(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

SHAPING AND SPINNING METALS BY ELECTRICITY.

No. 501,547. Patented July 18, 1893.

FIG. 1.

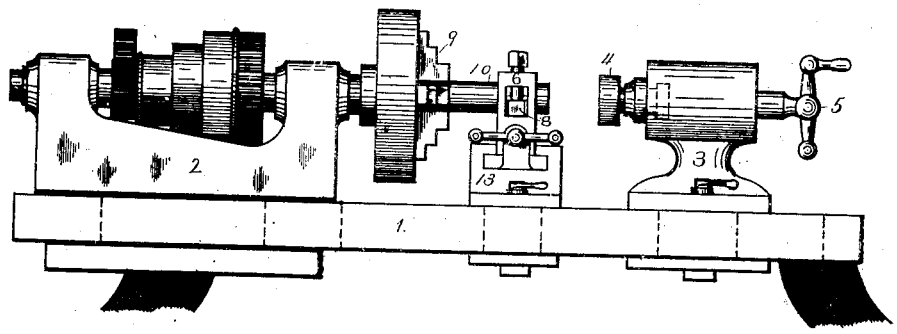


FIG. 2.

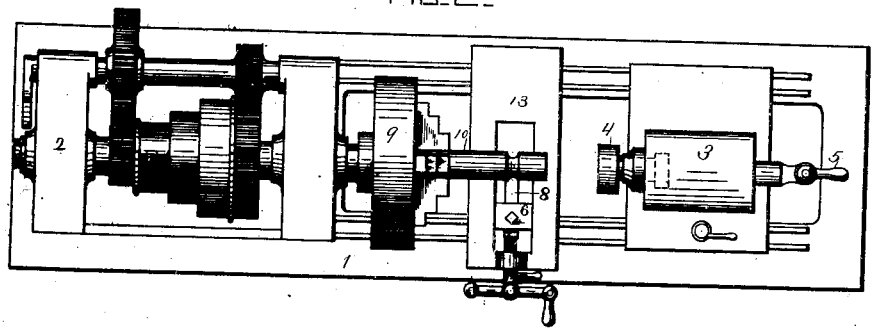


FIG. 3.

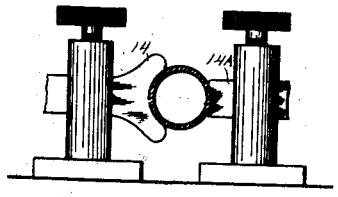


FIG. 4

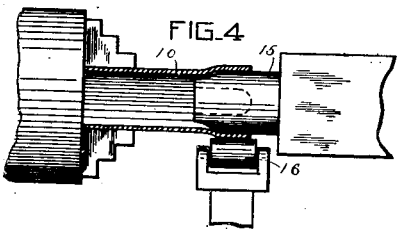


FIG. 5.

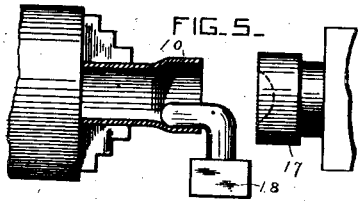
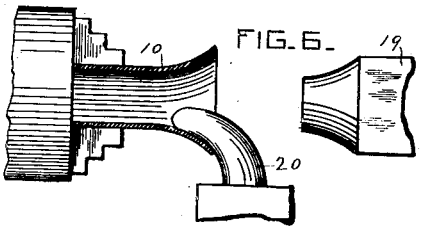


FIG. 6.



WITNESSES.

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(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

SHAPING AND SPINNING METALS BY ELECTRICITY.

No. 501,547. Patented July 18, 1893.

FIG. 7.

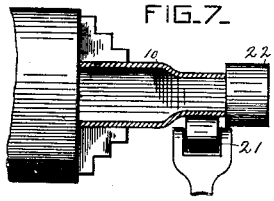


FIG. 8.

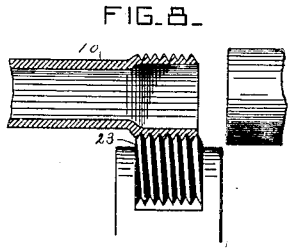


FIG. 9.

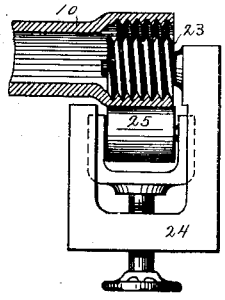


FIG. 10.

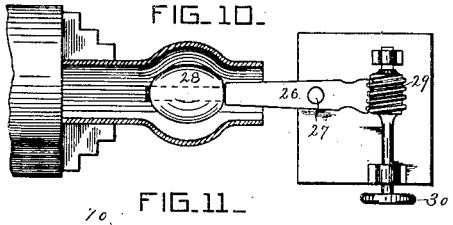


FIG. 11.

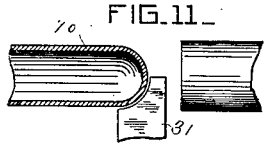


FIG. 12.

FIG. 13.

FIG. 14.

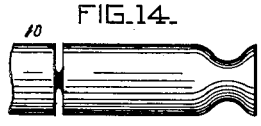


FIG. 15.

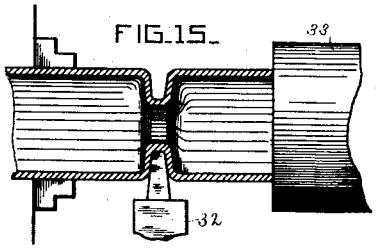


FIG. 16.

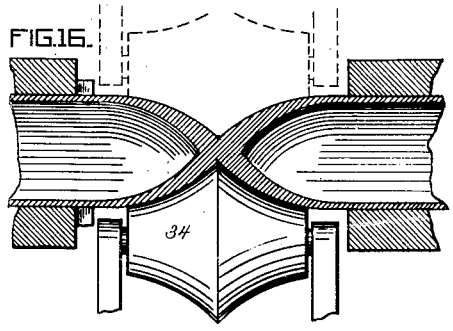


FIG. 17.

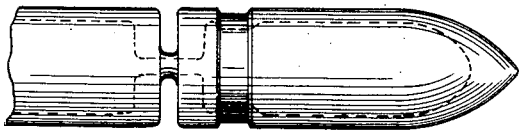
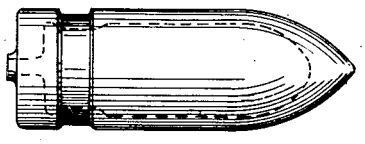


FIG. 18.



WITNESSES.

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO THE THOMSON ELECTRIC WELDING COMPANY, OF MAINE.

SHAPING AND SPINNING METALS BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 501,547, dated July 18, 1893.

Application filed January 8, 1891. Serial No. 377,159. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Swampscott, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Shaping and Spinning Metals by Electricity, of which the following is a specification.

My invention consists in a novel method of and apparatus for shaping or spinning metals by the aid of electricity, and consists in novel processes and devices hereinafter described involving the use of an electric current passed through the work for the purpose of softening the same.

My invention consists first in a novel method of forming metal articles of circular shape consisting in including the material in a heating electric circuit to soften the same and applying a suitable shaping force while the work or tool or both are rotated to gradually force or crowd the material into the desired shape.

In carrying out my invention the tool may be moved around the work or given any desired direction of motion with respect to the work. It is preferable, however, that the work should be revolved. The work is heated electrically by the passage through it or a portion of it, of heating currents of electricity obtained from any suitable source as from a low resistance secondary of a transformer fed properly by alternating or other currents circulating in its primary.

As my invention is analogous in some respects to previous inventions made by me in electric welding, forging and similar work, in so far as it involves the use of a heating electric current and the application of a suitable force for shaping the metal, and inasmuch as the various means for supplying electric current of the desired character to the work, are now well understood, it will not be necessary in the following description to refer particularly to the sources of current or the means of regulating the same, and I shall, therefore, confine my description principally to the work itself and the manner and means of performing it.

In carrying out my invention the heating electric current may be applied to soften the material and then withdrawn, after which the shaping or forming force may be applied or, if desired, the heating electric current may be passed through the work to heat it or keep it heated while it is being formed.

My invention consists also in a novel method or process of utilizing electricity in the spinning of metals, consisting in passing an electric current through the material to soften the same and then applying the pressure or other force to the heated material to gradually form or shape the same as the material or the tool rotates.

My invention consists further in novel processes and devices more particularly hereinafter described and more particularly specified in the claims.

In the accompanying drawings:—Figure 1, is a side elevation of an apparatus suitable for practicing the process constituting my invention. Fig. 2, is a plan of such apparatus. Fig. 3, shows the manner of applying the forming tools to a pipe. Figs. 4, 5 and 6, illustrate applications of my invention to the expanding of the end of a pipe. Fig. 7, shows the application of my invention to the contracting of the end of a pipe. Figs. 8 and 9, show a process of forming the screw thread upon the end of an expanded pipe. Figs. 10, 11, 12, 13, 14, 15, 16 and 17, illustrate variations of my invention, and of the work to which it may be applied. Fig. 18, shows a hollow projectile made by the process constituting my invention.

In the following description I have described my invention as carried out by the agency of devices for rotating the work so as to bring successive portions of the same circumferentially under the action of the compressing or shaping instrument.

The means for passing a heating current through the work to soften the same and for rotating the work in the spinning or shaping operation and illustrated in Figs. 1 and 2, comprise a lathe head 2, which is preferably insulated from the lathe frame and upon which is mounted a chuck 9, said chuck carrying the usual means, such as chuck jaws, by which the mass or piece of metal, as 10, which is to be worked electrically, may be grasped and rotated. The mass or piece of metal 10, may be a bar or rod or, as hereinafter described,

may be a metal tube which passes through the spindle of the lathe and is projected from the chuck 9, a determinate distance as may be required in the particular operation. A head 3, corresponding to the back head of the lathe carries an electrode or contact piece 4, which is designed to be brought into contact with the material to be worked for the purpose of passing a heating electric current through said work to soften it. This block or electrode of conducting metal, if liable to great heating, may have a water circulation provided in its body to keep it cool. The electrode 4, can be pressed into contact with the work 10, by means of the screw 5. The heads 2, 3, are connected by heavy cables or otherwise with a suitable source of electric supply. The tool post or support of the apparatus, indicated at 13, may also be connected with the source of electric supply. In the present instance it is shown as electrically connected to the table upon which the head 3, rests. The tool 8, resting on the post 13, will, by this means, be made an electrode of the heating circuit and when the tool is in contact with the work, the circuit will be completed through the work and current be introduced into the work for heating the same over the surfaces which are being spun or shaped during rotation. The tool 8, is held in a proper support or clamp 6. The back post 3, may move to and fro in the slotted ways of the lathe, as may also the tool post or pedestal 13.

Fig. 2, shows a top view of the parts which correspond in number and shows the tool 8, consisting of a stout bar of conducting metal applied to the work which has been heated by contact of the piece 4, with the end projecting and the passage of the current from the chuck through the work 10, and the piece 4, and back through the circuit. By these means any portion of the length of 10, may be heated which is allowed to project from the chuck to make contact with the piece 4. When the heating has proceeded to the desired extent the contact piece 4, may be thrown back and the tool 8, brought up to the work while it is rotating for impressing or spinning the hot metal into a grooved form or into any other shape desired. The tool 8, may be used to add to or maintain the heating by making it a pole of the heating circuit so that current will traverse it and pass into the work. It may, if desired, be also insulated from the bed and kept out of circuit.

Fig. 3, shows how the tools may be shaped or applied to the work as at 14, 14^a, where they may be brought up on opposite sides after the heating of the work between them, which is in this case shown to be a pipe in which a depression or groove is to be made, the operation being in effect a spinning operation.

If the end of a hollow piece of metal, as of a pipe, is to be expanded, the heating is accomplished as indicated in Fig. 4, by bringing the work 10, into contact with a piece of metal 15, which is introduced firmly into the end and which may be revolved with the work or not as desired. The piece 15, might be used simply as a heating electrode or the work might be heated by other means and then placed upon a piece 15, which should be disconnected from any circuit. By applying a pressure roll 16, to the work as it rotates and at the same time forcing the piece 15, having a conical end into the interior of the pipe as it expands the desired result can be obtained. Here the part 15, is in the nature of a mold or form upon which the metal is spun down. This again is a case of hot spinning, the heat being furnished by the current which may be kept on during the spinning operation or be shut off before this operation is carried on, and the part 15, furnishing a mold against which the metal is forced or conformed by the tool. It is manifest that while the work revolves under these circumstances the upsetting actions could be performed by revolving the tool and keeping the work stationary and it is also manifest that the roll itself might be supplanted by other devices such as hammers revolved about the work or striking the work, if the work revolves, at various points around its circumference, so as to apply the desired force for spreading and expanding the end.

In Fig. 5, the spinning operation is accomplished by first heating the work 10, projecting from the chuck by abutting it firmly against the piece 17, and passing the current, then removing the piece 17, after the heating has proceeded so as to render the metal plastic, and applying an interior burnishing tool 18, through which current may or may not be passed, as desired, for heating the work or maintaining the heat. By drawing the tool away from the center with some force, while the work revolves, the expansion of the hot metal is easily accomplished.

Fig. 6, shows a modification in the form of the parts for belling out or making the interior trumpet shaped, the piece 19, being made to fit the trumpet shape merely for assisting the expanding action when it is applied for the heating and conveyance of current. Fig. 7, shows similar modifications for producing a contraction of the end of a pipe where the tool 21, is applied laterally while the back head 22 completes the circuit through the exposed portion of the pipe or hollow body which may of course be replaced by solid metal in some cases.

Fig. 8, shows how a screw thread may be rolled upon the hot metal end after it has been expanded or contracted. Here the roll 21, Fig. 7, is replaced by a roll having a thread cut on it which revolves upon the pipe 10, or in contact with the pipe 10, after heating and impresses its thread upon the exterior without removing any metal.

As shown in Fig. 9, an interior thread may be made by an interior screw threading roll 23, drawn against the interior of the pipe which has been expanded by the former pro-

cesses, in connection with an outside roll 25, carried in a frame 24, for supporting the exterior during the pressing of the thread.

In Fig. 10, the work is shown as expanded or bulged out after heating by the application of an elliptical roll or tool 28, in its interior, pressure being applied by a lever 26, pivoted at 27, and by a screw 29, acting on the lever and turned by a handle 30, whereby as the work revolves the roll 28, bears upon the interior and causes it to expand into the form shown.

Fig. 11, shows a form of tool which may be applied to close the end of the pipe after heating to the welding heat as in Fig. 1, the tool 31, being forced against the end of the pipe as it revolves causing the metal to turn inward and weld into a joint. It may at the same time be caused to carry a portion of the current.

Fig. 12, shows how the tube after being closed may be again contracted by the application of another tool so as to practically produce a rounded end, as shown, and this, as shown in Fig. 13, may be cut off in the form of a ball and in fact successive hollow balls may be made by this operation of hot spinning from a pipe after heating of the same in a chuck the heating being accomplished electrically by the closure of the circuit between the back head and the chuck.

Fig. 14, shows a form of bottle or receptacle which can be constructed by following these same principles as before, the groove or depression which severs it from the tube 10, being made after the metal has been locally heated, by a narrow tool rapidly forced in toward the center. This tool may be a roll or burnisher. The process is shown partly accomplished in Fig. 15, where the tool is being applied to the hot metal locally.

It may be remarked here that the amount of the projection of the metal from the chuck and existing between the chuck and the contact abutment as 33, Fig. 15, or Fig. 4, may be varied in length so that in some cases a very short length may be subjected to the heating process, and that in the figures here shown the length has been exaggerated to some extent many of the operations being better performed with less length projecting than is shown in the figures.

Fig. 16, shows how the tube which is held in two chucks facing and between which current is passed may be brought down by a properly shaped roller 34, one or more of which may be applied on opposite sides so as to close the tube in the center and if the action be carried further to sever one portion from the other leaving a closed pointed structure thickened by the crowding of the metal from the outside inward at the point of narrowing by the action of the roll. If severed the result will be like the point of a hollow shell for firing from a gun.

As a further illustration of my process I show in Fig. 17, a further process of narrowing the back end of a shell and closing it so as to leave only a small opening at its back extremity, and also the formation of a peripheral groove for receiving the copper or lead ring used in rifled projectiles. A complete shell constructed from pipe, would be as shown in Fig. 18. It is manifest that the process may be applied to the construction of a variety of articles whose form may be greatly varied, the process consisting broadly in the process of electric heating and spinning into the desired form of metals in the manner specified.

What I claim as my invention is—

1. The method of forming metal articles into circular shapes, consisting in including the material in a heating electric circuit to soften the same and applying the shaping force while the work or the tool or both are rotated to gradually force or crowd the material into the desired shape.

2. The herein described method of forming metal into the desired form consisting in including the material in an electric circuit to heat the same, rotating the work, and applying lateral pressure, as and for the purpose described.

3. The herein described improvement in spinning metal consisting in passing a current of electricity through the material to soften the same, and applying pressure to spin the heated material into the desired form.

4. The herein described improvement in spinning metal consisting in rotating the material while included in a heating electric circuit, and applying a suitable force to gradually shape the metal as desired.

5. The herein described method of shaping metal consisting in rotating the metal while subjected to the pressure of a forming tool constituting a terminal or electrode of a heating electric circuit by which heating current is passed into the work.

6. The herein described method of contracting the ends of hollow pieces of metal, consisting in passing a current of electricity through the metal to soften the same at its end, and then gradually compressing the pipe by pressure applied while the same is rotated.

7. The herein described method of contracting or expanding the end of a hollow piece of metal, consisting in bringing the end into connection with an electrode forming a terminal of the heating circuit, passing current through the tube or pipe to heat the same, and then rotating the tube while applying the desired force or contract the end of said tube.

8. The herein described method of closing the end of a tube of metal, consisting in abutting the open end of the tube against an electrode forming the terminal of a heating electric current, passing a heating current into the tube so as to heat the open end, and then spinning down or closing the end.

9. The herein described improvement in forming hollow balls, consisting in including the end of a metal tube in an electric circuit

so as to heat or soften the same, and then spinning down the tube into the shape required, as and for the purpose described.

10. The herein described method of forming hollow metal objects by hot spinning them in succession from a metal pipe.

11. The herein described method of forming two hollow metal objects with closed ends, consisting in including a section of pipe or tube in a heating electric circuit and then spinning down the heated portion of the tube, as and for the purpose described.

12. The herein described method of forming hollow metal articles from a section of tube or piping, consisting in including the tube in an electric circuit so as to heat the same to plasticity, and then spinning down an intermediate portion of the tube so as to form the closed ends or sides of two articles simultaneously.

13. The herein described method of shaping or forming a piece of metal, consisting in including the same in an electric circuit, one electrode of which is applied to the surface to be formed or modified in shape, and applying the desired shaping or compressing force while the metal or tool is rotated.

14. The method of utilizing electricity in the formation of metal articles, consisting in electrically heating the metal, applying suitable force to form the metal as desired while the metal is rotated, and maintaining the metal in the heating electric circuit during the operation.

15. The herein described method of utilizing electricity in the formation of hollow metal articles, consisting in passing a current of electricity through the metal to soften the same, and then gradually forming the metal by pressure or other force over a die or mold.

16. The herein described method of utilizing electricity in the formation of hollow metal articles, consisting in electrically heating the metal while in position upon a die or mold, and applying pressure to gradually form the metal to the form of said die or mold.

17. The herein described method of utilizing electricity in the formation of metal articles, consisting in passing a current of electricity through a piece of metal having substantially the thickness of the finished article so as to soften the same, and then gradually applying pressure to form the metal into the desired shape over a suitable die or mold.

18. The herein described method of utilizing electricity in the formation of hollow metal articles, consisting in passing a current of electricity through a metal blank between two points, one upon the formed surface, and applying pressure to the blank to form the same over a suitable die or mold.

19. The herein described method of utilizing electricity in the formation of metal, consisting in electrically heating the metal while it is rotated and gradually formed or spun over or upon a suitable die or mold.

20. The method of utilizing electricity in the formation of hollow metal articles, consisting in electrically heating a blank of the desired thickness while it is rotated and formed upon a suitable die or mold.

21. The method of forming a hollow metal object, consisting in electrically heating a metal blank by passing a current of electricity through the same while it is rotated and formed or spun upon a suitable die or mold surface, and passing said current between two points, one at or near the point where the blank is held by the rotating device, and the other where the tool is applied.

22. The method of forming hollow metal articles, consisting in communicating a rapid circular motion to a metal blank of the desired thickness held against a mold, passing a heating current of electricity through the metal to soften the same, and then, by means of a suitable instrument, applying pressure to successive points to form the blank to the shape of the surface of the mold.

23. The herein described method of forming or shaping metals, consisting in communicating a circular motion to the blank, passing a heating current of electricity through it to soften the same, and applying pressure to successive parts of the metal to form it.

24. The herein described method of forming hollow metal articles, consisting in revolving a metal blank of the desired thickness, applying pressure upon successive parts of the blank to form or shape it, and at the same time passing a heating electric current through or into the blank at the points where the pressure is applied.

25. The method of utilizing electricity in the formation of hollow metal articles, consisting in electrically heating a metal blank to soften the same, and then gradually applying pressure to form the metal over a suitable circular die or mold.

26. The herein described improvement in forming conical point projectiles, consisting in including a section of a metal tube in a heating electric circuit, and spinning down the heated portion so as to close the tube and at the same time form the point with a thickened wall.

27. The combination in an apparatus for forming or shaping metals, of means for rotating the work, and a support or rest for the shaping instrument forming a terminal of the heating electric circuit.

28. In an electric apparatus for forming hollow metal articles, the combination with a die or mold, of means for holding and rotating said die and mold with the metal to be operated upon, connections to pass an electric current through the metal while it is rotated, and means for imparting pressure to the metal to conform the same to the surface of said die or mold.

29. In an apparatus for forming hollow metal articles, the combination with a die or mold, means for holding the metal against said die or mold, a removable pressure in-

strument for forming the metal blank to the shape of the mold, and electric terminals in contact with the metal.

30. The combination in an apparatus for forming or shaping metal, of means for holding the metal and rotating it, a removable shaping or forming instrument, and electric connections leading to the rotating holder and the said shaping or forming instrument.

31. The combination in an electric metal working apparatus, of a rotating chuck or holder connected to one terminal of an electric circuit, a removable contact mounted in line with said chuck and connected to another terminal of the electric circuit, and a tool post or support connected to the same terminal.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 31st day of December, A. D. 1890.

ELIHU THOMSON.

Witnesses:
JOHN W. GIBBONEY,
BENJAMIN B. HULL.