A. VIVARTTAS.

Machine for Bending Metal.

No. 217,560. Patented July 15, 1879.

Fig. 1.

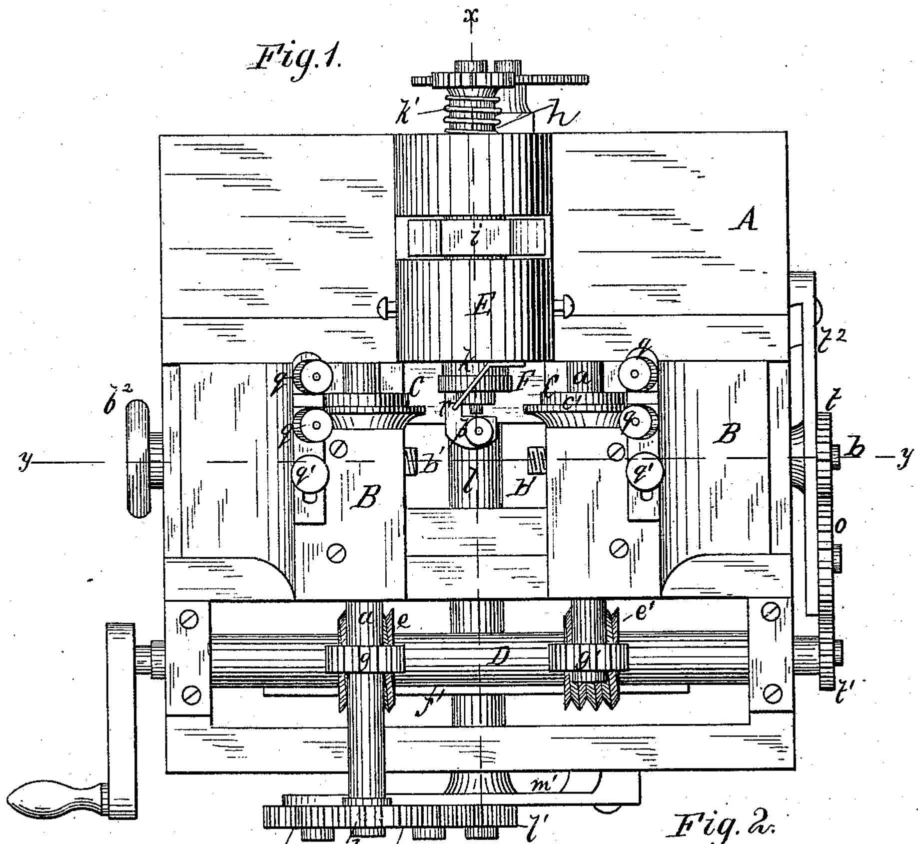


Fig. 2.

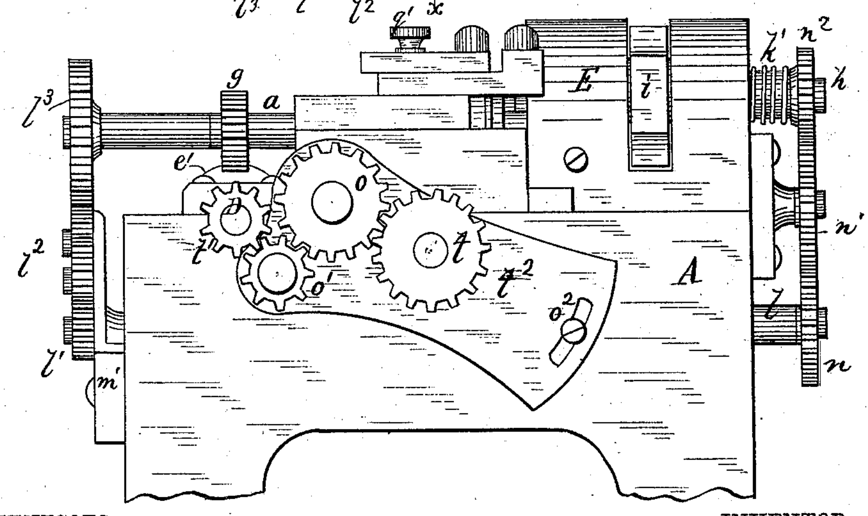


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Fig. 3.

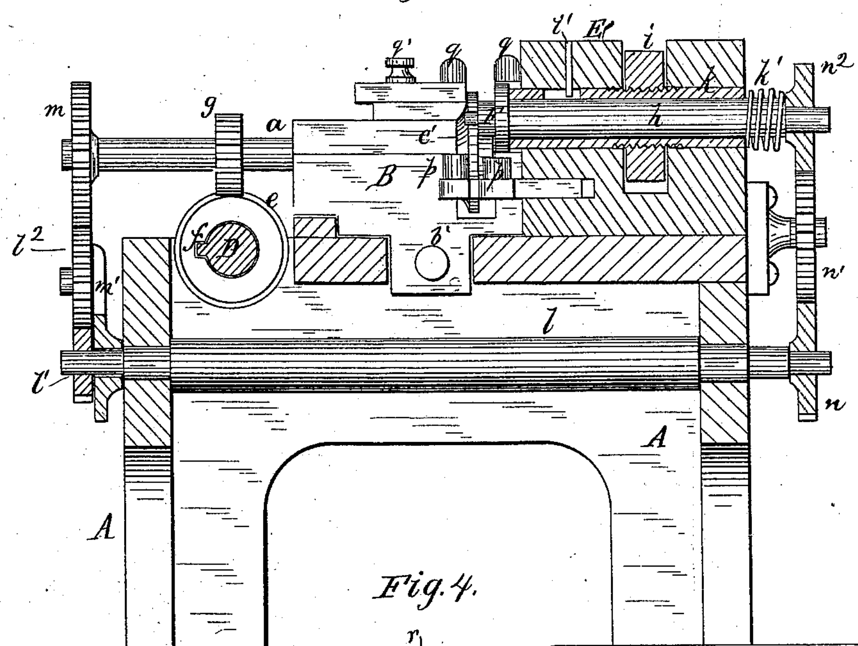
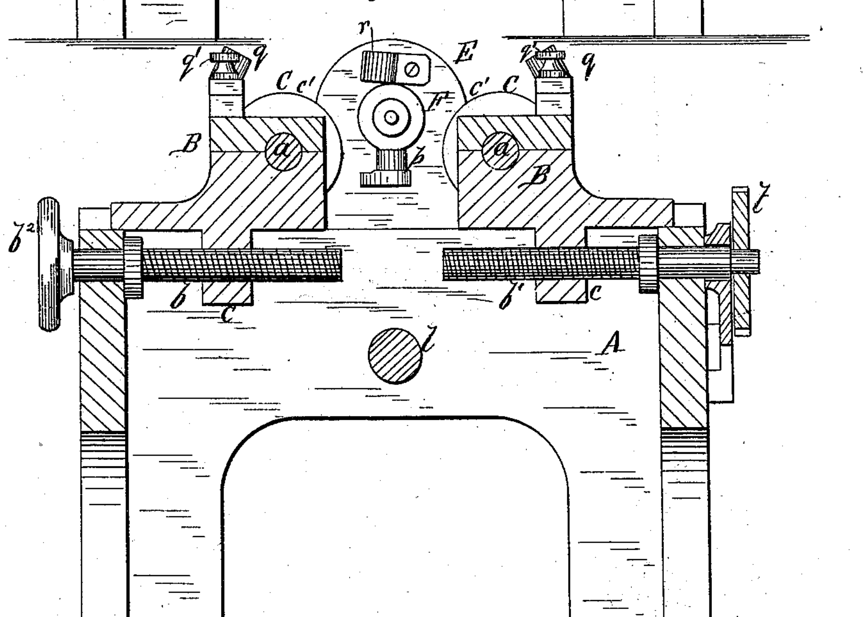



Fig. 4.

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# UNITED STATES PATENT OFFICE.

ALOHA VIVARTTAS, OF NEW YORK, N. Y.

## IMPROVEMENT IN MACHINES FOR BENDING METAL.

Specification forming part of Letters Patent No. **217,560**, dated July 15, 1879; application filed March 1, 1879.

*To all whom it may concern:*

Be it known that I, ALOHA VIVARTTAS, of the city, county, and State of New York, have invented a new and useful Improvement in Machines for Bending Metal, of which the following is a specification.

This invention relates to machines for bending or coiling metals and similar materials for the purpose of forming circles, ellipses, cycloids, involutes, straight cylindrical spirals, tapered or conical spirals, flat or helical spirals, or combinations of the same, as desired.

The material used is in the form of a wire, long rod, or plate, of which the cross-section is, as the work may require, round, square, triangular, flat, trapezoidal, or any desired figure.

Many of these forms have a strong tendency to bend always in the direction of their weakest diameter—as, for example, the square rod, which will always bend in the direction of its diagonal, unless absolutely controlled at the moment of receiving the bend or "set." This makes it necessary to combine in this invention two distinct principles—first, the bending mechanism, with power and motion to bend the material, and adjustments for regulating the amount of the bend and accommodating different sizes of material; and, second, the guiding and controlling mechanism, with power and adjustments for holding the various forms and sizes of material true and exact in position and motion, to permit the passage of the material without undue resistance during the bending process.

In this invention the bending or coiling process is performed by passing the material between three points, which may be described geometrically as one point within and two points without the required curve, and by the hereinafter-described adjustments of the relative positions of these points the degree of curvature given to the material is regulated.

To facilitate the passage of the material, these three points are made to appear upon the circumference of three rolls or wheels revolving in the same plane and with parallel axes.

It is found in practice that it is not necessary for either two of these rolls to grasp or pinch the material. Thus the three points, for example, may be set at a distance of an inch or more apart, yet, by reason of their relative positions, give a curve or bend to a wire less than one-eighth of an inch in diameter.

The controlling and guiding mechanism consists of flanges formed or secured upon the bending rolls, and also independent guide-rolls, the working-faces of all of which may be formed to suit the particular form of material in use, and the construction and adjustments of which are hereinafter fully described.

In practice it is found expedient in some cases to combine both the bending and guiding functions with their adjustments in the same piece of mechanism. In other cases they are distinct and separate. This is a power-machine, or, in other words, the machine is driven by belt or gearing from steam-engine or other power. A single operator may, as in the case of a turning engine, make all the necessary adjustments, supply material for, and attend to several machines at one time.

The construction and operation of the machine will be fully understood by reference to the accompanying drawings and the description hereunto annexed, similar letters of reference referring to the same parts in all cases.

Of the drawings, Figure 1 is a plan view. Fig. 2 is a side elevation. Fig. 3 is a vertical section on line $x$ $x$ of Fig. 1. Fig. 4 is a vertical section on line $y$ $y$ of Fig. 1.

The machine consists of a bed or frame, A, upon which are mounted a stationary head or pillow block, E, two sliding carriages, B B, and in suitable bearings or journals the main driving-shaft D.

The main shaft D carries one or more worms or screws, $e$ $e'$, which, by means of their worm-gears $g$ $g'$, the gears $l^1$ $l^2$ $l^3$, shaft $l$, and gears $n$ $n^1$ $n^2$, drive the three shafts $a$ $a$ and $h$, which carry the three bending-rolls C C and F.

The worm $e$ may be made of sufficient length to permit of the gears $g$ $g$ being located or shifted along upon their surfaces in making their necessary adjustments without affecting the engagement of the teeth of the gear with the thread of the worm. In this case the worm $e$ may be secured to the shaft D by key, feather, or set-screw or pin, and the thrust of the worm produced by its revolution against the teeth of all the gear is concentrated upon the shoulders of the journal-boxes of D. This is liable to produce undue friction and heat. In other cases the worms are made as many in number as the gear they are to drive, and are permitted to slide freely as relates to the shaft D, being caused to revolve by the feather at whatever point they may be. In this case a double hook or clip is made to surround both the shaft D and shaft of the gear $g$, and holding or clipping both worm $e$ and gear $g$ keeps them in their proper relative position.

The best plan is to make the clip-hook in the form of a close box, well fitted and tight, having journal-boxes for both shafts at right angles to each other. By this means the worms and gear are kept in their proper relative positions. The thrust of each worm is taken by its box and distributed to the journals through which the shafts pass, and both worm-shaft and gear-shaft may be made to slide freely, if desired, through the gear or worm. In this case the close box saves the necessary lubricant from waste and excludes the dirt.

These three methods of using the worm and gear are common among mechanics, have been in use many years, and are considered public property. Either method will work well in my machine, and my claims are not based upon either distinctively. The real advantage of using in my machine the worm and gear instead of any other device—as, for instance, plain spur or bevel gear—lies in the fact that the worms impart a smooth, steady, positive, and equable motion to their gear, and through them to the bending-rolls C C and F, which is essential to the production of the most accurate and correct results. The shaft D receives its motion from the hand or power, as preferred.

Upon the bed A are fitted two sliding carriages, B B, so arranged that they may slide independently of each other, but in the same direction to and fro. The carriages B B carry in appropriate journal-boxes the shafts $a$ $a$, on which are the bending-rolls C C and the worm-gear $g$ $g'$, which drive them. The shafts $a$ $a$ are parallel to each other, and the bending-rolls C C are in the same plane or opposite to each other, and by the movement of the carriages B B may be made to approach or recede from each other, as the work may require.

The carriages B B are made to traverse in their slides by means of the feed-screws $b^1$ $b^1$, which may be operated by hand, as shown at $b^2$, or by means of the gear $t^1$ on shaft D, gear $t$ on the screw $b^1$, and intermediates $o$ and $o^1$, that are carried upon the swing plate or arm $t^2$, so that by swinging the plate $t^2$ into such a position that gear $o$ engages with gear $t^1$ it will impart motion to gear $t$ and the screw $b^1$ in the one direction; but by swinging the plate $t^2$ until gear $o^1$ engages with gear $t^1$ the motions of gears $o$ and $t$ and the screw $b^1$ are reversed, or by swinging the plate $t^2$ until both gear $o$ and gear $o^1$ are free from gear $t^1$ the screw $b^1$ and carriage B will remain motionless. The plate $t^2$ is fixed or held in either position by the screw $o^2$.

In the head E is fitted a sleeve or pipe, $k$, which is provided with a longitudinal slot, and plays freely on a pin or key, $i'$, which is fixed in the head E, and while the pin permits the sleeve $k$ to slide endwise it prevents $k$ from revolving. The sleeve $k$ is threaded for a portion of its length on the outside, and provided with a nut, $i$, which, working in a recess in the head E, governs the motion of the sleeve $k$. Through the sleeve $k$ passes the shaft $h$ of the bending-roll F.

The shaft $h$ has a shoulder or collar at the end next the roll F, and at the other end the gear $n^2$, by which it is driven. On the shaft $h$, and between the gear $n^2$ and sleeve $k$ or head E, is a spring, $k'$, which serves to keep the shoulder of the shaft $h$ firmly up against the end of the sleeve $k$ and prevents "back-lash" or the intrusion of dirt or foreign matter, which seriously impairs the quality of the work.

The shaft $h$ is parallel to the shafts $a$ $a$, and in such a position that the roll F is opposite to or in the same plane with C and C, so that a piece of wire being started around between the rolls F and C C in either direction will, by the corresponding revolution of the rolls, be carried forward, receiving a regular amount of bend or set as it passes, and returning over the top to its starting-point, naturally forming itself into a plain circle or hoop, with the roll F within and the rolls C C without. The diameter of this circle will depend upon the relative size of the wire and distances of the centers of the rolls F C C from each other. Now, if the distances of these rolls be changed—as by means of the screw $b$ and carriage B—then will the radius of the curve given to the wire by the rolls be correspondingly changed; and if this change is made simultaneously with the passage of the wire an involute, or, if continued through several revolutions, a helix, is the result. It is obvious that this effect may be produced either by hand or by power, (the result will be the same,) and also by properly timing or speeding the changes of distance between F C C ellipses, cycloids, parabolas, or any other geometric plane curve may be produced with mathematical accuracy.

In the drawings, the roller F is shown of a double form, having a large and a small roller combined, the large roll being used for large and heavy work requiring much strength, and the small roll for smaller and lighter work. The two are combined simply for the purpose of saving expense and trouble when shifting from one class of work to another. Either the large or small roll is brought into exact opposition to C C when desired by means of the nut $i$ and sleeve $k$, as shown.

Again, if a wire be started in between the rolls F C C, as before described, and upon the completion of the circle the end of the wire be started to one side and the motion of the rolls be continued, the end of the wire will pass down by the end of the roll F and repeat continuously, the result being a plain cylindrical spiral, and the lay or twist of the spiral will be either right or left handed, according as the wire is fed and the rolls revolved from the one side or from the other; also, by changes of the distances F C C, as described, the spiral may be made to assume the various forms of plain taper, either increasing or decreasing in diameter, or these changes may be made with an elliptic spiral; or if the spiral be made with a change and return in the distances F C C properly timed as relates to the revolution of the spiral the form produced is a spiral of double curvature, the centers of the consecutive lays of wire forming the original spiral arranging themselves in a spiral position relative to each other—in short, the number of geometric forms the machine will produce is practically infinite, while any one of them may be repeated an infinite number of times with perfect accuracy, and the variety of sizes of any form is only limited by the strength and size of the machine.

As hereinbefore stated, various forms of material are refractory and inclined to bend in certain directions, making it necessary to control them while passing the rolls F C C. For this purpose the rolls C C are provided with flanges or shoulders on one side of the work, while the roll F has a similar flange or shoulder on the other side. The working-faces of these flanges are, when necessary, made to conform to the contour of the material, and, with the working-faces of the rolls, are finished smooth to prevent abrasion or injury to the work, and by means of the sleeve *k* and nut *i* these flanges are adjusted to suit various sizes of material.

The guide-rolls *p p* and *q q* are made adjustable by means of slides and set-screws *q′ q′*, for the purpose of guiding and controlling the material, either in connection with or in place of the flanges or shoulders of the rolls F C C. When it is desired to make the wire take the form of an open spiral, a fixed guide, *r*, is secured in the proper position, either upon the stationary head E or carriage B, as the nature of the work may require, which guide *r*, forcing the material as it comes from the rolls F C C to one side of the plane in which these rolls are, gives it a compound bend or set.

The intermediate gear, $l^2$, of the train that drives the roll F is carried by a swing plate or arm, *m′*, for two reasons—first, in cases of extreme change of position of the carriage B an adjustment becomes necessary to keep the gears $l^2$ and $l^3$ in proper contact, although ordinarily this is not needed; second, it is manifestly proper that the rolls F C C should have nearly the same surface speed when the work is changed from the larger to the smaller part of F, or, vice versa, a corresponding change in the size of the gear $l^3$ and adjustment of $l^2$ is made.

It is obvious that many of the details of the sizes and proportions of the parts are liable to great variation in machines constructed for making different sizes of work, but also many sizes are attainable upon one machine. Thus the same machine has worked wire of round, square, and trapezoidal sections, from one-eighth to one-quarter of an inch in diameter, making coils from five-eighths of an inch to eight inches in diameter, and giving good results; but by the general construction the use of the relatively-adjustable rolls F C C, with their flanges or the guide-rolls *q* or *p*, and the worm and gear driving power, with the various adjustments described, are all more or less essential to the best results.

Having thus described the nature and purpose of my invention, that which I claim, and desire to secure by Letters Patent, is—

1. In a metal-bending machine, the combination of the flanged rolls F C C, sleeve *k*, pin *i′*, nut *i*, and spring *k′*, substantially as and for the purposes set forth.

2. In a metal-bending machine, the combination of the rolls F C C, carriages B B, and screws $b^1$ $b^1$, substantially as herein shown and described.

3. In a metal-bending machine, the combination of the rolls F C C with the controlling guide-rolls *p p* and *q q*, substantially as herein shown and described.

4. In a metal-bending machine, the combination of the rolls F C C, carriages B B, head E, and fixed guide *r*, substantially as and for the purposes described.

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Witnesses:

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GEO. D. WALKER.