof to complete the auxiliary circuit through said auxiliary switch, a pull-in-magnet to close the first mentioned switch to supply the upsetting temperature to the rod, a dog to hold said first mentioned switch closed until the upsetting operation is completed, and means operable by said ram as it nears the limit of its advancing movement to release said dog to permit said first mentioned switch to be opened by its said spring.

10. In an apparatus for expanding the cross-sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means to supply hydraulic pressure to said ram to advance and retract it, an abutment positioned to be engaged by the end of said rod to form an upset thereon, said abutment being in spaced relation to said guiding means, a transformer circuit to electrically supply a forging temperature to the portion of said rod

between said guiding means and said abutment, a transformer circuit having a switch to control the same, said switch tending to assume an open position, a pull-in-magnet which when energized closes said switch, a catch to engage said switch and hold it closed after it is closed by said magnet, means to electrically energize said magnet, said means being controlled by the hydraulic pressure which operates said ram and being timed to energize said magnet to close said switch when the ram has advanced the work to the forging position, and an electrically operated device which is controlled by the hydraulic pressure that operates said ram, said device being thereby caused to release said catch to cut off the forging current when the work has been advanced by said ram toward said abutment to the predetermined limit.

11. In an apparatus for expanding the cross sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means to heat to an upsetting temperature the portion of said rod to be upset, means stationed in the path of said rod to form an upset thereupon during the advance thereof by said ram, a system of piping to supply hydraulic pressure to said ram to advance and retract it, a hydraulic pressure supply for said piping to operate said ram, a master valve to control the flow of liquid through said piping to said ram to direct the movements of the latter, and means operable by said ram when it advances to a predetermined point to move said valve to a position wherein it cuts off the supply of liquid to said ram and thereby stops the advance thereof.

12. In an apparatus for expanding the cross sectional area of rods and the like, in combination, a ram to advance the rod to be upset, said ram having a piston head, a piston chamber for said piston head, a liquid pressure supply, piping to supply liquid from said supply to said ram to operate the latter, a master valve to control the flow of liquid from said supply to said ram, operating means tending to operate said master valve, a latch normally restraining said valve operating means from action, and means actuated by the advance of said ram a predetermined distance to release said latching means and thereby cause said valve operating means to move to a position wherein it directs the liquid flow to the opposite side of the piston head of the ram thus imparting a reverse movement to said ram.

13. In an apparatus for expanding the cross-sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means to supply hydraulic pressure to said ram to advance and retract it, an abutment positioned to be engaged by the end of said rod to form an upset thereon, said abutment being in spaced relation to said guiding means, a transformer circuit to electrically supply a forging temperature to the portion of said rod between said guiding means and said abutment, a control switch to control the current through said transformer circuit, said switch tending to assume an open position, a pull-in magnet which when energized closes said switch, a two-arm switch the arms of which tend to spring apart from each other to open the switch, conductors connecting said two-arm switch with said pull-in magnet, said two-arm switch being closed only when both arms thereof are moved to a retracted position, means operated by said ram to maintain one of said arms in the retracted position while said ram is in the retracted portion of its travel and to cause said arm to move to the open or non-retracted position when said ram has advanced a predetermined distance, and means operable by the hydraulic pressure which actuates said ram to move the other arm of said two-arm switch to the retracted position whenever sufficient hydraulic pressure is supplied to said ram to cause the advance thereof.

14. In an apparatus for expanding the cross-sectional area of rods and the like, guiding means, a ram to progressively advance a rod longitudinally under the guidance of said guiding means, means to supply hydraulic pressure to said ram to advance and retract it, an abutment positioned to be engaged by the end of said rod to form an upset thereon, said abutment being in spaced relation to said guiding means, a transformer circuit to electrically supply a forging temperature to the portion of said rod between said guiding means and said abutment, a control switch to control the current through said transformer circuit, said switch tending to assume an open position, a pull-in magnet which when energized closes said switch, a switch provided with two operating elements both of which must be actuated to close the switch, means operated by said ram to maintain one of said elements in non-actuated condition while said ram is in the retracted portion of its travel and to cause said element to assume the actuated position after said ram has begun its advance, and means operable by the hydraulic pressure which actuates said ram to actuate the other switch-operating element whenever sufficient hydraulic pressure is supplied to said ram to cause the advance thereof against a predetermined resistance.

In testimony whereof I affix my signature.

LEM P. DRAKE.