(No Model.) 2 Sheets—Sheet 1.

W. A. McCOOL.

METHOD OF MANUFACTURING COLD DRAWN METALLIC ARTICLES.

No. 602,417. Patented Apr. 12, 1898.

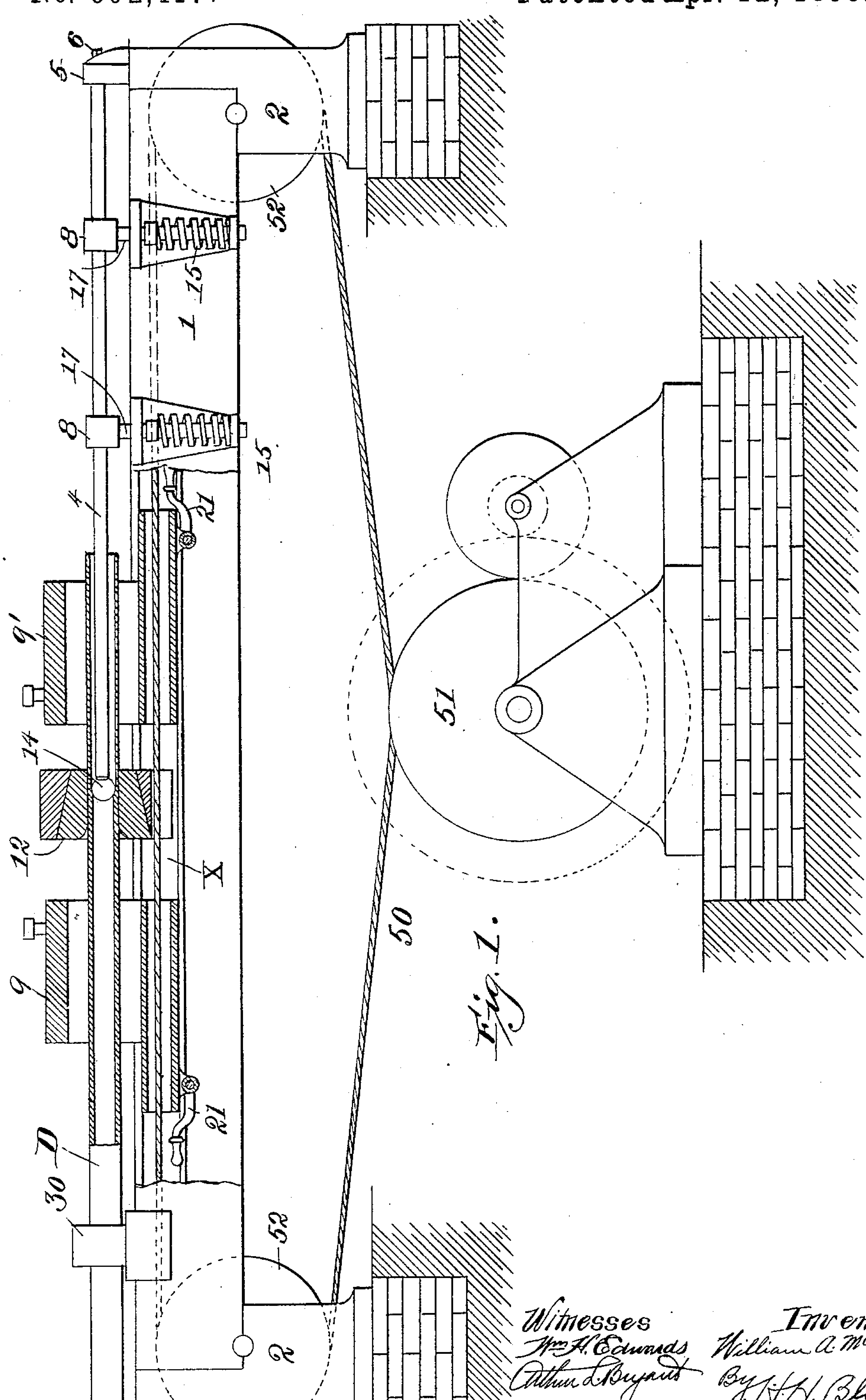

Fig. 1.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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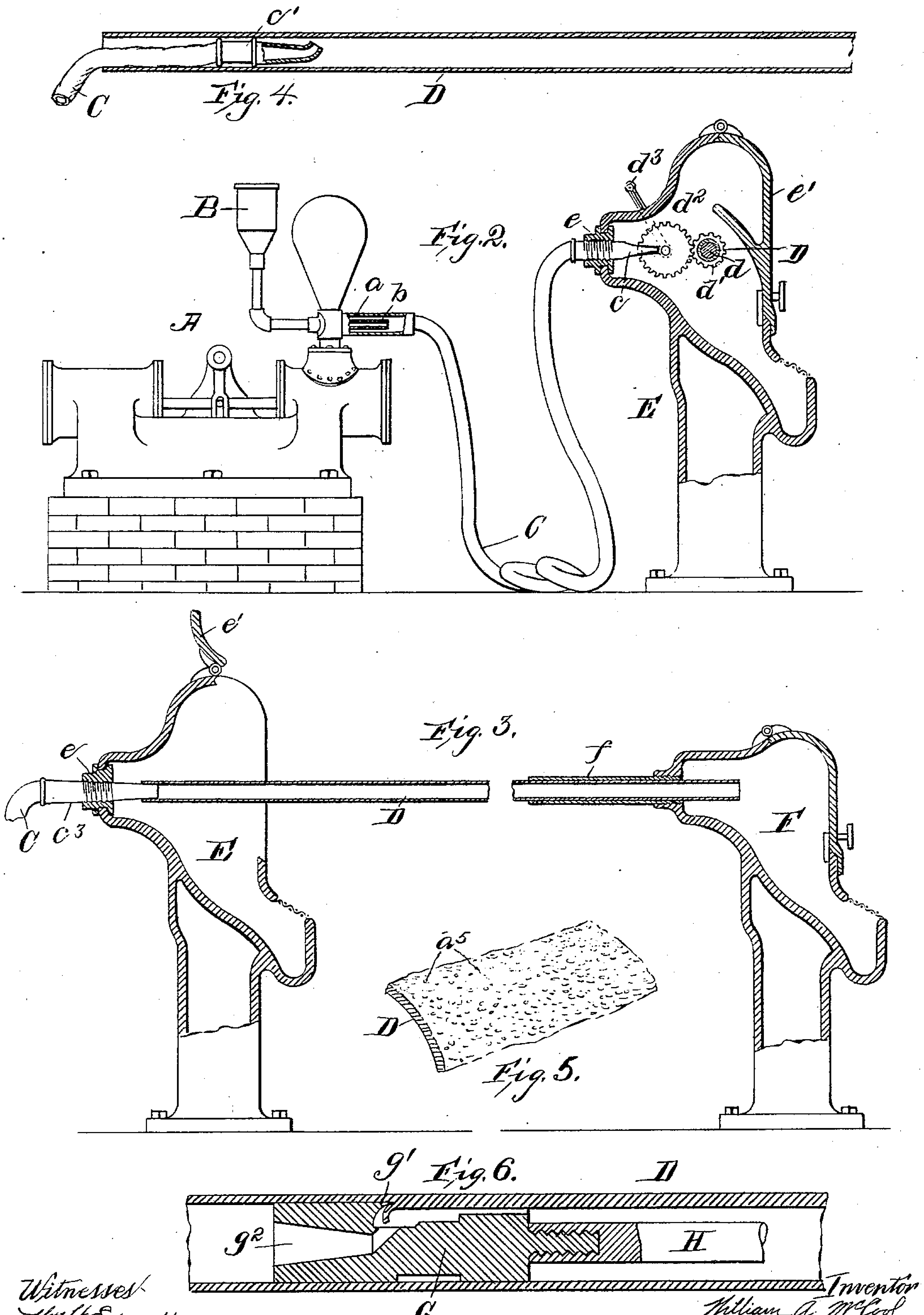

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UNITED STATES PATENT OFFICE.

WILLIAM A. McCOOL, OF BEAVER FALLS, PENNSYLVANIA.

METHOD OF MANUFACTURING COLD-DRAWN METALLIC ARTICLES.

SPECIFICATION forming part of Letters Patent No. 602,417, dated April 12, 1898.

Application filed October 24, 1896. Renewed March 24, 1898. Serial No. 675,039. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM A. McCOOL, a citizen of the United States, residing at Beaver Falls, in the county of Beaver and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Manufacturing Cold-Drawn Metallic Articles, (for all or parts of which there have been issued to me Letters Patent in the Kingdom of Great Britain and Ireland, No. 25,686, dated November 14, 1896; in France, No. 270,462, dated September 14, 1897, and in the Kingdom of Belgium, No. 130,827, dated September 24, 1897;) and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

Heretofore in manufacturing "cold-drawn tubing" it has been customary to employ billets of specially-prepared steel, which are first perforated axially by drilling or other suitable means and afterward have the central opening enlarged to the desired diameter, the billets being elongated by passing them while heated over mandrels of different diameters. After that they are cleaned of "scale" by the action of acid, "limed," and annealed and are then ready for "drawing."

One of the objects of the present invention is to obviate the expense incident to this method of manufacture heretofore followed.

Another purpose is to avoid the deleterious effect wrought upon the metal by the acid or basic materials heretofore used in cleaning the tubes.

By following my process even lap-welded or butt-welded tubing can be employed, such as is cheaply manufactured for various purposes.

To remove the scale (consisting of oxids and other materials) either at one of the initial steps of my manufacture or at the later stages, I subject the surface of the metal to mechanical abrasion in contradistinction from chemical treatment. This abrasion may be accomplished in any of several ways. At present I prefer to expose the metal surfaces to the action of a blast, such as a blast of air, carrying small particles of hard abrading material. Numerous materials consisting of masses of small particles suitable for this purpose are well known; but I have found that the best results are obtained when use is made of small particles of relatively hard metal, such as small shot or metallic globules, they being preferable to emery, sand, or non-metallic particles in this that they are not liable to adhere to or remain upon the surface of the metal, and if any of them should so adhere they will not cut or mar the mandrel or dies used in the steps of drawing. When a blast carrying suitable materials of this class is properly applied, it can by its simple mechanical abrasive action be caused to remove all scale and other excessively hard substances foreign to the pure metal desired and which are liable to mar the drawing dies or mandrels and also to leave imperfections in the tube, and this abrading can, if desired, be accomplished in such way as to form numerous more or less minute indentations on the surface of the metal, the result of such pitting being to assist the "flow" of metal when being drawn, minute spaces being provided adjacent to the contact-points of the dies and into which the fibers or molecules of the metal can pass under the pressure; but this may be regarded as independent of the cleaning or scale-removing effect of the abrasion. This mechanical abrasion can be applied as frequently as is desired during the entire process of forming the tube, it being generally desirable to apply it after each annealing or heating.

When my process is employed in the manufacture of drawn tubing from those initial tubes or blanks which are formed by bending up flat plates and "lap-welding" or "butt-welding" the edges, it is desirable sometimes to not only treat them in the way above described, but also to remove the surplus metal that appears along the line of union of the welded edges, and thereby produce a thickness of metal which is uniform in cross-section on all radial lines, and this I accomplish by cutting away such surplus metal on lines longitudinal of the tube. This can be done at an earlier or a later stage in the drawing of the finished tube; but generally I prefer to take this step, when necessary, at an early stage—to wit, after the initial cleansing of the interior surface.

I have also found that when tubing is being drawn on the bench it is very desirable to apply the longitudinal propelling force to the tube by mechanism capable of more or less yielding, so that the propulsion shall not be absolutely positive and fixed at all times, but such as to allow slight checks in the advance, the result being to permit the metal to more gradually flow at those instants when extraordinary resistance is experienced. For this purpose a frictional engagement of two of the driving or propelling devices is advantageous—as, for instance, by employing a driving-drum with a chain or cable wrapped around it.

Another matter of importance is to have the tube-propelling mechanism comprise two parts which can be brought into engagement at any transverse line—as, for instance, by having a cable or chain of uniform cross-section throughout its entire length and a gripper adapted to be quickly connected thereto at any point. This is in contradistinction from the plan commonly followed of drawing the tube by means of a hook or pin and a chain which can only engage with the hook at certain points separated by relatively large ntervals.

In the drawings I have illustrated tools and machines of some sorts which can be used in carrying out my process.

Figure 1 is a section of a drawing-bench. Fig. 2 is a side elevation of one form of apparatus adapted for mechanically abrading the exterior surface of a tubular blank in accordance with my invention. Fig. 3 is a view of a device adapted to apply the abrading material to the interior of the blank. Fig. 4 is a view of a slightly-modified device for applying the blast to the interior of the blank. Fig. 5 is a view, on an enlarged scale, of the exterior surface of the blank after having been subjected to the action of the mechanism shown in Fig. 3. Fig. 6 is a sectional view of the tool for removing surplus metal from the interior of the blank.

In the description below I will assume for the sake of simplicity that it is desired to manufacture fine cold-drawn tubing from initial blanks produced by lap-welding or butt-welding, it being understood, however, that some of the matters to be described are also applicable to the manufacture of tubes from solid billets. As generally I subject the blanks to the action of the drawing bench or machine at an early stage, I will refer briefly to that mechanism first.

1 1 designate the side rails of the bed or support of the apparatus, which rails are mounted at their ends upon suitable pedestals or standards 2 2.

12 designates a stationary circular die rigidly secured to the side bars 1 1 at an intermediate point of their length. This die may be constructed in any preferred and well-known manner.

In ways or guides X, formed on the inner faces of the side bars 1, are fitted carriages 9 9′, by which the tube is moved longitudinally of the bed through the circular die 12, each of these carriages being provided with adjustable jaws or clamps for grasping the tube or blank D.

50 designates an endless rope or cable which passes around a suitable driving-drum 51 and guide wheels or drums 52, journaled in the pedestals or standards 2. Each carriage 9 9′ is provided with means for attachment to said endless rope or cable, whereby such carriage and the tube D when engaged by said carriage may be moved longitudinally of the bed and the tube forced through the die 12.

The cable-gripping jaws of the carriage are arranged on opposite sides of the path of the cable 50 and adapted to be moved by a hand-lever or crank-handle 21 inwardly to grip said cable or outwardly to release the same. The handle 21 can be secured in position by any suitable means. By moving said handles the carriages 9 9′, or either of them, can be instantly connected with or disengaged and released from the cable.

4 designates the mandrel, which is supported from the bed at one end and may be of any suitable style and construction. Preferably it is supported in a tailpiece 5 and connected with an adjusting-screw 6. For holding the mandrel in a straight line throughout its length I employ a series of auxiliary supports or holders. Each of these movable holders comprises a vertical shaft 17, mounted in a bearing projected laterally from the side or bed rails 1. Each shaft 17 is provided at its upper end with an arm 8, which normally extends inwardly over the bed-frame and engages with the mandrel 4. The vertical shaft 17 is normally held in such position as to cause the arm 8 thereof to contact with the mandrel by means of a coiled spring 15, fitted around the lower portion of said shaft.

To support and guide the tube as it moves toward the compressing-die at 12, I employ a guide-stand 30, bolted to the frame-bars 1 1.

The mechanism above described is used as follows: The die 12 is properly placed and the mandrel is adjusted so that its head 14 is in proper position relative to the die. If the tube is to be compressed from the exterior only, the mandrel can be temporarily withdrawn, and vice versa. When the parts are in position, a tube D is pushed forward, and its front end is passed to a point somewhat in front of the carriage 9, the latter being at this time disengaged from the cable 50. When the tube is properly placed, the parts are so adjusted as to cause the tube-engaging jaws of the carriage to tightly grip the tube, and then the lever 21 is moved to cause the cable-gripping jaws to engage the cable. As soon as the carriage 9 is thus caught by the cable the latter forces it and the tube toward the die 12, the tube projecting a short distance in front of the carriage. The propelling of the tube continues until its forward end has passed through the die far enough to permit it to be connected to the carriage 9′. Then the carriage 9 is released from the cable and from the tube. After this the carriage 9′ is clamped to the tube and connected to the cable. After the occurrence of the latter the carriage 9′ commences to move with the cable and to draw the tube through the die.

If an interior mandrel is in use, its stem 4 is supported in alinement, as aforesaid, by the movable arms 8. If at any time it is desired to obtain a new grip upon the tube at points farther back from its forward end, the carriage 9′ is released from the cable and from the tube and pushed by hand or otherwise backward to a position near the die, after which it is again clamped to them and the drawing continued. Should it be desired to propel the tube from both sides of the die—that is, to impart both a pushing and a pulling action—both carriages can be clamped to the cable and the tube.

I have above briefly described and in Fig. 1 of the drawings have illustrated, more or less conventionally, the form of draw-bench which I at present prefer, the same being particularly described and illustrated in my application for patent, Serial No. 605,657, to which reference may be had for the details of construction; but it will be understood that other forms of drawing mechanism may be substituted for that selected for purposes of illustration herein without departing from my present invention.

It will be understood that to the mechanism above described the tube is subjected as often as necessary to reduce it to the desired thinness and to bring it to the required diameter and also understood that at suitable intervals between successive drawings in that machine it is subjected to the action of other tools or mechanisms when necessary, as for the purpose of cleansing, for removing surplus metal, annealing, &c. For cleansing it by mechanical abrasion, as above described, a simple mechanism can be used. In Figs. 2, 3, and 4 I have illustrated a mechanism adapted to carry out this step in my process, referring to which—

A designates an air-compressor, with which is connected a receptacle B for containing the shot or other abrasive material, said receptacle having a delivery-spout *b* arranged at the axis of the delivery-tube *a* of the compressor A. With the latter is connected a flexible pipe C, terminating in a nozzle *c*. The tube D is supported on a spindle *d*, mounted in a suitable casing E. Said spindle is adapted to be rotated by means of a pinion *d*′, with which meshes a gear d^2, connected with a crank d^3.

The nozzle *c* is adapted to be fitted to a holder *e*, fitted in suitable guides to move longitudinally of the casing E, so that the blast of air carrying the abrasive material can be applied to the entire exterior surface of the tube D.

Whether the devices just described or others be used for holding the metal while applying the blast the latter must be applied in such way as to similarly impinge upon each and every part of the surface, so that there shall be a uniform cleansing along all longitudinal lines and at all points. This can be readily accomplished in the way described by rotating the tube while the blast is being applied, so that the stream of shot will at one instant or another impinge upon every point or small area of the article and act uniformly throughout the entire surface. Such a treatment is superior to that attained by merely passing the article longitudinally past a fixed blast-nozzle or even passing the nozzle rectilinearly along one longitudinal line, for in such case there would be regions of abrasion and also lines where practically no abrasion occurs, with the resulting danger that small particles of the scale would be left adhering to the surface, any one of which would mar and possibly ruin the die. Hence I insure a uniform action of the blast upon all parts of the surface, not only to insure the entire removal of every particle of scale, but also provide against cutting away the steel more at one place than at another.

In order to apply the blast to the interior of the tube D, either of the devices illustrated in Fig. 3 or Fig. 4 may be employed. In the first the nozzle c^3 is inserted into a holder similar to that at *e*. The door *e*′ at the rear of the casing is opened, and the other end of the tube D is supported in a tubular holder *f*, carried by a casing F, similar to that at E; or, if desired, a nozzle similar to that shown in Fig. 4 may be employed. In this style the nozzle *e*′ is of such form and size as to pass into the tube D, and its movements are controlled by or through the flexible supply-pipe C. The scale upon the interior is often very refractory, and in order to have the blast exert the most efficiency it is better, prior to applying the latter, to pass the tube through properly-sized external dies, which will act to slightly compress it and by such compression crack or loosen the scale on the interior, and after such loosening by compression the abrading devices are able to entirely remove it and leave a clean and polished interior. The effect of the blast of abrading material upon the tube is to remove the scale therefrom and also form numerous minute indentations or pits in the surface of the metal, as indicated at a^5 in Fig. 5. This treatment by abrasion is advantageously applied after any step liable to produce scale, oxid, or the like—as, for instance, an intermediate annealing—and as concerns this feature of the invention it will be seen that it is applicable to drawn tubes whatsoever be the nature of the initial blanks, even those provided by perforating a solid billet; but, as above said, one of my purposes is to provide a method of treatment which shall also be applicable to tubes formed from blanks or initial tubes which are formed from plates with lap-welded or butt-welded edges. Tubes of this latter sort, owing to inaccuracy in the mechanism by which they are formed and owing to the nature of the union of the edges, have one or more longitudinal lines along which the metal is relatively thickened, the thickened part often amounting to a rib-like projection extending inward on the interior of the tube, and even tubes or blanks formed by perforating solid billets are often found to contain lines of metal which it is desirable to remove at an earlier or a later stage in the drawing. To remove such an inward-projecting part of the metal or to for any purpose effect a longitudinal cut, I prefer to employ an implement of the form illustrated and described in detail in my application Serial No. 605,656 and generally illustrated in Fig. 6 herein. It consists of a body G, adapted to be attached to a mandrel H and provided with a cutting edge *g* and a passage *g'*, through which the cuttings produced by the cutter can pass to a point in rear of the body of the implement.

Having thus described some of the devices at present preferred for carrying out my improvements, I now call attention to the ways in which they can be used.

For instance, I can either commence with blank tubes obtained from other manufacturers and made by the butt-welding or lap-welding process or can myself provide such blanks by heating flat sheets, bending them in suitable machinery, bringing together the side edges of each sheet, causing more or less of the metal along each edge to overlap that of the other and welding the edges, and there is generally more or less metal left as a surplus along the line of the weld, causing a variance from a uniform cross-section of the tube, or I can employ initial blanks, produced by perforating billets. In either case there are stages in the manufacture when heating is necessary or subjecting to some treatment which produces scale or foreign undesirable material that tends to cut or mar the dies or mandrels.

Let it be assumed that the "lap-welded" tubes are used and that I desire to reduce, for example, a large lap-welded tube (say one two inches in diameter) to a very thin walled tube of small diameter, (say one-half inch in diameter.) My invention provides for taking the following steps, among others, to wit: I first subject the blank to a cleansing of the exterior surface, preferably by submitting it to the aforesaid blast of air carrying particles of abrading material, though for the exterior surface, under some circumstances, as when the metal is sufficiently thick, other modes of cleansing can be followed, for the texture of the metal is not at such times dangerously attacked to any particular depth by the reagent. Then after cleansing the exterior the tube can be introduced into a drawing-bench, (such as in Figs. 1 and 2,) the external die only being present, the interior mandrel being removed, and after one or two passes the metal will be compressed sufficiently to crack or loosen the scale on the interior surface. After that the interior is subjected to the action of abrading material, and if this be a stream of small metallic particles, like minute chilled shot, the said surface will be thoroughly cleaned and nothing left therein of such character as to scratch or mar the dies or mandrel. This being done, it is advisable to now apply the cutting-tool (such as shown in Figs. 9 and 10) to remove surplus metal along the line of the weld and reduce the tube to a uniform thickness in cross-section. Ordinarily it will now be ready to go through a series of passes on the drawing-bench, the external die and the interior mandrel being so sized and related (for the purpose at present assumed) as to gradually both reduce the diameter of the tube and also reduce the thickness of its walls. During these steps of drawing it will often be found that a reheating of the metal is advisable. Such heating at once makes liable the production of new scale, oxid, &c. When this occurs, return must be had to the air-blast and abrading material. If the acid or basic treatment commonly employed be applied, the purity in the texture of the metal is attacked, particularly as the thinness increases, and yet all of the scale must be removed lest a remaining particle should, by reason of its extreme hardness, be crowded into the softer metal, and thereby create a serious flaw or cut into the smooth and polished surface of the die or mandrel, and thereby introduce a possible factor of destroying the whole article. Moreover, a serious difficulty, as is well known, is experienced almost everywhere in using the finished tubes, (as well as shafts or bars which have been subjected to acid treatment,) because of the fact that these articles refuse to receive and retain upon their surfaces other materials that may be applied—such as enamel, japan, and platings. This has been found to be due to the effects of the acid. Even the highest grades of cold-drawn tubing—such as are used in the manufacture of bicycles, for instance—are found to present upon their surfaces numerous pits or holes into which the acid has eaten its way, and the entire surface is more or less characterized by the presence of acid or its compounds, such as sulfate of iron. The bicycle manufacturer has to subject this tubing, after he has purchased it from the tube manufacturer, to a grinding and polishing action in order to cut the surface down to the bottom of these acidcavities. In other words, he has to reduce the surface far enough to reach a wide surface of pure metal before he can apply the enamel, japan, or other surfacing material; otherwise the latter would peel off or flake off, as is well known to manufacturers. Even then it is no uncommon occurrence to have this chemical action of the acid continue after enameling or japanning until the metal is eaten through or weakened to the point of breakage. All this is obviated by following the method which I have devised. The metal articles pass from my hands to the other manufacturer in such a pure state that the surfaces that require enameling or japanning can be successfully and permanently coated immediately without further treatment. The acid materials (used at one stage or another in the drawing process for cleaning such articles) accomplish their work by attacking the pure metal and eating under the specks or flakes of scale or silicate compound, whereas in the present process these foreign materials are directly attacked by the shot-blast and removed, leaving all the pure metal.

I am aware that glass has been cut and that metal surfaces have been treated by means of sand-blasts, but I believe myself to have discovered that such a treatment of metal as I have described can be employed as an important adjunct in the cold drawing of it, in that I can thereby give to the external or interior dies or mandrels surfaces of pure metal to act upon—that is, surfaces not only free from the scale formed in earlier stages of treating the metal and that formed during the process of cold-drawing, but also free from acid and acid compounds.

As above stated, I prefer to use for the cleansing agent masses of very minute spherical metallic shot in contradistinction from masses of particles having angular surfaces. Sand and similar materials can be successfully used, provided that great care is taken to subsequently clean such material off from every part of the surface and also repeatedly cleanse the surfaces of the dies and of the mandrels. Such materials as sand and the like have more or less angular surfaces and therefore there is a tendency for them to adhere to the smooth metallic surfaces of the dies and of the tubes or bars, and if any should thus adhere, even though very minute, they would result in a cutting not only of the tubing, but of the drawing implements, for, as is well known, the very dust itself of such bodies results frequently in great loss. The globular metallic particles which I employ are superior, because of their lacking entirely the tendency to adhere to metallic surfaces. When propelled in a stream with great force, they cut the scale rapidly and thoroughly and then instantly disengage themselves from the metal surfaces, so that neither the mandrels nor the dies are harmed.

It will be readily seen that many of the features of improvement are just as applicable in treating tubes which commence initially as perforated billets, for it is just as necessary with them to effect a cleansing at one stage or another, and under some circumstances it is desirable to cut or similarly remove from them certain lines or projections of metal which prevent the production of the desired uniform tubing.

What I claim is—

1. The herein-described method of treating blanks for the manufacture of drawn tubing, it consisting in abrading the exterior surface of the blank, then compressing the blank radially, then abrading the interior surface of the blank, and then subjecting the blank to the action of the draw-bench, substantially as set forth.

2. The herein-described improvement in the manufacture of drawn tubing, it consisting in drawing a tubular blank through a die and compressing the metal of the blank radially, abrading the interior surface of the blank, and then drawing the blank over a mandrel or through a die, substantially as set forth.

3. The herein-described improvement in the method of manufacturing drawn tubing, it consisting in drawing a tubular blank through a die to compress the metal radially, then abrading the interior of the blank, then drawing the blank over a mandrel or through a die, then heating the blank, and then again abrading the blank to remove any "scale" that has formed thereon, substantially as set forth.

4. The herein-described improvement in the method of manufacturing drawn tubing, it consisting in abrading the exterior surface of a tubular blank, then drawing said blank through a die to compress the metal radially, then abrading the interior surface of the blank, then drawing the blank over a mandrel or through a die, and then heating the blank, substantially as set forth.

5. The herein-described improvement in the method of treating metallic blanks in drawing, it consisting in rotating the blank and while rotating exposing it to a stream of minute globular metallic shot, whereby its surface is uniformly cleaned in contradistinction from subjecting them to the action of acid or other chemical reagents, to remove scale and expose a surface of the pure metal, and then subjecting the blank to compression radially along the cleaned surface to elongate and condense the fibers, substantially as set forth.

6. The herein-described method of manufacturing blanks for drawn tubing from lap-welded or butt-welded tubes, it consisting in removing "scale" from the exterior of the tube, then compressing the blank radially to loosen the interior "scale," then removing said interior "scale," and then reducing the walls of the tube to uniform thickness by re-

moving surplus metal on lines longitudinally of the blank, substantially as set forth.

7. The herein-described method of preparing blanks for the manufacture of drawn tubing from lap-welded or butt-welded tubes, it consisting in abrading the exterior of the tube, abrading the interior of the tube, and then removing surplus metal from the inner surface of the tube on lines longitudinal of the tube, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM A. McCOOL.

Witnesses:

JOHN W. CULMER,

JAMES F. MERRIMAN.