(No Model.) 2 Sheets—Sheet 1.

W. A. McCOOL.

APPARATUS FOR DRAWING METAL.

No. 600,012. Patented Mar. 1, 1898.

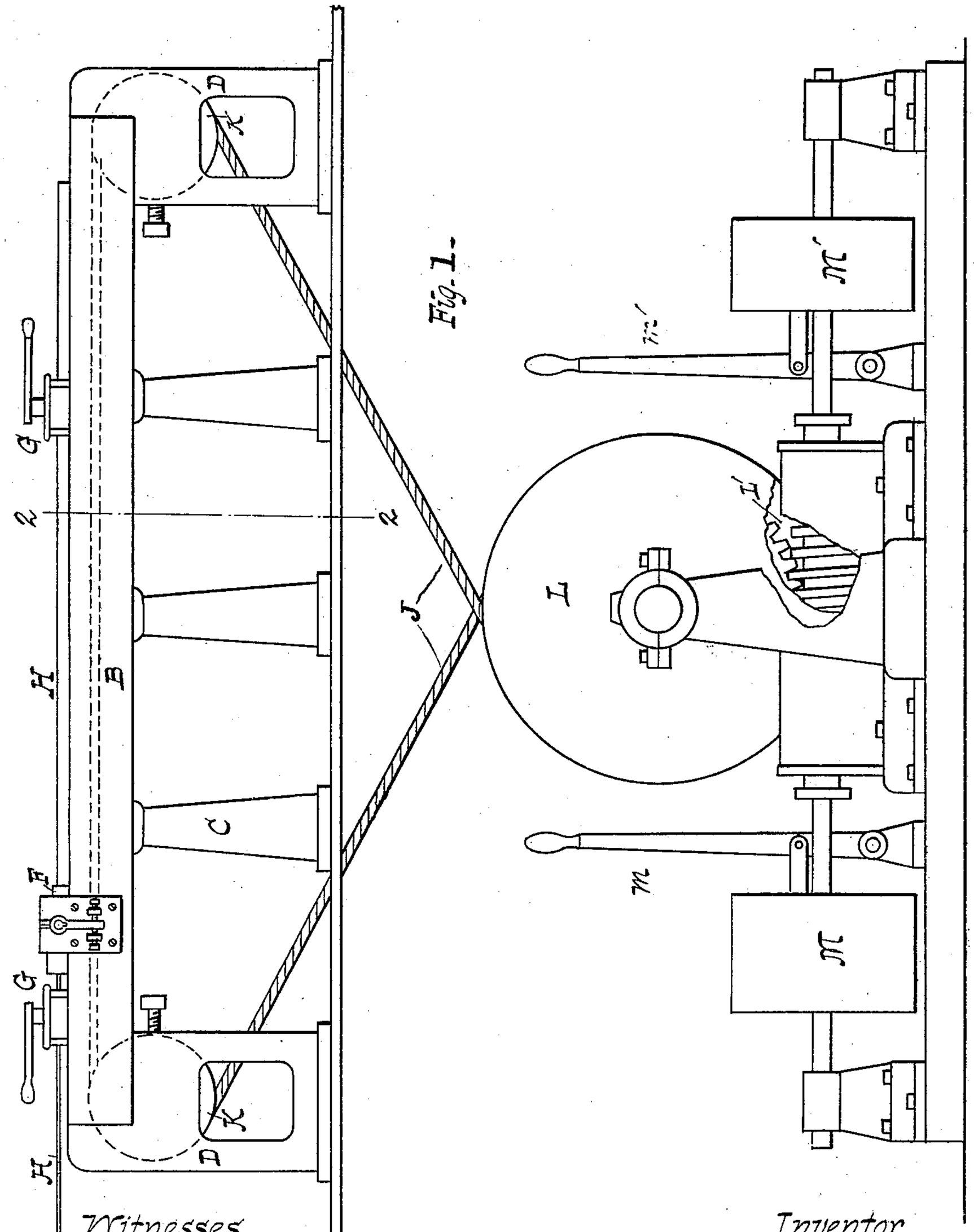

Fig. 1.

Witnesses
J. Landsing
Chamberlain

Inventor
William A. McCool.
by Harold B. Penny
Attorney

(No Model.) 2 Sheets—Sheet 2.

W. A. McCOOL.

APPARATUS FOR DRAWING METAL.

No. 600,012. Patented Mar. 1, 1898.

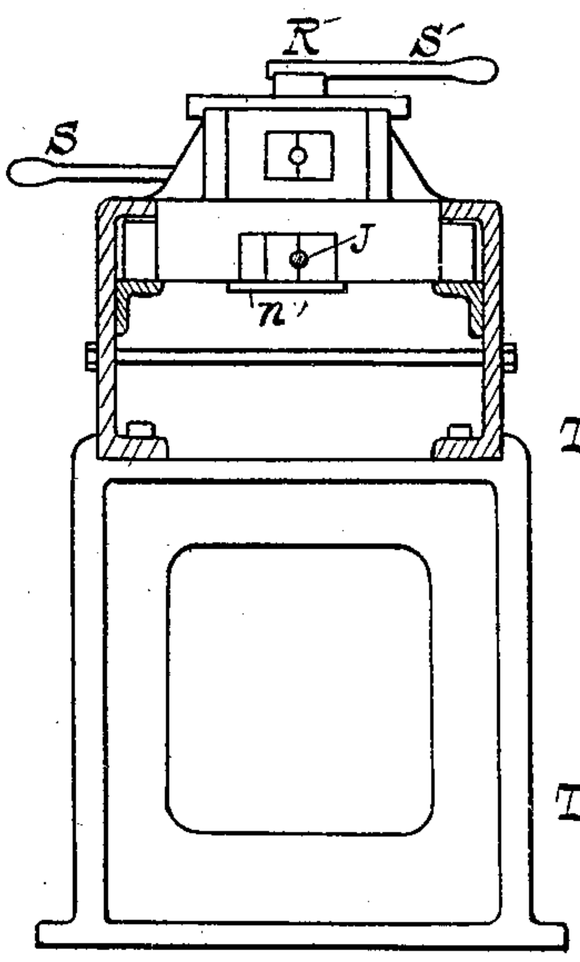

Fig. 2.

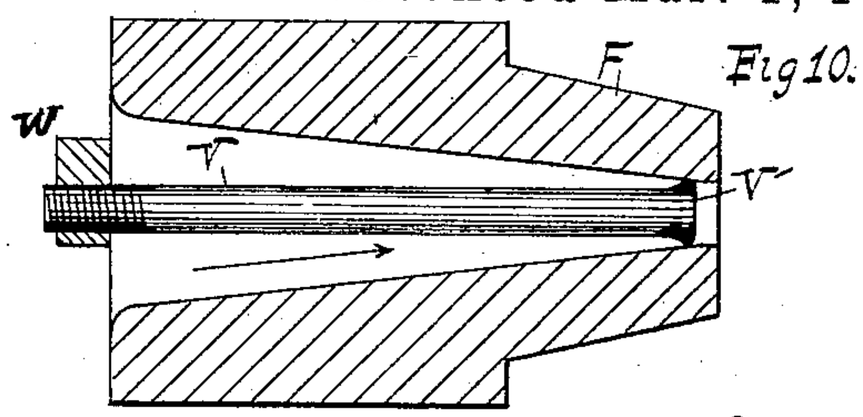

Fig 10.

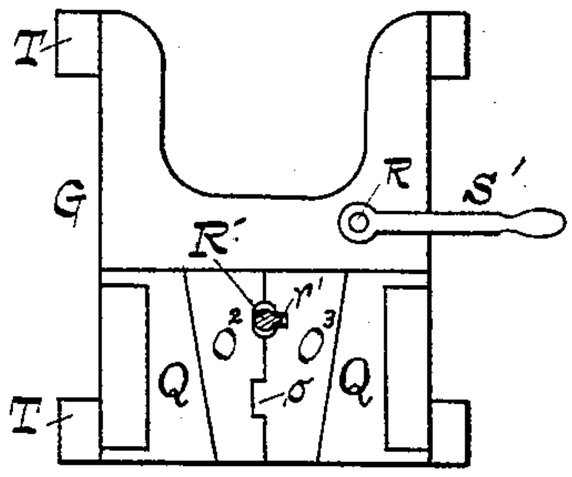

Fig. 3.

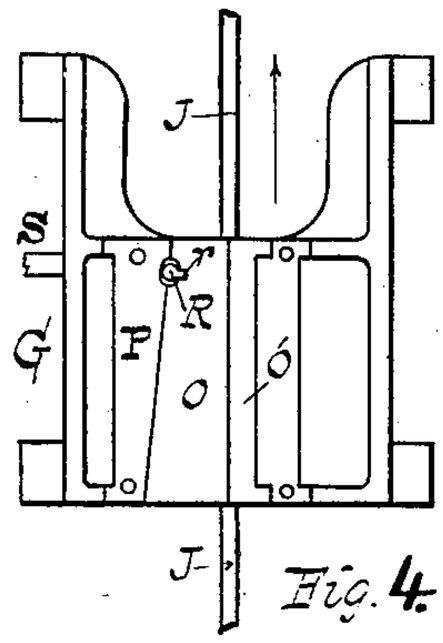

Fig. 4.

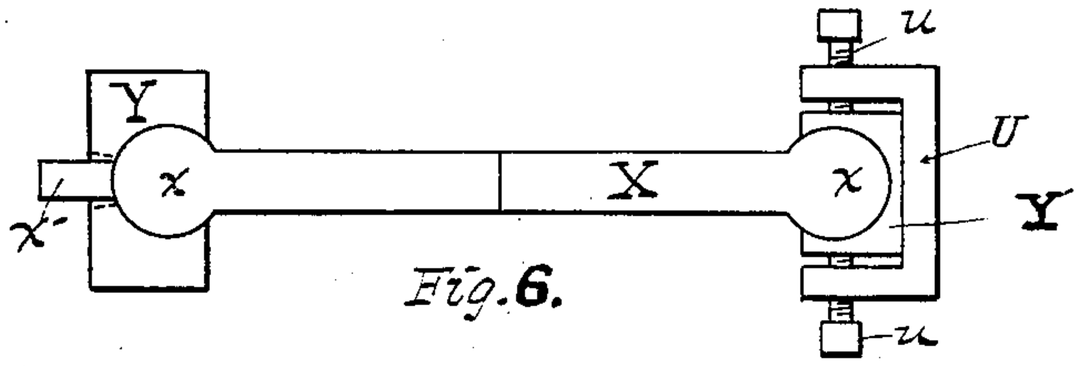

Fig. 6.

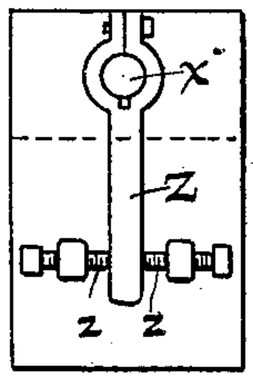

Fig. 9.

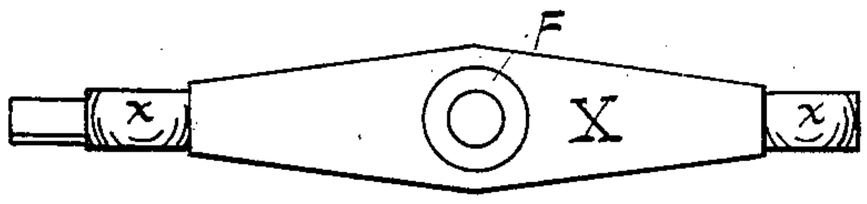

Fig. 7.

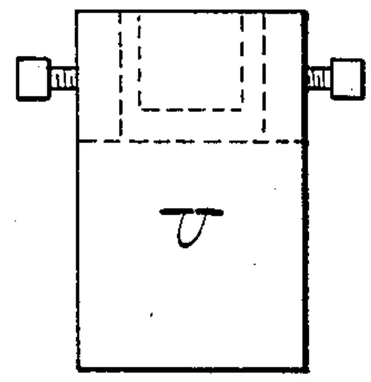

Fig. 8.

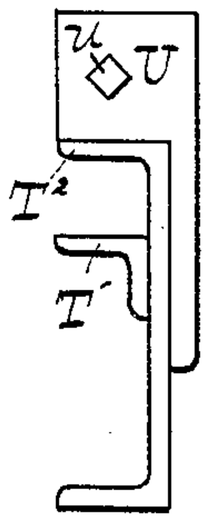

Fig. 5.

Witnesses

J. Landsing

Chamberlain

Inventor

William A. McCool

by Harold B. Gray

Attorney

UNITED STATES PATENT OFFICE.

WILLIAM A. McCOOL, OF BEAVER FALLS, PENNSYLVANIA.

APPARATUS FOR DRAWING METAL.

SPECIFICATION forming part of Letters Patent No. 600,012, dated March 1, 1898.

Application filed December 9, 1895. Serial No. 571,476. (No model.) Patented in England November 14, 1896, No. 25,686; in France September 14, 1897, No. 270,462, and in Belgium September 24, 1897, No. 130,827.

To all whom it may concern:

Be it known that I, WILLIAM A. McCOOL, of Beaver Falls, Pennsylvania, have invented certain new and useful Improvements in Apparatus for Drawing Metal, (for all or parts whereof there have been issued to me in the Kingdom of Great Britain and Ireland Letters Patent 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,) of which the following is a description, referring to the accompanying drawings, which form part of this specification.

The invention relates particularly to the apparatus for giving travel to the pushing and pulling heads of the draw-bench or drawing-machine, the details of such pushing and pulling heads, the adjustable die-block or die-holder, and the die and internal mandrel for forming tubing.

In certain prior patents issued to me I have shown certain forms of draw-benches wherein the pushing and pulling heads or carriages were operated by chains, to which they were variously adapted, and I have shown several different forms of gripping devices for gripping the bar or other metal to be drawn. Among these prior patents I may mention No. 346,126, of May 31, 1887; Nos. 388,701 and 388,782, of August 28, 1888, and No. 400,238, of March 26, 1889. The present invention forms in some respects an improvement upon these prior devices, but also includes distinct departures from anything shown in such prior patents, as will appear from the following description and claims.

According to the present invention an endless cable, belt, or similar device travels lengthwise along the drawing-frame and may be run at will in either direction continuously or stopped when desired, and the die is supported in slightly-adjustable bearings, as will hereinafter more fully appear.

The pushing and pulling heads or carriages have each two sets of gripping devices, one set being arranged to take the endless cable or belt at any point of its length, and thereby cause the head or carriage to be drawn along upon its tracks or guides, and the other grip is arranged to hold the metal so that in the case of the pushing-head it may be forced into the die and in the case of the pulling-head the metal may be drawn through the die.

In addition to providing an improved drawing apparatus for drawing bars, tubes, or other metal my invention contemplates an improved method of forming tubing from flat sheets or blanks by means of a loose adjustable bulb-mandrel, which is held in the die by the drawing action of the metal and thereby assists in the forming of the tubing.

The use of a cable or other similar traction device, to which the movable heads or carriages are attached by friction-grips, is of great importance, as there is enough slip in the connection between the grip and cable or other endless traction device of sufficient elasticity to prevent the pulling apart of the metal being drawn. Moreover, the elasticity of the cable, which gives a springy yielding pull, is a great advantage. These two points serve to radically distinguish the device from the rigid unyielding connection formed by a hook and chain (or other traction device) into which the hook is secured.

I have now briefly described the general features of my invention and have indicated the operation and general purposes of the various parts of my apparatus. To these general purposes and to certain other new and useful purposes, which will more fully hereinafter appear, my invention is embodied in an apparatus constructed, arranged, combined, and used in a manner similar to that hereinafter described, illustrated, and claimed.

In the drawings, Figure 1 illustrates the general arrangement of my draw-bench, and endless power-driven cable for operating it, the parts being arranged for forming a tube from a flat sheet or blank. Fig. 2 is a sectional view on the line 2 2 of Fig. 1. Fig. 3 is a plan view of the gripper head and carriage shown in Fig. 2, showing the grip for engaging with the bar or tubing being drawn. Fig. 4 is an inverted plan or bottom view of the same head or carriage, showing the grip for the actuating-cable. Fig. 5 shows in side elevation the supporting-bracket for one end of the adjustable die-holder. Figs. 6 and 7 are respectively a plan and side elevation of the die-holder. Fig. 8 shows in front elevation the bracket

illustrated in Fig. 5. Fig. 9 is a detail view of the other supporting-bracket for the adjustable die-holder and the adjusting devices carried thereby. Fig. 10 is a longitudinal sectional view, on an enlarged scale, of the die and mandrel employed when forming tubing from a flat plate.

Throughout the drawings like letters of reference indicate like parts.

Referring to Fig. 1 for the general arrangement and to the other figures for details of my construction, B indicates the longitudinals of the guides or tracks of my draw-bench, they being supported by posts or columns C and terminating at each end in the frames or supports D. In Fig. 1 the die is indicated at F, and the pushing and pulling heads or movable carriages at G G′, respectively. A tube issuing from the die and secured to the right-hand pulling or drawing head G′ is indicated by H, and the flat plate from which the tube is formed by my improved process is shown at H′.

The drawing-heads G G′ each consist of two grips mounted in a suitable carriage provided with wheels T, which run on rails T′, preferably formed by angle-bars secured to the inner face of the side rails B of the main frame. As shown in Fig. 5, the longitudinals or side rails B are preferably provided with an inwardly-extending horizontal flange at both their upper and lower edges, and the said wheels T of the movable heads or carriages are arranged between the aforesaid rails T′ and the top flanges T^2 of the side pieces of the main frame.

The movable heads or carriages G G′ differ only in the form of the upper metal-grip, that in the carriage G being adapted to engage the plate H′, while that in the carriage G′ is, as shown in Figs. 1, 2, and 3, adapted to grip a bar or tube. Through the lower grip of each of these heads G G′ extends the wire rope or cable J, which passes over a pulley K, supported at each end of the draw-bench, and around a power driving drum-wheel L, preferably located in the basement beneath the drawing-bench. The driving-drum L may be driven by the worm and worm-wheel L′, inclosed in a suitable casing, as shown in Fig. 1, and the worm-shaft may be driven by means of the two reversely-turning pulleys M M′, controlled by the respective friction-clutches and hand-levers *m m′*.

The wire rope or cable L is endless and during the usual operation of the draw-bench is run continuously in the direction in which the metal is drawn, or to the right in Fig. 1. The movable heads or carriages G G′ may be gripped onto this cable at any point at will, so that instantly and without delay the cable will transmit power and motion to the heads. In the ordinary operation the pushing-head is drawn back to a convenient position, both its grips being open. The metal to be thrust into the die is then gripped in proper alinement in the head, and the cable-grip is then tightened, instantaneously causing the head to be drawn forward with the cable, forcing the metal into the die.

I describe no means for automatically releasing the cable-grip when the carriage or head reaches the end of its travel, because these details do not concern the essential features of the present invention.

When the metal has been initially forced into the die by the pushing head or carriage, that head is ungripped from both the cable and the metal, and the other (the pulling head or carriage) is then brought into play. This is run up by hand to the mouth of the die and gripped onto the metal projecting therefrom. Then the grip is closed upon the cable and the head or carriage travels forward with the cable, drawing the metal through the die, until the head has traveled to the end of the bench or until for some other reason it is desired to stop. The head or carriage is then released from the cable and may be ungripped from the metal and run back by hand toward the mouth of the die, where it can be reëngaged with the metal and cable to continue the drawing operation, if desired.

While usually it is advantageous to keep the cable running continuously in one direction and to return the head in the opposite direction by hand, when for any reason it becomes necessary to apply power for forcing the metal backward through the die or for forcing either of the heads or carriages backward the cable can be stopped and reversed by means of the clutches and hand-levers *m m′*.

The details of the cable-gripper and the metal-gripper in the movable head or carriage G′ are similar to each other, and as the cable-gripper in the head G is the same as that of the corresponding gripper in the head G′ and the metal-gripper of said head G differs from the corresponding one in the head G′ only in the form of its jaws, whereby it is adapted to grip the plate H′ instead of a bar or tube, I have not thought it necessary to illustrate in detail the grippers of the carriage G.

It will be understood that, when my improved apparatus herein illustrated and described is employed for drawing rods, bars, or tubing instead of for forming tubing from a flat plate, both the pushing and pulling heads or carriages will be similar to that at G′ herein described, the details of which are clearly shown in Figs. 2, 3, and 4.

Fig. 4 shows the details of the cable-gripping mechanism, the movement or drawing action taking place in the direction of the arrow. In this figure the bottom plate *n′* (see Fig. 2) is removed to expose the grip. O designates the movable jaw of the grip, and O′ the fixed jaw. This movable jaw is of the wedge shape shown and slides upon the inclined piece P. The operating-key R, provided with a single tooth working in the corresponding notch *r* of the wedge-shaped jaw O and turned by means of the hand-lever S, gives a slight longitudinal movement to the

wedge-shaped jaw and causes it to close upon or release the cable J. It will be seen that the movement of the cable in the direction of the arrow is in a direction to cause the jaw to wedge tightly upon the cable, and therefore little force need be exerted in closing the grip, whereas in opening it a sudden throw of the lever S releases the grip and allows the cable J to slide easily through without transmitting motion and power to the head.

In Fig. 3 the gripper for the metal is shown. In this two wedge-shaped jaws O^2 O^3 are used instead of one, as in the above-described cable-grip, so that the jaws will always be accurately centered in the head and so that they will close equally upon the tube, bar, or other metal for which they are formed. The two jaws are interlocked against longitudinal play or movement as regards each other by means of the projection *o* on one jaw, which enters a registering recess in the other. The longitudinal movement required to cause these jaws to wedge upon and grip the metal is produced by a rotary shaft R′, turned by the handle S′ and provided with a tooth which engages the notch *r′* in one of the jaws O^3. In this gripper the incline of the relatively stationary wedge-shaped guides Q, which guide the said jaws O^2 O^3, is of course reversed to that of the cable, because it is in this case the jaws which grip upon and draw the metal, whereas in Fig. 4 it is the cable which transmits power to the jaws of the grip. It will be seen that the reversely-inclined wedges Q (shown in Fig. 3) will cause the jaws to grip more tightly upon the tubing or other metal when greater resistance or pull is offered by the metal.

I have found that by slightly altering the position of the die with relation to the line of travel of the metal I can control the drawing action and overcome certain difficulties and irregularities heretofore present in apparatus for drawing metal. Indeed, the need of straightening the tubes is to a large extent obviated, as any tendency of the tubes to curl in one direction or the other may be overcome by slightly adjusting or directing the die. I obtain this adjustment of the die by means of two distinct angular adjustments, one horizontal and the other vertical. The die, which may be of any suitable and desirable form, is rigidly mounted in the usual manner in a die-holder X. In the drawings two forms of die are more or less conventionally illustrated. That shown at F, Figs. 1 and 10, is of such length as to project beyond both sides of the die-holder, while that at F′, Figs. 6 and 7, does not thus project. The holder X is itself adjusted in order to vary the position of the die with relation to the metal being drawn. Each end of the holder in the embodiment of my invention herein illustrated is provided with a globe-shaped bearing *x*, which bearings are mounted in blocks Y Y′, supported upon the draw-bench frame. The block Y is stationarily secured to the draw-bench by means of a flange which extends down over one of the side pieces B, and one of the ends of the die-holder is seated in a socket formed in said block and provided with a projecting stud *x′*, which extends outwardly through a passage formed in said block. To this projection *x′* is secured a depending arm or short lever Z, upon which bear the two set-screws *z*. By these screws *z* the lever-arm Z may be adjusted through a small angle and, by reason of the holder X rocking in its support, the die thereby angularly adjusted in a vertical plane. The block Y′, in which is mounted the end of the die-holder opposite that provided with the projection *x′*, has a slight horizontal adjustment or travel upon the bench. This horizontal adjustment is obtained as follows: The block Y′ is mounted to slide horizontally in a stationary bracket U, secured to one of the sides B of the draw-bench, and set-screws *u* extend through the end walls of such bracket and bear upon the block Y′, as shown in Fig. 6. By the adjustment of these screws *u* a slight travel or adjustment may be given to the block Y′ in a direction longitudinal of the draw-bench, and thereby the die is given an angular adjustment in a horizontal plane. By reference to Fig. 6 it will be seen that the passage in the block Y through which the projection *x′* extends is enlarged toward its outer end or provided with flaring walls, whereby such projection *x′* is allowed to adjust itself to the position into which it is moved by the screws *u*. Owing to the globe or spherical bearings *x* or to the use of any other universal joint these two angular adjustments of the die are entirely independent of each other, and therefore the die may be directed or inclined not only in the horizontal and vertical planes but in any plane or angle of direction and the desired correction of any curling tendency in the drawn metal compensated for.

There now remains to be described my improved bulb-mandrel, which is employed when forming tubing from flat sheets and which is illustrated in detail in Fig. 10. Referring to this figure, V designates the stem of the bulb-mandrel. This stem is adjustably connected with a cross bar or support *w*, which extends across the rear end of the die. The action of the metal after being drawn through between the mandrel and the die in the direction of the arrow, Fig. 10, is to draw the mandrel into the die with great force, and as the flat plate enters the die and is bent up around the mandrel to form the tube it is confined and drawn through between the polished bulb V′ of the mandrel and the mouth of the die. As the throat of the die is conical or tapered, as shown, the space between the bulb of the mandrel and the die may be very readily adjusted to a nicety by allowing the head of the mandrel to go farther into the die to decrease the space or by drawing it slightly out of the die to enlarge the

space. The mandrel is shown as having the rear end of its stem threaded and projecting slightly beyond the rear end of the die, said threaded portion of the stem being screwed into a suitable socket or passage formed in the cross-piece W. The construction illustrated in Fig. 10 and described above allows the mandrel to be readily and quickly adjusted longitudinally when the parts are in operative position and without requiring the removal of the mandrel from the die. When the drawing action is taking place, the mandrel is drawn into the die until the cross-piece W rests against the rear end of the die and prevents the further entry of the mandrel; but although considerable power is required to form cold-drawn tubes in this manner there is no difficulty in removing a partly-formed piece of tube from the die, because no jamming can take place between the mandrel and the die and because any backward motion of the metal at once relieves the metal from pressure in the mouth of the die, loosening the mandrel and allowing it to be drawn out by hand. There are many other advantages due to this improved adjustable mandrel and die, which will be readily understood by those skilled in the art.

I have now described all of the essential features of my invention. I have omitted the enumeration of many details and many modifications which may be made in the apparatus without departing from the principles involved, because to set all these forth at length would obscure rather than make clear the more essential features.

I claim, however, and desire to secure by Letters Patent of the United States, together with all such modifications and variations as may be made by those skilled in the art and with such limitations and restrictions as are expressed or by law implied in view of the related arts, the following:

1. In a metal-drawing machine, the combination of a bed-frame, an endless power-cable, a die, a mandrel, and a carriage having adjustable metal-engaging jaws and independent adjustable jaws for engaging with the cable, substantially as set forth.

2. In a metal-drawing machine, the combination of a relatively stationary die having a passage for the metal to be drawn, the movable metal-gripper on one side of said die, the movable metal-gripper on the other side of said die, an endless cable, power devices for actuating the said cable, means for detachably and gradually connecting said cable to the first aforesaid metal-gripper, and means for detachably and gradually connecting the cable to the second aforesaid gripper, substantially as set forth.

3. In a metal-drawing machine, the combination with the relatively stationary die having a passage for the metal to be drawn, of the movable metal-gripper on one side of said die, the movable gripper on the other side of said die, the endless traction device arranged adjacent to the said metal-grippers, means for detachably connecting the said traction device to the said grippers, and a power driving mechanism having a frictional connection with the endless traction device, substantially as set forth.

4. In a draw-bench, the combination of a die having a passage or aperture therein, a movable gripper adapted to move toward and from the die and to force the metal to be reduced through said passage or aperture, a cable or traction device having an exterior surface of uniform cross-section, whereby the gripper can be gradually clamped to the traction device at any point of the length thereof, and means for frictionally connecting, gradually, the gripper to the said traction device, substantially as set forth.

5. In a draw-bench, the combination of a bed or supporting-frame, a die adapted to be held stationary on said bed, an endless cable or traction device, extending longitudinally of the bed, and having a uniform diameter, driving mechanism having a frictional engagement with said traction device, and a gripper mounted on said bed or support and having two independently-acting gripping mechanisms, one arranged in the plane of the die to engage the article to be moved therethrough and the other adapted to be connected with said traction device at any point in the length thereof, whereby the article will be moved through the die with a yielding pressure, substantially as set forth.

6. In a draw-bench, the combination of a die, an endless cable or traction device, means for driving said traction device with a yielding force, and a gripper adapted to be engaged with said traction device, at any point in the length thereof, and with the article to be drawn, substantially as and for the purpose set forth.

7. In combination in and with draw-bench apparatus, the die mounted upon two supports at each side of the draw-bench, one of said supports being adjustable longitudinally upon the said draw-bench, whereby a horizontal angular adjustment of the die may be had, substantially as set forth.

8. In combination in and with draw-bench apparatus, the die support or holder pivotally mounted in suitable bearings, and provided with the arm Z, and one or more set-screws as *z*, for turning the same arm to slightly adjust the said die.

9. In combination in apparatus for drawing metals, the frame or bed thereof, the die or draw plate mounted on the said frame, the head or carriage mounted to travel longitudinally in the said frame, an endles traction device of substantially uniform cross-section throughout its length running longitudinally in the said frame, driving mechanism therefor, means for securing the said head or carriage to the metal to be drawn, and an independently-controlled friction-grip mounted upon the said carriage or head, in line with

the said traction device, substantially as set forth.

10. In combination in apparatus for drawing metals, the bed or frame thereof, the die or draw plate mounted on the said frame, the head or carriage mounted to travel longitudinally in the said frame, an endless traction device of substantially uniform cross-section throughout its length running longitudinally in the said frame, driving mechanism therefor, and two separate gripping mechanisms upon the said head or carriage, one in line with and adapted to engage the metal to be drawn, and the other in line with and adapted to engage the said traction device, substantially as set forth.

11. In combination in apparatus for drawing metal, the frame or bed, the die or draw plate, a head or carriage traveling longitudinally in the said frame, a gripper mounted upon the said head to travel in line with the said die, a power-cable running longitudinally through the said bed or frame, a second gripper carried by said head or carriage, in line with and adapted to engage the said cable, and means for gradually engaging and disengaging the last said gripper at will, substantially as set forth.

12. In combination in apparatus for drawing metals, the bench, bed or frame, the traveling head thereon, provided with two separately-controlled grippers, the die or draw plate arranged in line with one of the said grippers, and a cable running longitudinally of the said bench, bed or frame, in line with and through the second of said grippers, whereby when both the said grippers are in operation, one upon the said cable and the other upon the metal to be drawn, the said metal may be drawn with a yielding pressure, substantially as set forth.

13. In a draw-bench, the combination of a bed-frame, a die supported on said frame, an endless cable or traction device extending longitudinally of the bed, a carriage mounted on the bed and adapted to engage with the article to be drawn, jaws mounted in said carriage for engaging with the traction device, means for moving one of said jaws toward or from the traction device, and guiding means on the carriage whereby the strain or pull exerted by the traction device acts to more firmly connect the carriage to said traction device, substantially as set forth.

14. In a draw-bench, the combination of a bed-frame, a die supported on said frame, a carriage mounted on the bed and adapted to engage with the article to be drawn, an endless cable or traction device, a relatively stationary jaw, O′, on the carriage and at one side of the traction device, a movable jaw on the carriage and at the opposite side of said traction device, means for moving the last said jaw longitudinally, of the carriage, and a guide on the carriage for simultaneously moving said jaw toward the traction device, said guide being so related to the said jaws and the traction device that the strain or pull of the traction device acts to draw the movable jaw into closer engagement therewith, substantially as set forth.

15. In a draw-bench, the combination of a bed-frame, a die on said frame, an endless cable or traction device, a carriage mounted on the bed and adapted to engage with the article to be drawn, a stationary jaw on the carriage, in the plane of the traction device, a stationary guide on the carriage on the opposite side of the traction device from said stationary jaw and having its face adjacent to said jaw inclined toward the said traction device from its rear to its forward end, a movable jaw arranged between said guide and the traction device, and means for moving the last said jaw, substantially as and for the purpose set forth.

16. In a draw-bench, the combination with a main frame, of a die-holder adapted to extend transversely of said frame and connected therewith by a ball-and-socket joint, means for adjusting said holder about an axis extending transverse of the main frame, and means for holding said holder stationary in any adjusted position, substantially as set forth.

17. In a draw-bench, the combination with a main frame, of a die-holder adapted to extend transversely of the frame and having one end connected therewith by a ball-and-socket joint, an arm connected with said holder and adapted to rock the holder about an axis extending transverse of the main frame, and means adapted to engage said arm and retain the holder in the desired adjusted position, substantially as set forth.

18. In a draw-bench, the combination with a main frame, of a die-holder having ball-like end portions, socket-pieces on the main frame for receiving said ball-like portions of the holder, adjusting devices adapted to move one of said socket-pieces on the main frame, means for adjusting the die-holder independently of any adjustment of the last said socket-piece, and means for securing the holder in any adjusted position, substantially as set forth.

In testimony whereof I have hereunto set my hand, at Beaver Falls, Pennsylvania, this 2d day of December, A. D. 1895.

WILLIAM A. McCOOL.

In presence of—
E. C. REBESKE,
F. N. BEEGLE.