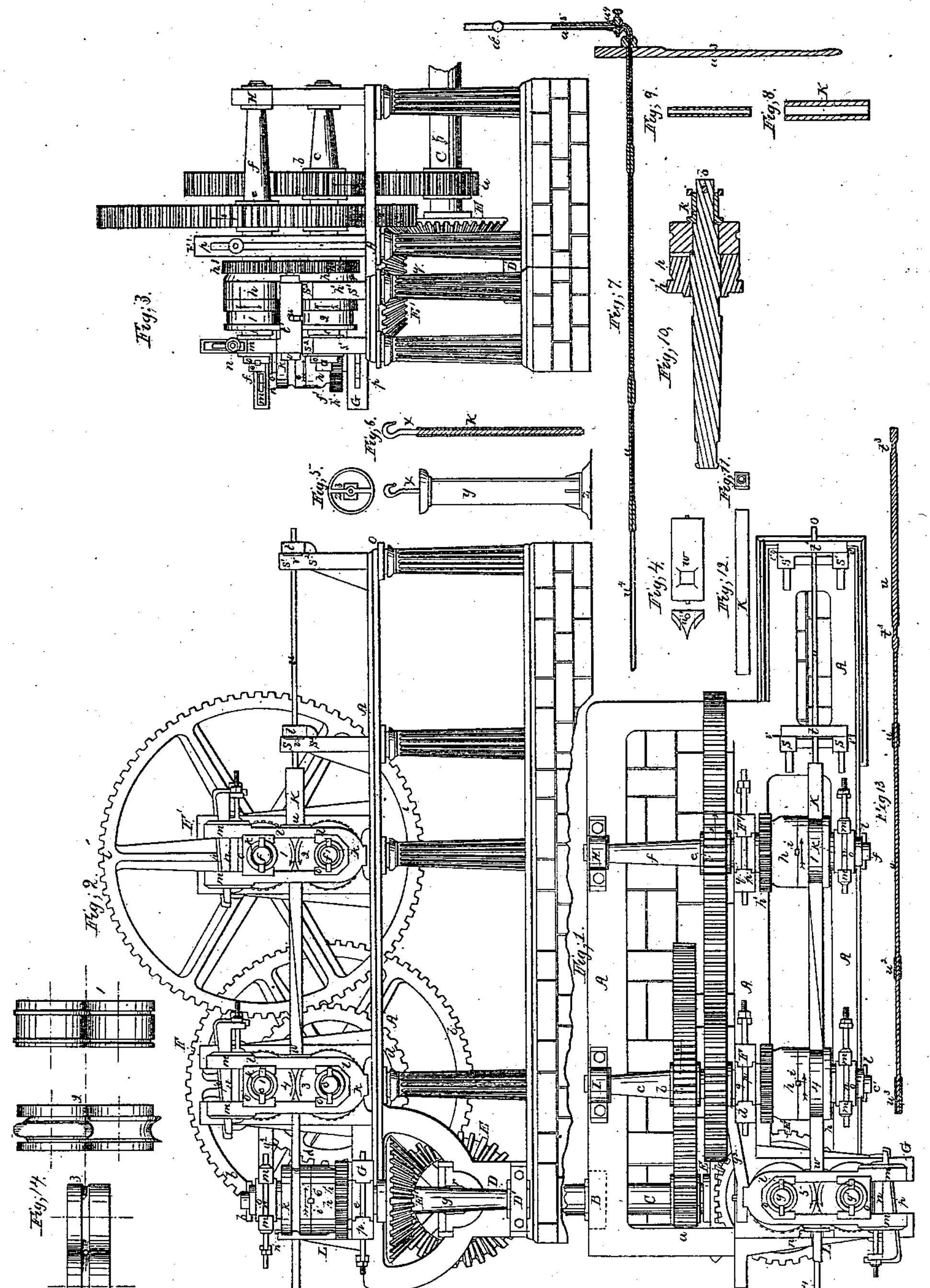
J. E. SERRELL.

Making Metal Tubing.

No. 2,918. Patented Jan. 20, 1843.



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IMPROVEMENT IN MACHINERY AND IN THE PROCESS OF MANUFACTURING METALLIC PIPES.

Specification forming part of Letters Patent No. **2,918**, dated January 20, 1843.

To all whom it may concern:

Be it known that I, JAMES E. SERRELL, of the city, county, and State of New York, civil engineer, have invented, made, and applied to use certain new and useful improvements in the arrangement, construction, and combination of well-known mechanical means for the manufacturing of pipes or tubes of metal, or of mixtures of metals, or combinations of metals, and of exterior pipes of one metal lined or coated internally with another metal of any desired form and available for any use or purpose to which metal pipes or tubes are or may be applicable, and that the said improvements can be modified and made applicable to the manufacture and conversion of metals into various forms for other purposes, as set forth hereafter in these presents, and for which improvements I seek Letters Patent of the United States, and that the said improvements and the mode of constructing and using the same are fully and substantially set forth and shown in the following description and in the drawings annexed to and making a part of this specification, wherein—

Figure 1 is a plan. Fig. 2 is a front elevation representing the general arrangements of a machine for the above purposes. Fig. 3 is an end elevation, as seen from the end *o* of the machine in Figs. 1 and 2.

The detached figures are separately referred to and the same letters or numbers, as marks of reference, apply to the like parts in all the figures.

A is the bed of the machine.

B is a hanging standard attached beneath the bed A. The position of this is shown by dotted lines in Fig. 1, and it carries the outer end of the main shaft C, by which the machine is connected to any competent motive power. The inner end of this shaft C is supported in a second hanging standard, D, at the opposite side of the bed A. (See Fig. 2.) This standard is hid by the columns in Fig. 3. This carries the lower end of the vertical shaft *g*, (referred to hereinafter.) The shaft C has on it the pinion *a*, (partly seen in Figs. 1 and 2,) and also the miter-wheel E. The bed A carries, also, two pairs of upright standards, F and F′, one pair of horizontal standards, G, a standard, H, and a plumber-block, I, on the back of the bed A.

The pinion *a* gears into a driving-wheel, *b*, on the shaft *c*, which is supported in the fixed standard F and plumber-block I. The shaft *c* also carries a spur-wheel, *d*, which gears into a larger driving-wheel, *e*, on the shaft *f*. The shaft *f* is supported by the two fixed standards F′ and H.

The hanging standard D has on it the horizontal plumber-block D′, which carries the lower end of the shaft *g*. The upper end is supported in the horizontal standard G.

The shafts *c*, *f*, and *g* are each fitted with a face-boss, *h*, keyed or shrunk on the shaft within the standards F, F′, and G, and each face-boss has a gear-wheel, *h′*, made on the edge nearest the standards F, F′, and G. These gear-wheels *h′* connect and move together the successive pairs of rollers described hereinafter, which are driven at speeds increasing in proper proportions from that of the first pair of rollers, so that each successive pair clears the metal sent on by the preceding pair of rollers. The shafts *c*, *f*, and *g* extend through the face bosses *h* to carry the shifting or changeable grooved rollers 1, 3, and 5. These rollers are prevented from turning round except with the shafts and face-bosses *h* by keys *i* between the face-boss and the shifting-rollers. The rollers are kept in place by hollow cylinder-journals *k*, which come against the opposite ends of the rollers. These journals pass over the ends of the shafts *c*, *f*, and *g*, the inner ends of which come against the outer ends of the rollers, and the cylinder-journals *k* are kept in place by wedge-keys *l*, going through the ends of the roller-shafts *c*, *f*, and *g*.

The roller 1 has a corresponding roller, 2, below it, which is fitted on the shaft *f′*, with a face-boss, *h*, gear-wheel *h′*, key *i*, hollow journal *k*, and wedge key *l*, precisely as before described, and as shown detached in the sectional Fig. 10, and this description and mode of fitting applies alike to the rollers 4 and 6. The hollow cylinder-journals *k* on all these shafts work in adjustable sliding journal-boxes *o o*, and are held together by wrought-iron straps *m*, mounted in steps on the bed A of the machine, except on the shafts *g* and *g′* over the standard G, where the horizontal strap *m* is supported at the foot by a steady-strap, g^2, which is fixed to the standard F, or may be supported by brackets standing up from the bed A. These straps m carry the outer ends of all the shafts and sustain the pressure caused at this end of the shafts by the "metal" being reduced as it passes between the rollers, and each of these straps m is fitted with keys and gibs n, which secure the journal-boxes o in place, and in the standards F, F′, and G a second set of keys and gibs, p, hold the opposite journal-boxes q and their shafts and rollers in place and sustain the pressure on the opposite journals of the shafts from those before described by the standards F, F′, and G. The inner end of the shaft C is supported by the hanging standard D in the journal-box r. The miter-wheel E on the shaft C gears into a second miter-wheel, E′, on the vertical shaft g, which carries the roller 5, and this gears into the roller 6, as above described.

At the opposite end of the machine two pairs of standards, s and s', on the bed A have each a bracket-shoulder, s^2, to carry two mandrel-clips, t and t', which are each fitted with a notched bearing to receive the journals t^3 of the mandrel u, (see Fig. 13,) so as to hold and carry the mandrel while in work. The clips t and t' have a wedge, v, between the standard and clip at each end of each clip to shift the strain while in work onto either pair of standards.

In Fig. 4, w is a front elevation, and w' an end view, of one of a set of guide-pieces which are fitted and suited to match the circumference of the rollers by the concave wedge form shown in w', Fig. 4, and a hole or mortise through each of these guide-pieces w is to be the same size as the metal intended for reduction by the rollers to which the guide belongs.

In Fig. 5, y represents a mold made to open to cast "ingots" of metal in. x is a mandrel or core which passes through the center of the mold y. The mold is held together at the bottom by the foot-piece z and at the top by the top piece, z', which is made like a cup without a bottom, with a cross-piece, z^3, in it, which carries the top of the mandrel or core x, and a hole or countersink in the foot-piece z supports the bottom of the mandrel or core. At the cup-piece z' the melted metal is to be poured in to fill the mold and make an ingot, K, of the form shown in Fig. 12.

Fig. 7 represents a section of a hollow mandrel with a holding-lever, a^3, instead of the mandrel-clips t and t'. The purpose of this lever is to draw the mandrel out of the pipe after it has passed through the rollers, as there will be a portion of the pipe on the mandrel after it has passed the rollers. The cock a^4 is then to be withdrawn and the mandrel is then to be taken out, as it has to be passed through each ingot that has to be rolled; or a mandrel like that shown in Fig. 13 may be hollow and the ingot charged on in the manner herein described. This hollow mandrel is to be used with water admitted to run through it to keep it cool while the hot metal is on it by the cock a^4 from the pipe a^5, connected to a supply-pipe by a swing-joint, a^6, which allows of the cock being removed to or from the mandrel.

When the machine is thus made, fitted, and adjusted, any proper motive power is to be applied to turn the shaft C in the direction of the arrow 1. This turns the pinion a in the same direction, which gears into and turns the driving-wheel b on the shaft c and spur-wheel d in the same direction as the arrow 2. The spur-wheel d turns the driving-wheel e on the shaft f in the direction of the arrow 3. This drives the rollers 1, 2, 3, and 4 in the direction of the arrow on each roller. The miter-wheel E on the shaft C gears into and drives the miter-wheel E′ on the shaft g. This drives the rollers 5 and 6 in the direction of the arrow on each roller. When set in motion at the proper speed required by the material to be operated on, the mandrel-clip t' is to be taken off the end of the mandrel and an ingot of metal, K, (see Fig. 12,) is to be slid on the mandrel. The clip t' is then to be replaced and the wedges v are to be driven in. The inner clip, t, is then to be removed and the ingot of metal K is to be put up to the rollers 1 and 2 through the guide-piece w, which leads and retains the metal fair with the grooves in the rollers and thus makes the reductions equal on both sides of the metal. The guide-pieces w are held in place by pins in the ends, (see Fig. 4,) which go into the straps m and standards F, F′, and G. The hole in the guide w is to be perfectly central with the meeting and groove of the rollers. The rollers take the ingot along, and when it has passed the clip-seat t^3 (see Fig. 13) on the mandrel and standards s the clip t is then to be replaced and the wedges v are to be driven in sufficient to take the strain of the rolling and loose the clip t', when a second or successive piece or ingot is to be charged on the mandrel while the former is reducing without stopping the machine in its work.

Figs. 1 and 2 show metal in progress of reduction to pipe.

Fig. 11 shows the general proportions and forms of the progressive reductions made on the ingot by each successive pair of rollers until the last pair deliver it in the form of a pipe or tube, (which may be of any form.) These proportions will of course vary with the size of the pipe and description of metal, but will be nearly as represented. As the metal passes from the rollers 1 and 2 toward the rolllers 3 and 4 the workman takes hold of it with a proper tool—such as a wrench—and gives it a quarter-turn before it enters the hole in the second guide w, which is before the rollers 3 and 4; or this turning may be effected by angular guides set to twist the metal as it passes through the rollers instead of the workman turning it. The rollers 3 and 4, 5 and 6 being set at right angles to each other, the metal does not require to be twisted between them. This last pair of rollers, 5 and 6, deliver the metal in the form of a pipe or tube, which may be passed through the triblet n' in the standard L, which finishes the outside of the pipe or tube perfectly smooth, as there will be an expression or impression on the pipe where the rollers meet, which the triblet will remove.

Fig. 6 represents the ingot-core x, surrounded by a tube or pipe of any metal which will adhere to another metal poured round it in the mold y—such as a tube of tin placed on the mandrel or core x—and placed in the mold y and lead cast at the right heat round the tin, with a common flux to unite the metals, which are then to be rolled out, as before described. This operation will produce a pipe or tube of lead with a coat or sheet of tin inside of the lead pipe or tube of a thickness according to the extension in length by the reduction in area effected by the rollers.

When the outside metal will not adhere to the inside metal by reason of a higher heat being needful to melt the inside metal, then the ingot may be formed as shown in Fig. 8. Where the hole is larger than is intended for the bore of the pipe, then the coating metal is to be cast inside the outside metal, in any convenient manner, as it is best to pour the metal which requires the greatest heat to melt it against cold metal, which requires the less heat to melt it, to make both adhere with a perfect joint by the other metal fusing and adhering to the hot metal.

The hollow mandrel u (shown in Fig. 7) is to be used for iron and other metals when worked hot, or with cold should it be considered necessary to prevent the mandrel being heated by friction.

The mandrel u, Fig. 7, is to be passed through the ingot, and the waste-pipe u^4 is to be put on the end of the mandrel. After it is in place, the cock a^4 is then to be put in the end of the mandrel and opened instantly to let water from a competent supply run through it. The metal is then to be passed through the rollers, as before described, and the waste-pipe u^4, which fits at the opposite end of the mandrel to the cock, carries off the water clear of the hot metal which is being operated on. When the metal has passed through the rollers, the cock a^4 is to be shut and the mandrel withdrawn from the metal, as described, by the lever a^3. The waste-pipe u^4 is then to be removed from the end of the mandrel. It is then to be taken out of the hot metal, when it and the mandrel will be ready to receive a second or successive pipe or ingot. The waste-pipe u^4 is not needed when the metal is worked cold, as the water may run into metal which is being operated on, should it not injure it.

Fig. 8 represents an ingot of any metal or mixture of metal with a hole or core through it larger than is intended for the bore of the pipe, and Fig. 9 represents a piece of pipe or tube of a different metal or mixture to that in Fig. 8, which second piece is to be placed inside the "first," Fig. 8, while either or both pieces of metal are hot, with a flux on either or both, and these are to be passed through the rollers while hot, in the manner before described. By these means lead pipes may be lined with tin or iron pipes may be lined with copper in the act of manufacture, and pipes or tubes of any metal or mixtures of metal or combinations of metals may be thus lined with an internal coat of another metal, or pipes or tubes may be covered with an external coat of a different metal, or may be both "lined" and "covered" "inside" and "out" by either any or all the metals being heated, and flux on any or all. They may be welded together in the act of manufacture, provided the affinities of heat, cohesion, and flux will assist the operation and complete the adhesion of the metals to each other; or an internal or external coating of metal may be formed that shall not adhere to the outside or inside metal, provided the adhesion is not needed.

By the mode described of connecting the rollers and shafts the rollers can at any time be changed to produce different-sized pipes or tubes by employing rollers with larger or smaller grooves and mandrels of larger or smaller diameter by removing the keys l and loosening the keys and gibs n, so as to take off the strap m, journal-boxes o o, and hollow cylinder-journals k. The grooved rollers with one-sized grooves may be changed by taking them off the shafts and the rollers with different-sized grooves be substituted, as the action of rollers with any sized grooves is secured by the keys i, which force the rollers to travel with the face-bosses h. The standards F, F′, and G and straps m being made of a strength equal to the strain of the maximum-sized grooves in the rollers, I do not intend to limit myself to using rollers with one groove; nor do I intend to confine myself to the number of pairs of rollers shown in the drawings; but I intend to use any number of "pairs," either set at any angle to the pairs adjoining or in lines parallel to each other, that may be required by the nature of the material and the size of or kind of pipe intended to be made, and I intend to use such rollers with the centers of the grooves in the same horizontal planes or parallels, whether the rollers are all horizontal or all vertical, or part horizontal and part vertical, or in any way at angles to each other, and in all cases to vary the speeds or diameters of the rollers, or both speeds and diameters, so as to give the speed which is needful to make any following and successive pair of rollers receive and reduce the amount of extension in length caused by the reduction made in the sectional area of the material by the preceding pair of rollers.

The mandrel u may be made straight or as shown in Fig. 7, where the mandrel is made smaller where the rollers do not operate on it. This is done to prevent friction, as much as possible, on the mandrel; or the mandrel may be formed, as shown in Fig. 13, with thimbles or collars, as shown at u', u^2, and u^3, so that the sliding friction while in work will be only "there," and will not operate on other parts of the mandrel. These collars may be made to shift and screw on and off, so that one mandrel with different-sized collars will make different-sized insides of pipes or tubes. These arrangements of rollers and guides can be used for forming wire from lead and other metals, or for rolling metal into bars, as by this arrangement hot metal can be forced through in a course of regular and rapid reductions in a manner which has not been before used for making bar-iron, as it is not returned through the same pairs of rollers, as in the old mode. This arrangement of rollers, guide-pieces, and mandrel may be used when making short lengths of pipe or tube, when the metal does not feed from one roller to the other, but may only pass from one roller to the next, and the rollers travel at any speed at pleasure of the operator, or according to the nature of the material to be operated on, by the centers of the rollers being sufficient distance apart to allow of the extension made on the ingot by each particular pair of rollers.

Fig. 14 represents a modification of the mode of making iron pipes or tubes. As it is found in practice that the rapidity at which heated iron must be passed through the machine by the motion of the rollers and off the mandrel u to prevent it being heated by metal being in contact sufficient time to heat and injure the mandrel is hazardous, therefore the following mode is applied as being a more safe operation: The pair of rollers 1 deliver the iron in a flat bar of the desired thickness and sufficient in width to make, when turned or bent into a circle, a pipe or tube of the required size. As it passes from said rollers 1 the bar goes into the rollers 2, which bend it into a semicircular form as it passes through. It then goes into the rollers 3, which turn the edges together and deliver it in the form of a pipe or tube, ready to be reheated to a welding heat and passed through a similar pair of rollers to those last described, or it may be drawn through a triblet-hole, either of which operations will bring the meeting edges of the joint together and weld them and deliver it in the form of a welded pipe or tube. The guide-pieces w, though not shown in front of these rollers, are to be used to guide the metal, as before described. The general arrangements of these rollers can be used for forming nearly every regular or irregular form—such as nails, rivets, and also for making shot and balls of lead—as the desired form can be given one way, and the roller being so set that the form beforegiven matches in the succeeding rollers. As they all travel together, a continuous length can be carried through without the least attention after the rollers are once set, or by making the rollers of the cam form pipes or tubes can be made of the form of gun-barrels. This mode of rolling I intend claiming by an improvement on this application, so soon as I shall have completed these operations in practice.

I am aware that a portion of the parts herein described have been before used for various mechanical purposes, and therefore I do not claim to have invented any such parts taken separately from the arrangements forming the combinations thereof with each other, which I claim as new, such combination being as follows:

1. The arrangements and application of mechanical means, as herein described, for reducing pieces or ingots of metal, or mixtures of metals, or combinations of metal into pipes or tubes, or into bars, rods, wire, or other forms, by the operation of any number of pairs of grooved, beaded, indented, raised, or hollowed rollers, either set in lines parallel to each other or at any angle to each other, or both angular and parallel rollers combined, when such pairs of rollers or combinations of pairs of rollers travel, work, or move at speeds successively increasing according to the amount of extension in length caused by the reduction in the area effected by each preceding pair of rollers, so that the finally-required form of metal shall be produced by the action of the last pair of rollers on the metal or metals of any ingot operated on in the manner herein substantially described and set forth.

2. The combination, with the arrangement of rollers above described, of the changeable guide-pieces w and the changeable hollow or solid mandrel u, either mounted and held in the clips t and t' or operated on by the lever a^3, such parts being constructed, combined, and operating substantially as herein set forth.

3. The several modes herein described and set forth of forming ingots of more than one distinct metal, or of mixture of metals, when such ingots are afterward to be made into pipes or tubes having either the inner or outer surface, or both, formed of different metals or mixtures of metals, substantially as the said modes of forming ingots for such purposes are described and set forth.

In witness whereof I have hereunto set my hand, in the city of New York, this 9th day of November, 1842.

JAMES E. SERRELL. [L. S.]

Witnesses:

JOHN B. FRANKS,

T. A. WAKEMAN.