3 Sheets—Sheet 1.

S. W. GEAR.

Machine for Bending Sheet-Metal Tubes.

No. 230,125. Patented July 20, 1880.

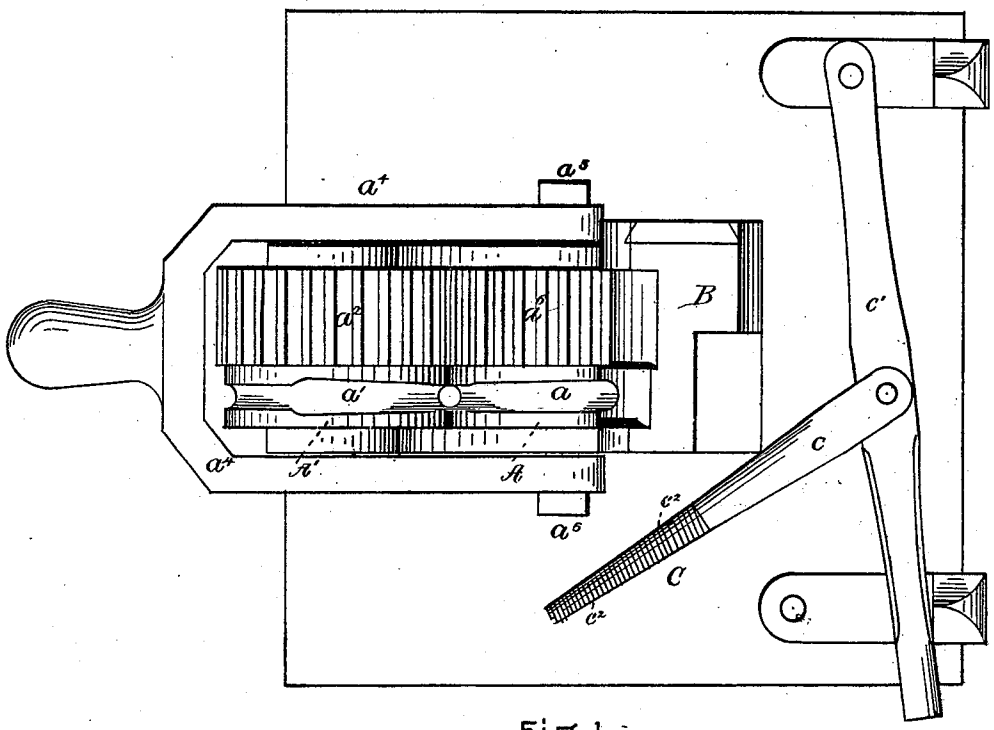

Fig. 1.

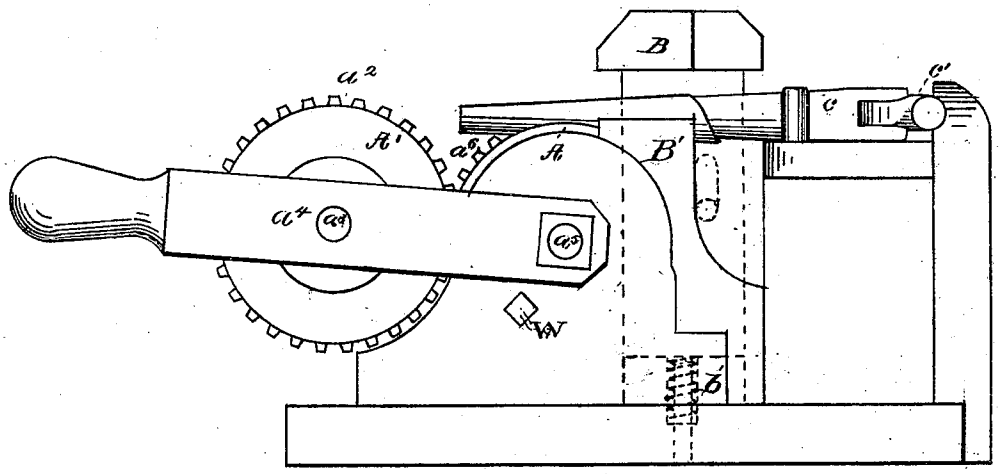

Fig. 2

WITNESSES

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by his attys

Clarke & Raymond

3 Sheets—Sheet 2.

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Machine for Bending Sheet-Metal Tubes.

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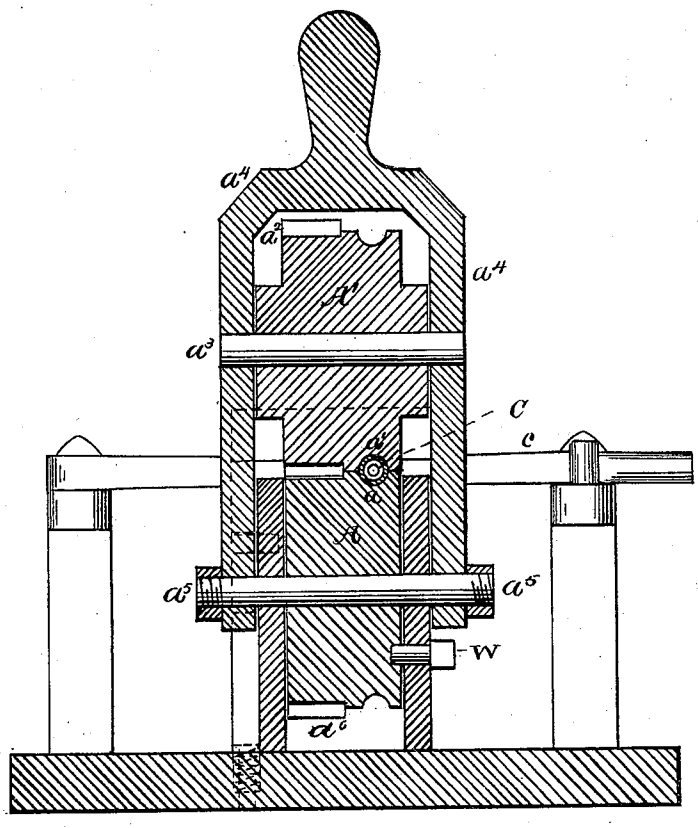

Fig 3.

WITNESSES
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3 Sheets—Sheet 3.

S. W. GEAR.

Machine for Bending Sheet-Metal Tubes.

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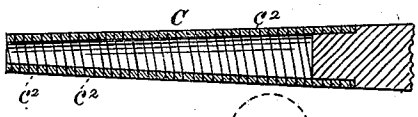

Fig. 5.

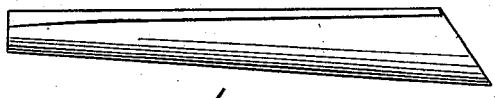

Fig. 6.

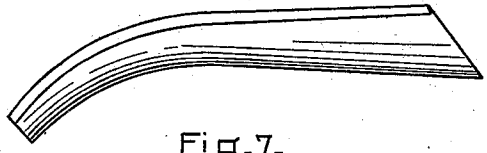

Fig. 7.

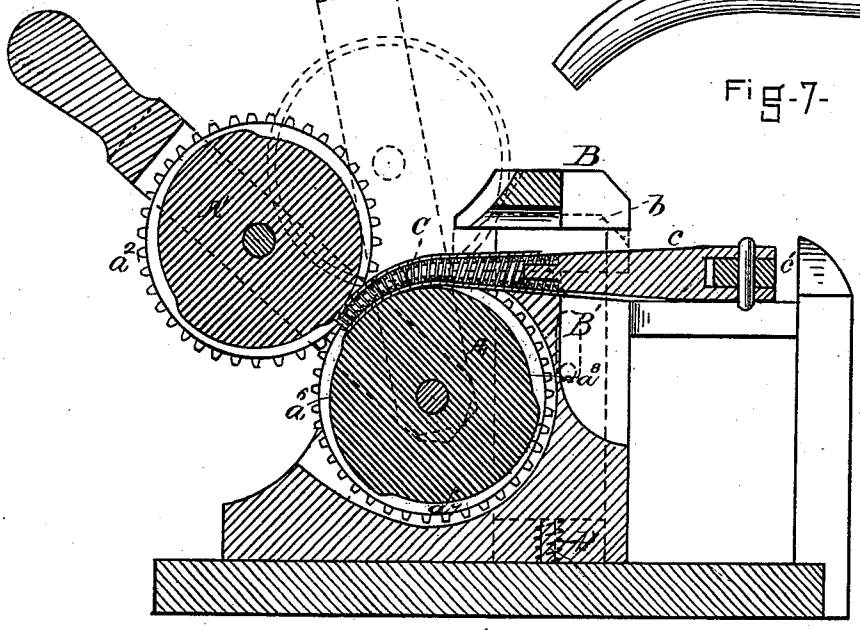

Fig. 4.

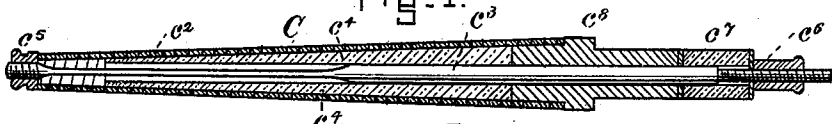

Fig. 8

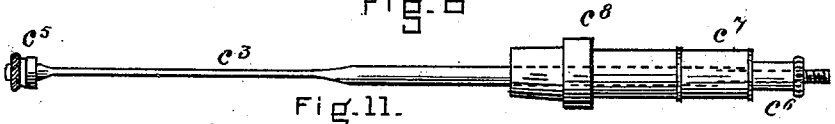

Fig. 11.

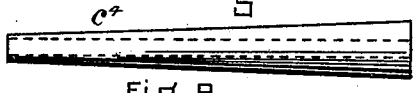

Fig. 9.

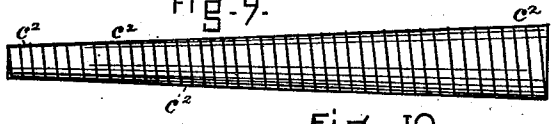

Fig. 10.

WITNESSES

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UNITED STATES PATENT OFFICE.

SAMUEL W. GEAR, OF CAMBRIDGEPORT, ASSIGNOR TO DOVER STAMPING COMPANY, OF BOSTON, MASSACHUSETTS.

MACHINE FOR BENDING SHEET-METAL TUBES.

SPECIFICATION forming part of Letters Patent No. 230,125, dated July 20, 1880.

Application filed February 14, 1880.

To all whom it may concern:

Be it known that I, SAMUEL W. GEAR, of Cambridgeport, in the county of Middlesex, in the Commonwealth of Massachusetts, have invented an Improvement in Machines for Bending Tubes of Metal, of which the following is a specification.

This invention relates to machines for bending tubes of thin metal, and it is an improvement upon the machine patented to Valentine & Rideout, No. 37,205, dated December 16, 1862; and it consists, first, in an improved mandrel for use in the swaging apparatus; second, in combining with the swaging-dies gearing whereby the movement of one die over the other is made more positive and the flexible and elastic belt and cushion of the patented Valentine & Rideout apparatus are dispensed with; third, in various details of organization constituting mechanical combinations essential for the working of the various parts of the machine together.

Prior to the invention of Valentine & Rideout tubes of thin metal were bent with considerable difficulty and expense, the most usual method being to fill the tube, or such portion of it as was to be bent, with a fusible metal, such as tin, and then to swage the same into shape gradually by repeated blows or rubbings. The improvement of Valentine & Rideout employed a flexible mandrel comprising a series of thin elastic metallic plates surrounding an india-rubber core, in connection with a shaping-block covered by a flexible and elastic cushion, and also in connection with a grooved swaging-wheel guided to the surface of the shaping-block, and also surfaced by an elastic cushion formed of a belt partially wrapped around the said wheel, and in further connection with a clamp to clamp the straight part of the tube to the straight part of the shaping-block.

In the present improvement the shaping-block is grooved to correspond with the exterior section of the tube to be bent, and no elastic cushion is used. The groove in the shaping-block serves as a die to receive the part to be bent, and the groove in the straight part serves, in connection with the clamp, to hold and maintain the tube positively and accurately in position.

A segmental gear fastened on the exterior shaping-block serves, in connection with a a gear-wheel upon the axis of the rolling swage, to enable this use of a die in the shaping-block to be made. This shaping-block is fixed with relation to the frame of the machine so that it does not rotate during the movement of the swaging-roll A′ over it. This locking device may be a pin run from the frame of the machine into the said block at any suitable point away from the spindle a^5, and it is represented by a pin immediately below said spindle, extending from the frame of the machine into the block A, in Fig. 3 of the drawings.

The rolling swage is also made with a groove of a cross-section at each particular point, corresponding to the cross-section of the tube to be bent, and these two dies thus formed are so positive in their action that cushions upon the shaping-block and upon the rolling swage are rendered unnecessary. Not only this, but the mandrel of a Valentine & Rideout machine was made of thin longitudinal plates of steel surrounding an india-rubber core, and although this possessed considerable advantages over the system of fusible metallic filling, yet experience has demonstrated that it could be greatly improved.

The mandrel in the present machine is composed of a thin ribbon of steel or other suitable material coiled into a helical or volute form, with the edges abutting but not overlapping, and in case a conical mandrel is to be used the ribbon should taper gradually and slightly from the butt to the point of the mandrel. In the interior of this coil of metallic ribbon is placed a rubber core having through its center a flexible axis provided with means for clamping the coiled ribbon at each end. I prefer to make this metallic axis so that it shall be capable of bending only in certain directions, or be more easy to bend in certain directions than in others, and to produce this result I flatten it most in those places where the bend is desirable, leaving it round in the other portions of its length.

It will be seen that this mandrel gives a very much more complete and thorough support upon the interior of the tube to be bent, by virtue of its transversely-arched form, than would a mandrel made of a series of thin longitudinal plates, as described in said patent; and in addition to this advantage there is no slipping of any part of the mandrel upon any other part of itself or of the tube to be bent, as would be the case in the use of the mandrel described in the said Valentine & Rideout patent. By providing, also, for the superior flexibility of the mandrel in a predetermined direction by means of flattening a portion of the metallic axis, the point of bending is determined in advance, and the direction of the bend in the axis is also determined, so that a greater durability is given to the machine. Besides this the use of regular dies between which the tube is bent, instead of dies having compressible surfaces, as described in the said patent, which were thus imperfectly shaped to the contour of the tube, renders the work performed by this machine superior to that performed by machines having cushioned dies, as above set forth. Another advantage consists in the ease with which the bent tube is removed from the mandrel, as any strain lengthwise the mandrel, such as would be used in removing the tube therefrom, causes it to lengthen somewhat, and thus reduce its diameter sufficiently to allow the bent tube to be very easily taken off.

To enable one skilled in the art to make and use this invention, the following description with reference to the accompanying drawings, which are hereby made a part of this specification, will be found sufficient.

Figure 1 is a top plan. Fig. 2 is a side elevation. Fig. 3 is a vertical transverse section. Fig. 4 is a vertical horizontal section, all these views being of the machine. Fig. 5 is a longitudinal section of the exterior helical skin of the mandrel. Fig. 6 is an elevation of the unbent spout. Fig. 7 is an elevation of a bent spout. Fig. 8 is a longitudinal section of the mandrel, showing all its details. Fig. 9 is an elevation of the rubber core. Fig. 10 is an elevation of the helical skin of the mandrel. Fig. 11 shows the central rod and end attachments of the mandrel.

A represents the shaping-block, having a die, *a*, a portion of which is horizontal and a portion regularly curved, as shown.

A′ is the swaging-roll, which has a die, *a′*, upon its periphery, is provided with the cog-wheel a^2 and with the bearings a^3 in the swinging frame a^4, which is pivoted at a^5 to the shaping-block or any other suitable support. A segmental gear, a^6, is arranged alongside the shaping-block, is stationary, and the gear-wheel in the swinging frame travels upon it, thereby accurately adjusting the two dies to each other.

A clamp, B, having a groove, *b*, in its under surface immediately over the horizontal portion of the groove in the block B′, is provided with a vertical movement in relation thereto by the treadle motion of said Valentine & Rideout machine, already referred to, or by any other desirable means, and serves to clamp the tube and mandrel during the shaping of the tube by the swaging-roll and shaping-block. The upper portion of the clamp is cut away to permit the rolling swage to take hold of the tube close in to the lower edge of the clamp.

The block B′ is provided with a vertical adjustment by means of the screw *b′*, whereby the elevation of the block supporting the tube and mandrel may be varied to correspond with the height of the die, in order that the groove and the die in the roll A may be upon the same level.

The mandrel C is supported in a horizontal position at the end of the arm *c*, and is provided with a horizontal movement by means of the lever *c′* or any other suitable way. I prefer to use a lever, *c′*, hinged at one end to the frame of the machine, and having the mandrel-arm *c* hinged at or near the center of this lever, as by this means I get not only a horizontal movement of the mandrel to and from its place in the dies in the direction of the median line of said dies, but also a movement transverse to this line of the dies, whereby, after a tube is formed, the mandrel C can be thrown to one side, the bent tube readily removed, almost dropping off of itself, and a new tube put in and swung into position where it can be put forward into place readily. This mandrel C consists of the thin metallic ribbon c^2, coiled into a helical or volute form, as shown, the metallic axis c^3, and the rubber core c^4.

The metallic surface of the mandrel is secured upon the metallic axis by means of nuts c^5 c^6, or any other desirable way, and there may be interposed between the butt-end of the mandrel and the extreme end of the axis an elastic cushion, c^7, which serves in one capacity as a nut-lock by maintaining a tension upon the nuts. The nuts also act, in connection with the shoulder c^8, to regulate the extent of horizontal movement of the coiled metallic ribbon.

It will be observed that the shaping-block A is provided, in addition to the die *a′*, with other dies, a^7 a^8, in its periphery, the die a^7 being smaller than the die *a*, and the die a^8 being smaller than the die a^7, and that the swaging-roll, in addition to the die *a′*, is further provided upon its periphery with the additional dies a^9 a^{10}, the die a^9 being smaller than the die *a′* above referred to, and the die a^{10} being smaller than the die a^9.

The dies *a* a^6 a^8 in the shaping-block are of the same shape as the corresponding dies *a′* a^9 a^{10} in the swaging-roll, and when it is desired to adapt the machine for tubes of less diameter than that represented the shaping-block is turned upon its shaft until the die of the proper size is uppermost, and the swaging-roll A′ is moved outward by releasing the frame a^4, and is turned until the die which corresponds in size with the die uppermost in the swaging-

roll is brought to its right position, when it is set back and the swinging frame fastened.

The gearing, it will be observed, centers the dies so that they are adapted to accurately come together, and also causes the roll A′ to be positively revolved about a quarter-revolution; but the gears are extended around the peripheries of the block and roll for the purpose of the adjustment and operation of the dies in the swaging-roll and shaping-block, as above described.

The operation of the machine is as follows: A straight tube of metal of the desired length and shape is adjusted upon the mandrel, the mandrel moved to its proper position in relation to the shaping-block, and then clamped, together with the end of the tube, by the clamping mechanism. The swaging-roll is then moved downwardly, curving the tube in the dies to the desired shape. The clamping mechanism is then released and the curved tube removed from the mandrel. I prefer that the clamp should have an automatic releasing movement.

I do not confine myself to a mandrel having a rubber core and metal axis, as in some instances a mandrel composed of the coiled ribbon of metal alone will answer. Neither do I confine myself to the specific construction, shape, and operation of the clamping mechanism, shaping-block, and swaging-roll, as the mandrel may be used in connection with any suitable forming mechanism for curving metal tubes.

It will be noticed that the movable swage A′ is so geared to the fixed swage A that it has a motion of rotation upon its own axis, not only such as is due to the rotation of its axis in a planetary manner around the axis of the roll A, but also a further rotation produced by the gearing.

While it is true that geared rotating swages have been made for bending straight pipe, such as are shown in Patent No. 171,402, of December 21, 1875, to McWilliams, yet these geared swages are so geared that a large gear meshes into a small one, and therefore gives to one of the rotating swages a movement upon its circumference much more rapid than the other, while in this contrivance it is important that the motion of rotation should be equal in the one and in the other, and therefore the swage A′ is so geared that it gives two complete revolutions upon its axis in one revolution of its axis around the axis of the swage A.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

1. In a machine for bending conical metallic tubes, a flexible mandrel the working-surface of which consists of a metallic ribbon coiled into the exterior shape of a frustum of a cone and supported on its interior upon an elastic core surrounding a flexible spindle, substantially as described.

2. The combination, in a mandrel, of a rubber core and a strip of metal coiled around said core with its edges abutting each other, substantially as and for the purposes described.

3. In a mandrel, the combination of a metallic axis and a core of india-rubber or other suitable material, and a metallic surface composed of a ribbon of metal wound spirally around the rubber core and enveloping the same, substantially as and for the purpose described.

4. The combination of a block, A, having a shaping-die, a, upon its periphery, with the rolling swage A′, provided with suitable means to remove the same, having a shaping-die, a', upon its periphery, the shaping-block and rolling swage being provided with gears a^2 a^6, meshing into each other, giving to the block A′ a partial revolution on its axis, in addition to the partial revolution around the axis of the shaping-block A, as specified.

5. In a machine for bending conical metallic tubes, the combination of a flexible mandrel for holding and presenting a tube to the shaping mechanism, with said shaping mechanism, consisting of the block A, having a shaping-die, a, the rolling swage A′, having a shaping-die, a', and the gears a^2 a^6, meshing into each other and giving to the swaging-block A′ a partial revolution on its axis and a partial revolution around the axis of the shaping-block A, as specified.

6. The shaping-block A, provided with two or more dies varying in size, and adapted to be revolved upon its center and then locked with the swaging-roll A′, provided with dies corresponding in shape and number with those in the block A, whereby provision for bending a number of sizes of tubes is given the machine, substantially as and for the purposes described.

7. The combination of the shaping-block A, provided with two or more dies varying in depth, the swaging-roll A′, having dies corresponding in shape and number with those in the block A, the vertically-adjustable block B′, and the vertically-movable jaw or clamp B, all substantially as and for the purposes described.

SAMUEL W. GEAR.

Witnesses:
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A. J. OETTINGER.