June 5, 1934. W. H. SPIRE 1,961,256

ELECTRIC METAL GATHERING MACHINE

Filed Oct. 1, 1931 3 Sheets-Sheet 1

Fig-1

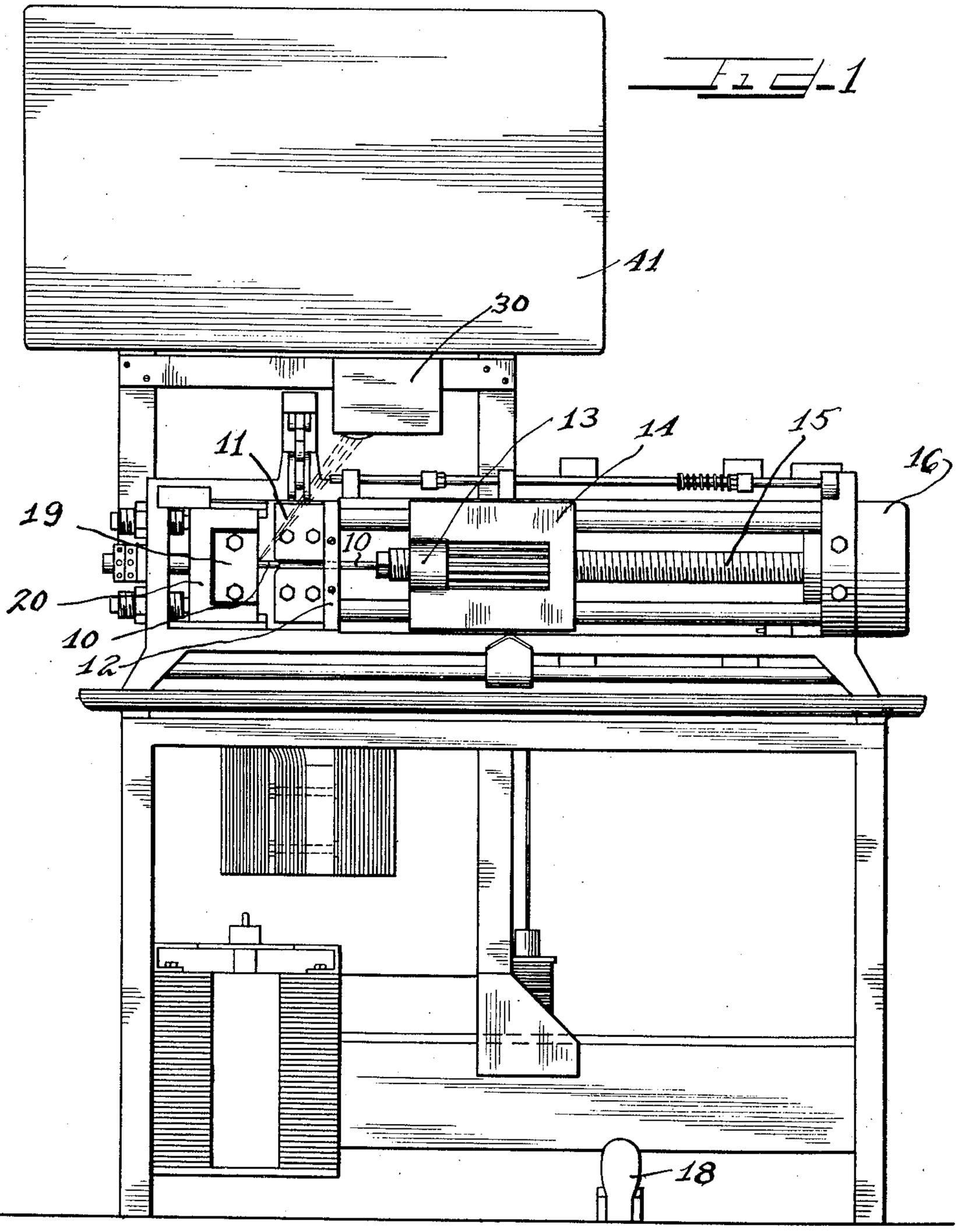

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Fig. 2

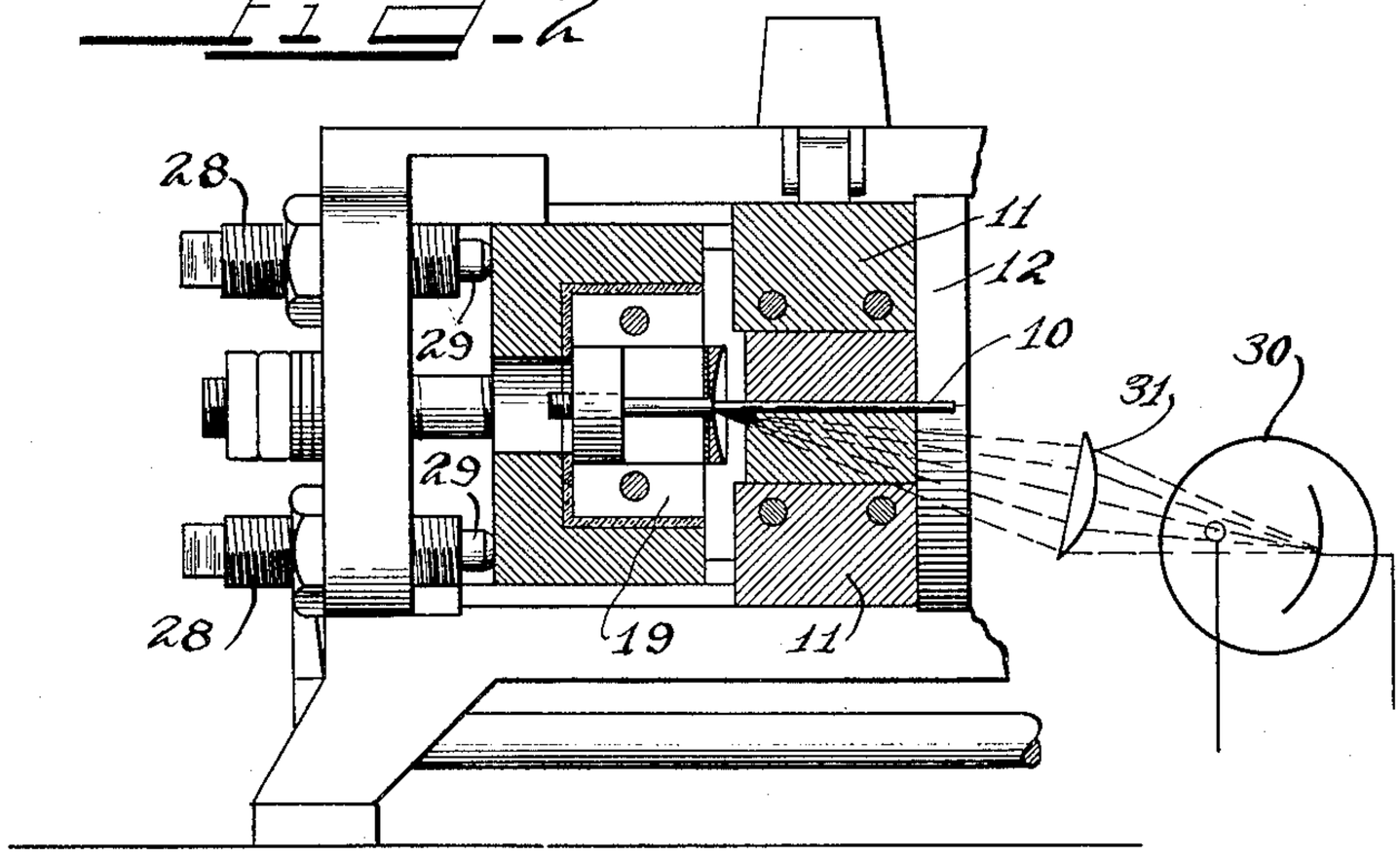
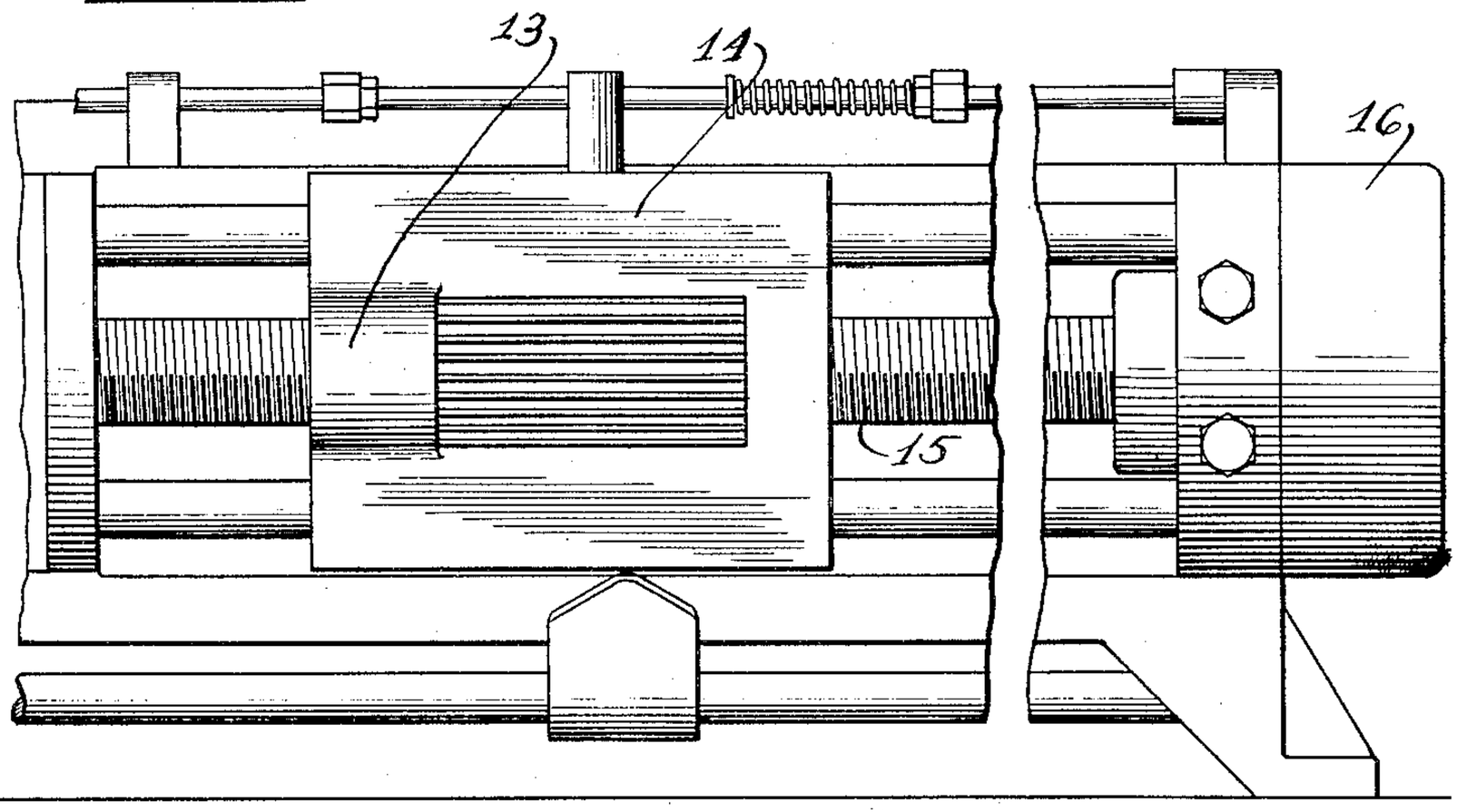


Fig. 3



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ELECTRIC METAL GATHERING MACHINE

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Fig. 4

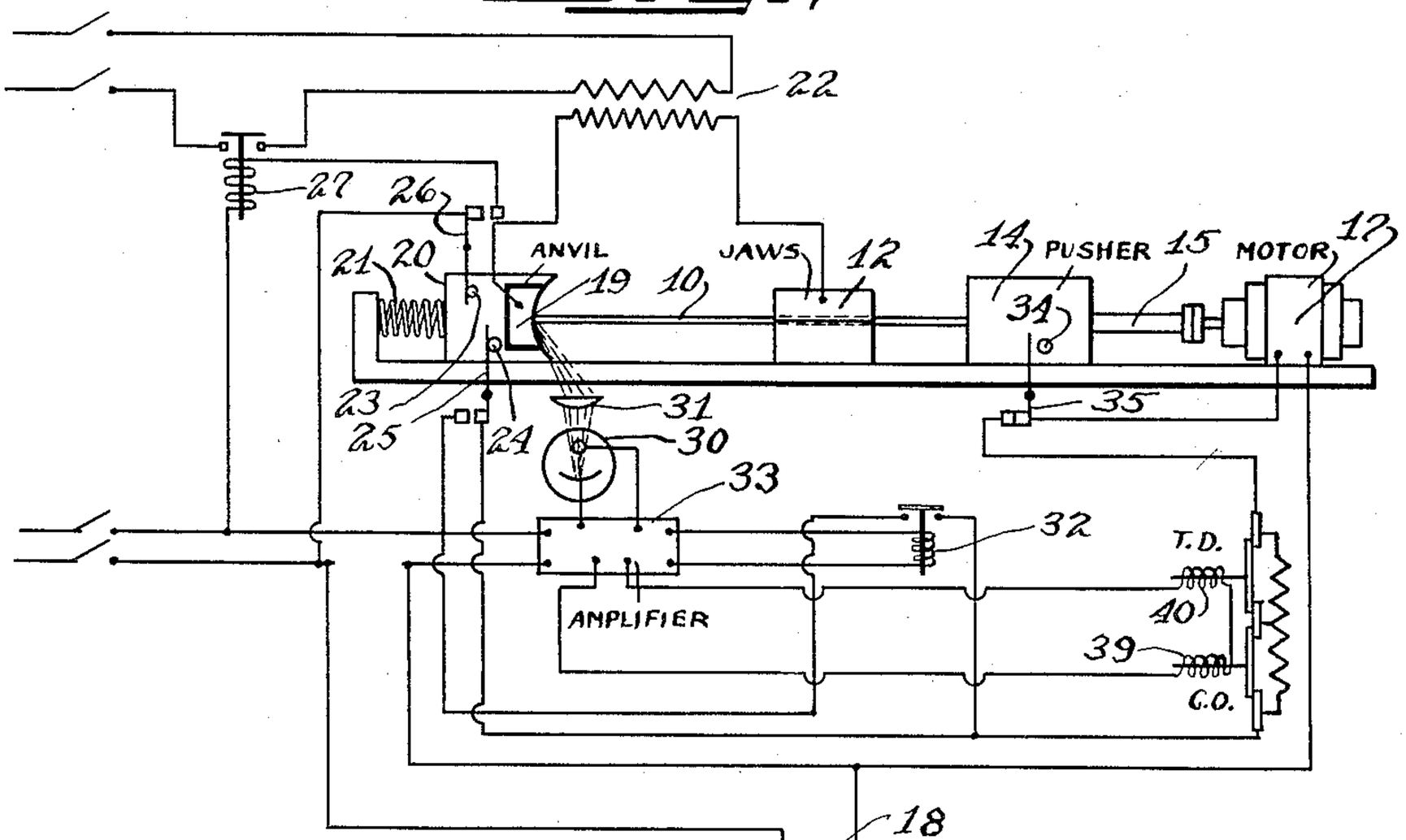
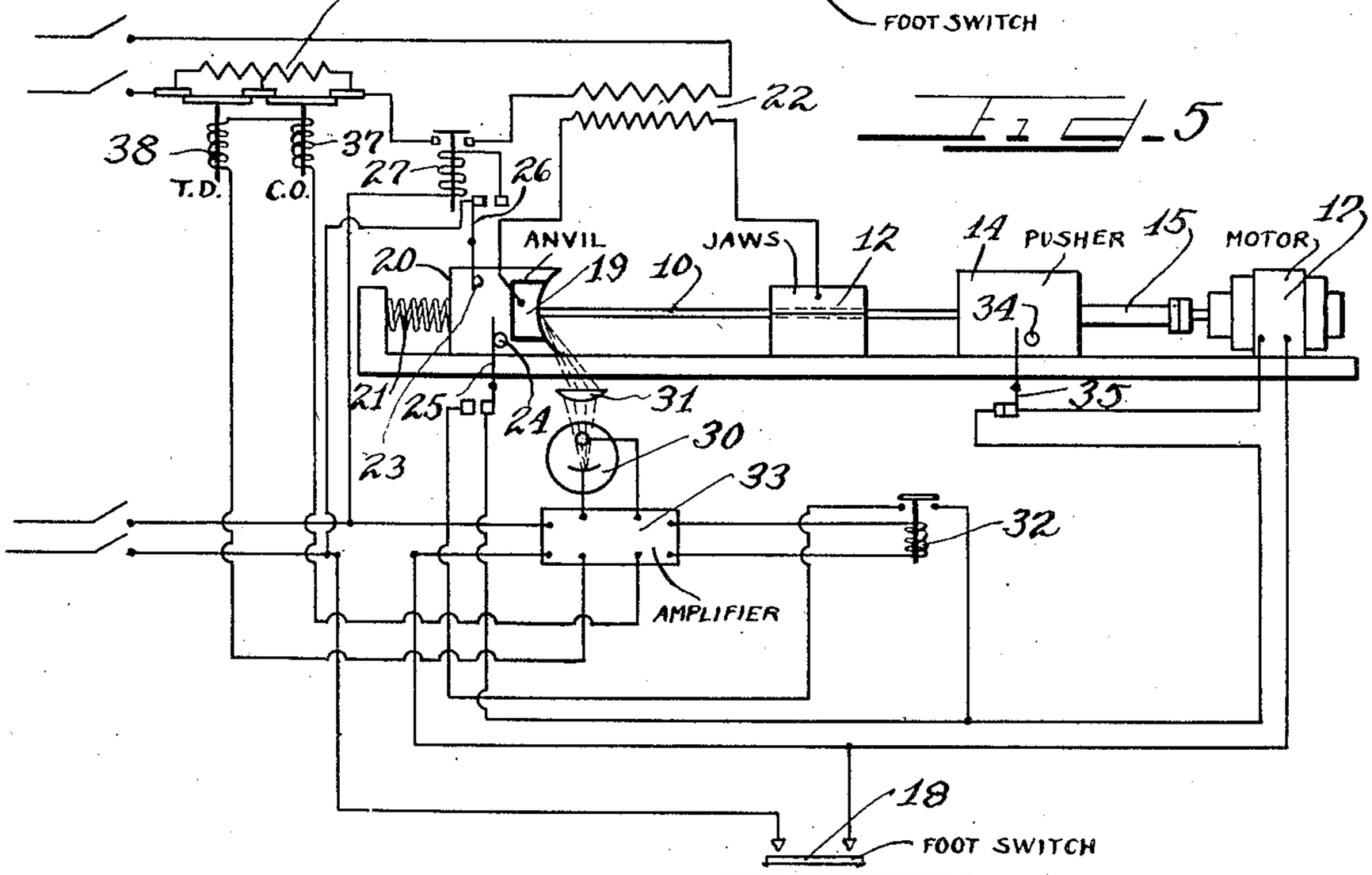


Fig. 5



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Patented June 5, 1934 1,961,256

UNITED STATES PATENT OFFICE

1,961,256

ELECTRIC METAL GATHERING MACHINE

William H. Spire, Cleveland, Ohio, assignor to Thompson Products, Incorporated, Cleveland, Ohio, a corporation of Ohio

Application October 1, 1931, Serial No. 566,205

20 Claims. (Cl. 219—3)

This invention relates to an improved apparatus for electrically upsetting the ends of rods such as, for instance, to produce the heads of poppet valves for internal combustion engines.

This invention relates to an improvement of the Electric metal gathering machine described in my application for patent Serial No. 234,159, filed on November 18th, 1927.

It is an object of this invention to provide an automatic machine in which, after the rod is initially placed in contact with an abutment electrode, or anvil, to be heated by current flowing through the rod and the anvil, means for forcing the rod against the anvil to upset the end of the rod do not become operative until the end of the rod has reached a predetermined temperature, and become operative when the end of the rod has reached the desired temperature.

It is of great practical importance that the rod pushing means become operative immediately upon the end of the rod being raised to the proper temperature to prevent burning and spawling of the rod, undue heating of the anvil electrode, an undue waste of electrical energy, and loss of productive time of the machine.

On the other hand, it is also of great practical importance that the rod pushing means be held inoperative until the end of the rod reaches the desired working temperature to prevent bending of the rod and the waste of expensive rod material caused thereby.

It is a further object of my invention to so coordinate the temperature of the end of the rod and the pushing effort applied to the rod during the upsetting process that the shaped end will be free from corrugations or folds, and also free from such an internal structure condition and lack of homogenity that is the result of the metal being fed into the upset portion at an improper rate.

It will be evident that if the metal is fed into the upset portion too slowly then that portion of the rod becomes unduly hot, while if it is fed too fast the cold metal entering the "gather" reduces the temperature thereof unduly, and causes unduly high compressive forces that produce lateral spreading of the metal, and a misshapen head. In coordinating the pushing effort with the temperature of the upset portion I have produced an improved product, and have increased the production of the machine, while practically eliminating waste.

Other and further important objects of this invention will be apparent from the disclosures in the drawings and specification.

This invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a front elevation, from the operator's position, of a machine embodying the features of this invention.

Figure 2 is an enlarged sectional view, with parts in elevation, of a portion of the machine shown in Figure 1.

Figure 3 is an enlarged elevational view, with parts broken, of another portion of the machine of Figure 1.

Figure 4 is a diagrammatic view of the machine shown in Figure 1, including the wiring diagram of the control means.

Figure 5 is a diagrammatic view substantially similar to that of Figure 4, but including the wiring of additional control means.

As shown on the drawings:

Figure 1 is a front elevation of an electric metal gathering machine described in my copending application for patent Serial No. 234,159, filed on November 18th, 1927, as seen from the operator's position. The machine shown is adapted to upset one end of a short rod to form a ball or knob of metal which is subsequently forged in a heading machine to form the valve head of a poppet valve for internal combustion engines.

A metal rod 10 is placed between the jaws 11 of a guiding clamp electrode 12, and one end of the rod 10 is engaged by a boss 13 on a pusher block 14. The boss 13 is shaped to receive the end of the rod and push it in aligned relation through the guiding electrode 12. The pusher block 14 is moved by a screw 15 which is suitably driven by gearing 16 connected to an electric motor 17.

After the rod 10 has been placed in position the motor 17 is energized by the closing of a foot switch 18 thereby pushing the rod 10 through the electrode 12 against an anvil electrode 19. The anvil electrode is suitably arranged in, and insulated from, a housing 20, which housing is arranged for limited movement rearwardly against resilient means, such as a spring 21.

Rearward movement of the housing 20 causes a stop 24 thereon to open a switch 25 in the motor circuit, thereby stopping the motor, and at the same instant a stop 23 on the housing 20 closes a switch 26 to operate a relay 27 to energize the heating transformer 22.

It will be obvious that the particular switch and stop means shown are employed for the sake

of simplicity of description, and that other switch means may be variously connected to the machine to stop the motor and close the heating circuit when the rod abuts the anvil.

The spring means 21 are suitably housed in casings 28, best shown in Figure 2, and impel movable plungers 29 therein against the anvil housing 20.

So far, I have described the initial operation of bringing the rod into firm contact with the spring-pressed anvil, stopping the pushing motor, and causing a heating current to flow through the rod. When the end of the rod becomes heated and softened, the next obvious step is to start the motor again and push the rod to form an upset ball or knob of metal on the heated end. Should the operator, in a manually operated machine, start the motor before the heated end of the rod is of the proper temperature and condition, the metal at the heated end will not flow readily and the rod becomes bent and becomes waste material. On the other hand, undue delay in starting the push results in the end of the rod becoming unduly hot, with burning and spawling of the metal, and too rapid spreading of the metal when the rod is pushed so that the upset portion is of an improper shape, and of burned metal, and again we have a useless product. It will be obvious also that the anvil is overheated and its life shortened.

The whole operation of placing the rod, upsetting the end, and discharging it to the heading machine takes but a few seconds, so it will be clear that nothing short of unusual skill on the part of the operator is essential to avoid waste and loss of productive time of the machine.

To insure a uniformly good product of the machine, and practically eliminate the human skill factor in the upsetting operation, I have devised the means best shown in Figure 4.

A photo-electric cell 30, of a conventional type, is so positioned with respect to the heated end that the heat and light rays from the end enter the cell through a lens 31, such as is usually employed in connection with such cells. The responsivity of the cell to heat and light rays is so adjusted that upon the proper upsetting temperature being reached, the cell 30 energizes a relay switch 32 to energize the motor, thereby resuming the pushing operation. The cell is suitably connected to a source of energy and to the switch 32 through a conventional type of amplifier 33. Such amplifiers usually employ a grid-glow tube or other thermionic tubes in the amplifying circuits.

When a predetermined amount of the rod has been fed into the upset portion, the motor circuit is interrupted, as for instance, by a stop 34 on the pusher block 14 engaging and opening a switch 35. Then the motor is reversed by suitable means, not shown, and the rod is removed from the machine.

It will be obvious that the regulation of the heating and motor supply circuits, and variations in the make-up of the rod used will affect the performance of the machine during the upsetting operation. If metal is not fed into the upset at the proper rate the upset portion may become unduly hot, with burning and spawling, and, on the other hand, if the rod is fed faster than it ought to be fed the upset portion becomes chilled and receives improper mechanical treatment.

The temperature of the metal, and the mechanical treatment due to the pushing of the metal against the anvil and into the upset portion must be nicely regulated to produce a desirable product.

In Figure 5, I have shown means for coordinating the temperature of the upset with the rate of feeding of fresh metal by controlling the rate of energy supply to the upset. A resistor 36 is inserted in the primary of the transformer 22, and this resistor is controlled by relay switches 37 and 38. It will be obvious that as the temperature of the upset portion increases the current passed through the cell 30 will also increase, and the cell 30 is suitably connected through the amplifier 33 to relay 37 so that the current therethrough increases. When the current reaches a predetermined value in relay 37 the relay opens its switch, thereby inserting resistance in the primary of the transformer 22. Relay 37 has been identified with the letters C. O., the conventional symbols applied to current overload relays. Relay switch 38 is in series with relay 37, and is of the current-overland definite-time-delay type, so that should the temperature of the upset portion remain abnormally high over a predetermined period of time, then it operates to open its switch and insert resistance. Relay 38 has been identified with the letters T. D., the conventional symbols applied to time-delay relays.

It will be understood that the means shown for controlling the temperature of the upset by varying the resistance of the transformer primary have been adopted for ease and clearness of description. Other means will readily suggest themselves, such as an induction regulator in the primary circuit, with relay means to control the motor of the rotor of the regulator.

In Figure 4, I have shown other means of coordinating the temperature of the upset portion with the rate of feeding of fresh metal. Relay switches 39 and 40, equivalent to relays 37 and 38, respectively, insert resistance in the motor circuit to control the speed of the motor. Relay switch 39 is arranged to insert resistance after a predetermined temperature of the upset portion has been exceeded, as indicated by an abnormal current passing through the amplifier connected to the cell and the relay 39, and relay switch 40 becomes operative to open its switch and insert resistance in the motor circuit should the cell current remain abnormal for a predetermined period of time.

It is usually a simpler matter to coordinate the temperature of the upset portion with the rate of feeding the rod by regulating the voltage of the heating transformer.

The photo-electric cell 30 may be variously placed in the path of the light and heat rays from the upset portion, and may be placed above the machine, as shown in Figure 1, adjacent a cabinet 41 which houses the main supply switches, and the amplifier and the several relays.

It will be understood that a similar operative combination may be obtained where other rod-pushing means are employed.

While I have described an electric metal gathering machine for upsetting one end of a rod as a step in the manufacture of poppet valves, it will be understood that my invention is applicable in butt-welding, forming bolt and rivet heads, riveting, and analogous operations, and that I do not intend to limit my invention to the gathering machine described.

While it is generally said that the conventional type of photo-electric cell is responsive to light rays, it nevertheless is true that it is a device

responsive to the temperature of a hot body through its being responsive to energy at many different frequencies emitted by the body.

It is conceivable that a tube of the grid-glow type may be substituted for the photo-electric cell, making use of energy emitted by the upset end of the rod, within a certain range of frequencies, to cause a change in the electrostatic field about an external plate connected to the grid of the tube. However, I would again have a device responsive to the temperature of the heated end. Filters may be placed in the path of the emitted rays in a manner well-known in the electronic tube art to limit the responsivity of the photo-electric cell, or the grid-glow tube to emitted rays within a definite band of frequencies, and thus "sharpen" the responsivity of the tube to those frequencies.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim:

1. In combination, an abutment electrode member, means for sending current through a metal rod and said abutment member to heat the end of the rod when it is in contact with said abutment member, means to push the rod against said abutment member to upset the heated end of the rod, means responsive to radiant energy emitted by the heated end of the rod, and means including said energy responsive means connected to control said pushing means.

2. In combination, an abutment electrode member, means for supporting a metal rod with an end thereof disposed in contact with said abutment member, means for sending current through the rod and said abutment member to heat the end of the rod in contact with said abutment member, means to push the rod against said abutment member to upset the heated end of the rod, means responsive to radiant energy emitted by the heated end of the rod, and means including said energy responsive means connected to coordinate movement of said pushing means with the temperature of the heated end of the rod.

3. In combination, an abutment electrode member, means for supporting a metal rod with an end thereof disposed in contact with said abutment member, means for sending current through the rod and said abutment member to hea the end of said rod in contact with said abutment member, means to initially push the rod into contact with said abutment member to close an electric heating circuit therethrough, means to restrain movement of said pushing means when the electric heating circuit is first established, and means comprising means responsive to radiant energy emitted by the heated end of the rod to release said pushing means for movement to upset the heated end of the rod when the heated end attains a predetermined temperature.

4. In combination, an abutment electrode member, means for supporting a metal rod with an end thereof disposed in contact with said abutment member, means for sending current through the rod and said abutment member to heat the end of the rod in contact with said abutment member, means to push the rod against said abutment member to upset the heated end of the rod, means responsive to the temperature of the heated end of the rod to control movement of said pushing means, and means including said temperature-responsive means to control the current through the rod and thereby control the temperature of the heated end while it is being upset.

5. In combination, an abutment electrode member, means for supporting a metal rod with an end thereof disposed in contact with said abutment member, means for sending current through the rod and said abutment member to heat the end of the rod in contact with said abutment member, means to push the rod against said abutment member to upset the heated end of the rod, and means responsive to radiant energy emitted by the heated end to control the current therethrough during the upsetting operation.

6. In a machine for imparting mechanical and heat treatment to a metal rod, in combination, means to heat the rod, means to apply force to both ends of the rod, and means responsive to radiant energy emitted by the rod to coordinate the effectiveness of said force-applying means with the temperature of the rod.

7. In a machine for imparting mechanical and heat treatment to a metal rod, in combination, means to heat a portion of the rod, means to limit movement of one end of the rod in one direction, means to apply a force to the other end of the rod, and means responsive to radiant energy emitted by the heated portion of the rod to control the effectiveness of said force-applying means.

8. In a machine for imparting mechanical and heat treatment to a metallic member, in combination, means to heat a portion of the metallic member, means to limit movement of the member in one direction, means to apply a force to the member, and means responsive to radiant energy emitted by the heated portion of the member to coordinate the effectiveness of said force-applying means with the temperature of the heated portion of said member.

9. In a machine for imparting mechanical and heat treatment to a member, in combination, means to heat a portion of the member, means to apply opposed forces to the member and means responsive to radiant energy emitted by the heated portion of the member to coordinate the effectiveness of said force-applying means with the temperature of the heated portion of the member.

10. A metal gathering machine, comprising a pair of spaced electrodes, means to push a metal rod connected to one of said electrodes into engagement with the other electrode, means to supply current to said electrodes to heat the rod for upsetting, and means responsive to radiant energy emitted by the upset portion of the rod to actuate said rod-pushing means.

11. A metal gathering machine, comprising a pair of spaced electrodes, means to push a metal rod connected to one of said electrodes into engagement with the other electrode, means to supply current to said electrodes to heat the rod for upsetting, and electronic tube means responsive to the temperature of the upset portion of the rod to actuate said rod-pushing means.

12. In a combination, a movable abutment electrode, another electrode adapted to support a rod, means to push the rod into engagement with said abutment electrode to move said electrode, means responsive to movement of said abutment electrode to stop movement of said rod-pushing means, current supply means connected to said electrodes to heat the rod, means responsive to movement of said abutment member to render said current supply means effective, and means responsive to the temperature of the heated rod

to subsequently release said rod-pushing means for movement to upset an end of the rod against said abutment member.

13. In combination, an abutment electrode, means for supporting a metal rod with an end disposed in engagement with said electrode, current supply means for passing a current through the rod and said abutment electrode to heat the end of the rod engaging said electrode, means to push the rod against said abutment electrode, means responsive to the temperature of the heated end of the rod, and means including said temperature responsive means connected to cause pushing movement of said rod-pushing means to thereby upset the end of the rod.

14. In combination, a pair of spaced opposed members adapted for mechanical treatment upon a member positioned between said opposed members, means for heating the intermediate member, means responsive to radiant energy emitted by the heated member and means including said energy responsive means adapted to cause relative movement of said opposed members with respect to the heated member to thereby impart mechanical treatment to the heated member.

15. In a machine for imparting mechanical treatment to a heated metal member, in combination, power means to shape the metal member, means responsive to radiant energy emitted by the metal member, and means including said energy responsive means connected to vary the effectiveness of said power means during the shaping operation.

16. In a machine for imparting mechanical treatment to a heated metal member, in combination, heating means including a current supply in circuit connection with the metal member, power means to shape the metal member, and means responsive to the temperature of the metal member connected to condition said supply circuit for the production of a desired heating of the metal member, and means including said temperature responsive means connected to vary the effectiveness of said power means during the shaping operation.

17. In a machine for imparting mechanical treatment to a heated metal member, in combination, power means to shape the metal member, electron tube means responsive to radiant energy emitted by the metal member and means including said electron tube connected to vary the effectiveness of said power means during the shaping operation.

18. In a machine for imparting mechanical treatment to a heated metal member, in combination, power means adjustable to shape the metal member, heating means including a current supply in circuit connection with the metal member, and means responsive to radiant energy emitted by the metal member connected to condition said supply circuit for the production of a desired heating of the member.

19. In combination, power means movable to retain a member in position for heat treatment, means to heat the member while held by said power means, means responsive to radiant energy emitted by the member, and means including said energy responsive means connected to effect movement of said retaining means.

20. In a machine for imparting mechanical treatment to a heated metal member, in combination, power means adjustable to shape the metal member, heating means including a current supply in circuit connection with the metal member, and electronic tube means responsive to radiant energy emitted by the metal member connected to condition said supply circuit for the production of a desired heating of said metal member.

WILLIAM H. SPIRE.