

J. F. COX.  
PIPE BENDING MACHINE.  
APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 1.

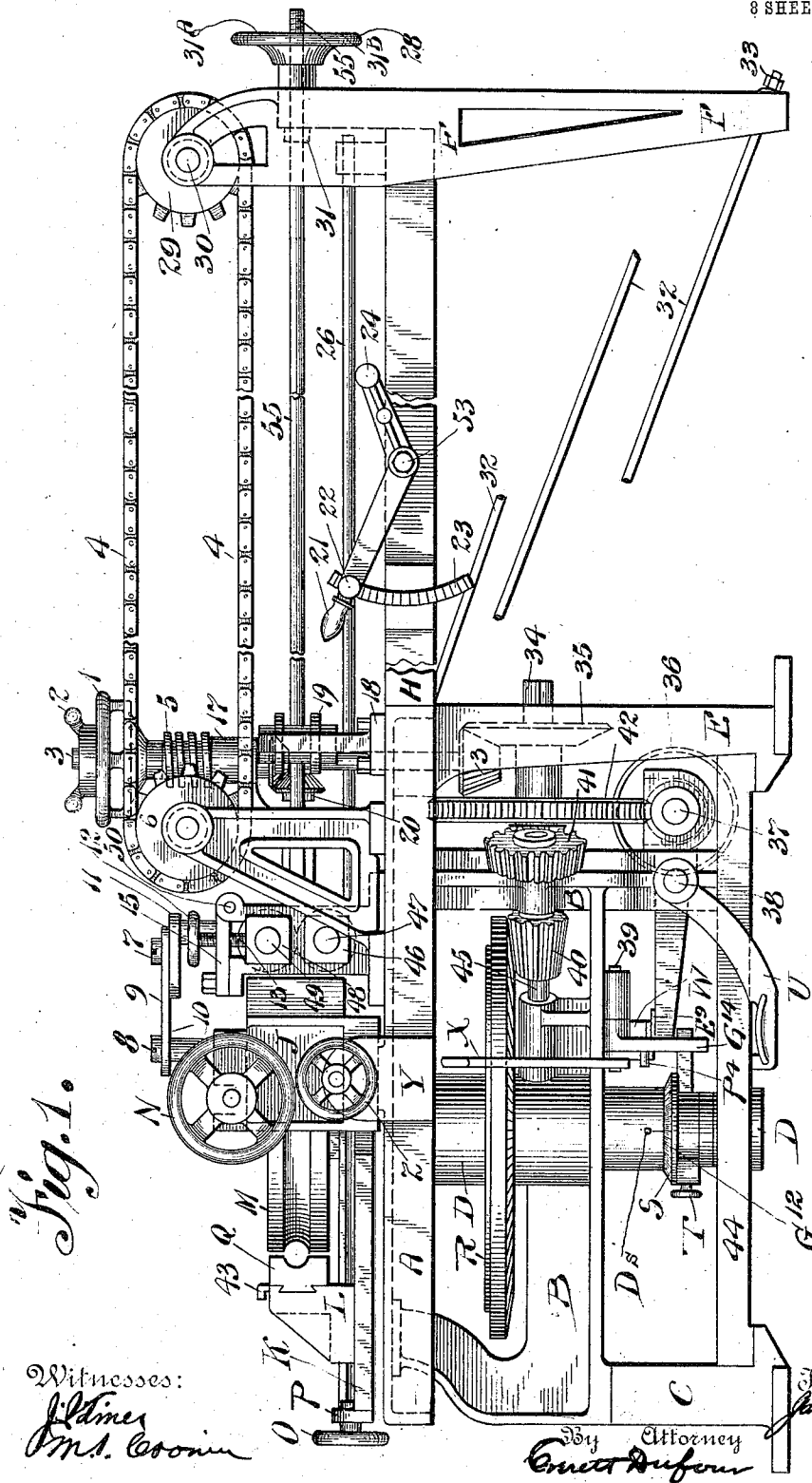


Fig. 1.

Witnesses:

J. Limer  
M. S. Cronin

By Attorney  
Ernest Dufour

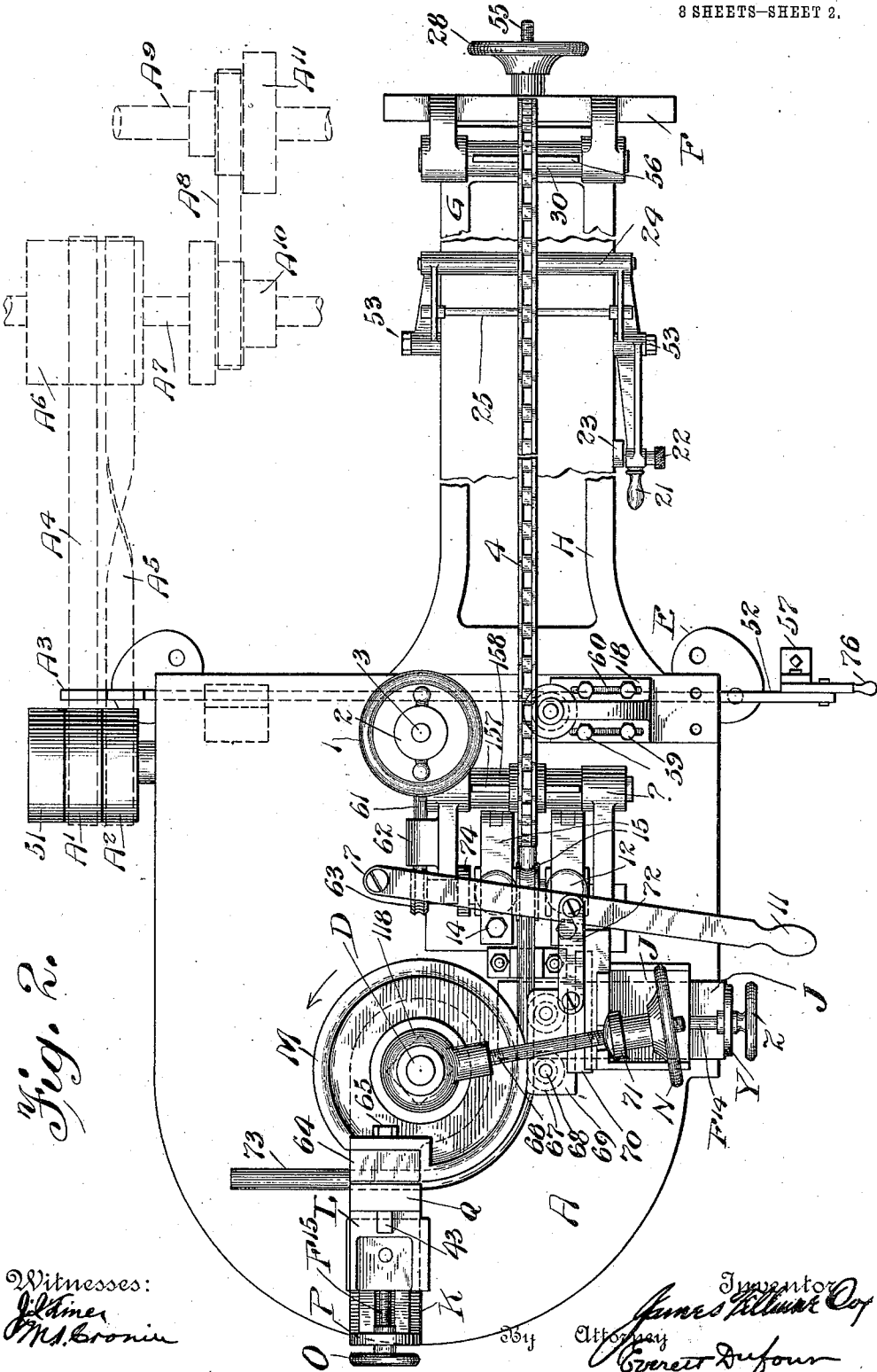
Inventor  
James F. Cox

J. F. COX.  
 PIPE BENDING MACHINE.  
 APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 2.

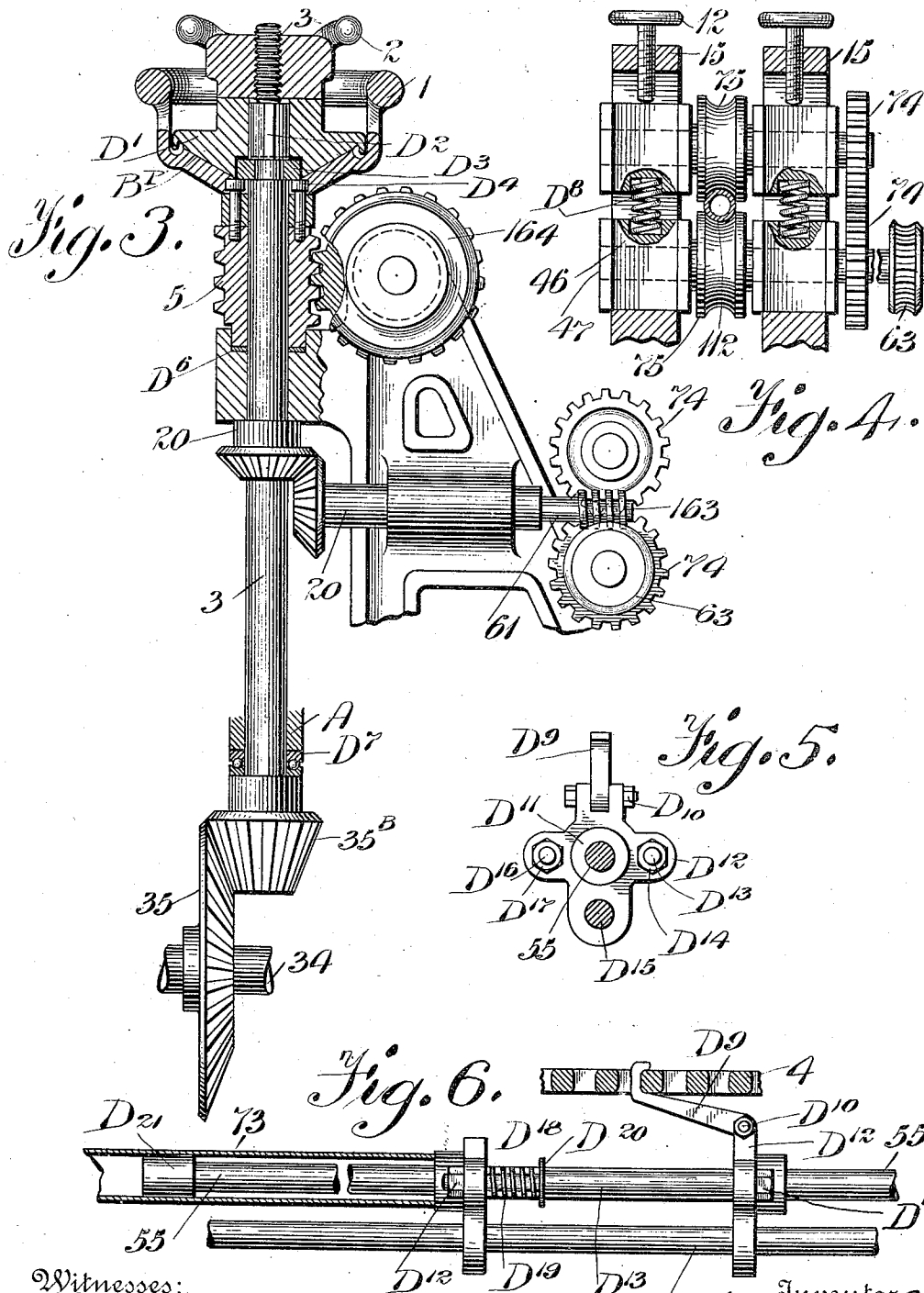


J. F. COX.  
PIPE BENDING MACHINE.  
APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 3.



Witnesses:  
J. P. Limer  
M. A. Cronin

Inventor  
J. F. Cox  
By His Attorney  
R. G. James  
Brett & DeFour

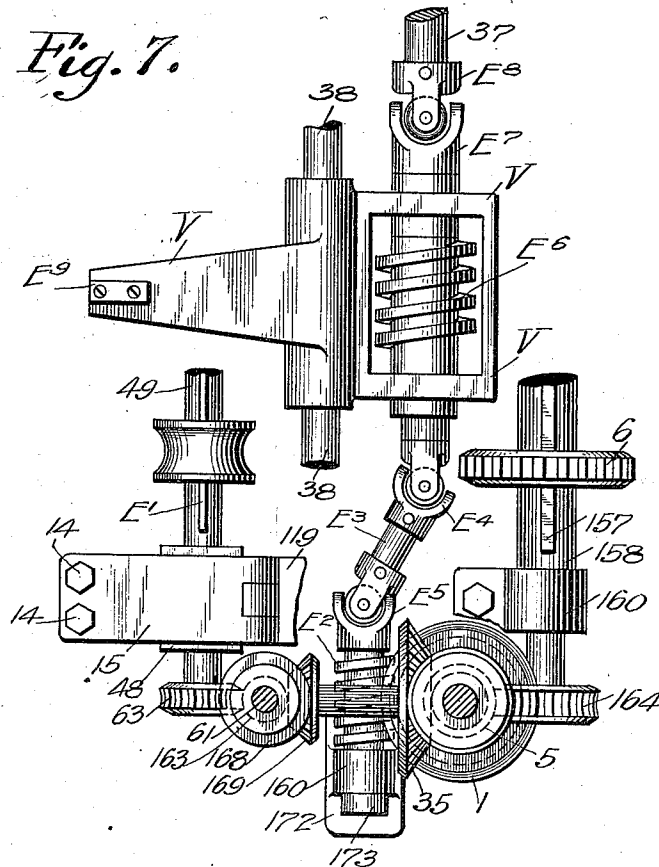
J. F. COX.  
 PIPE BENDING MACHINE.  
 APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 4.

*Fig. 7.*



Witnesses:  
*J. H. Jones*  
*M. A. Cronin*

Inventor  
*J. F. Cox*  
 By *E. H. Dufour*  
 Attorney

1,013,839.

8 SHEETS--SHEET 5.

*Fig. 8.*



Haines  
M. L. Cronin

உயி

Inventor  
E. J. Hillman & Co.

Harriet DeFoor

1,013,839.

8 SHEETS—SHEET 6.

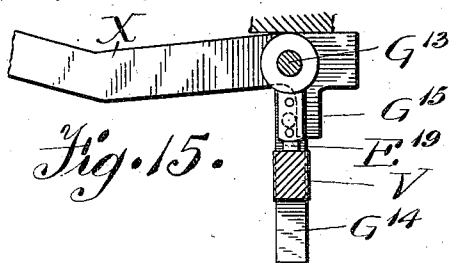


*Fig. 15.*

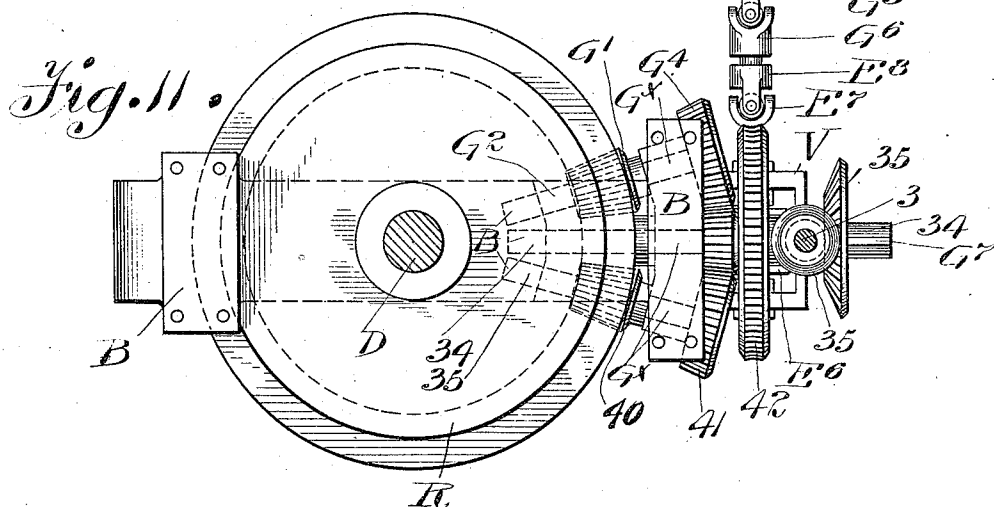


*Fig. 11.*

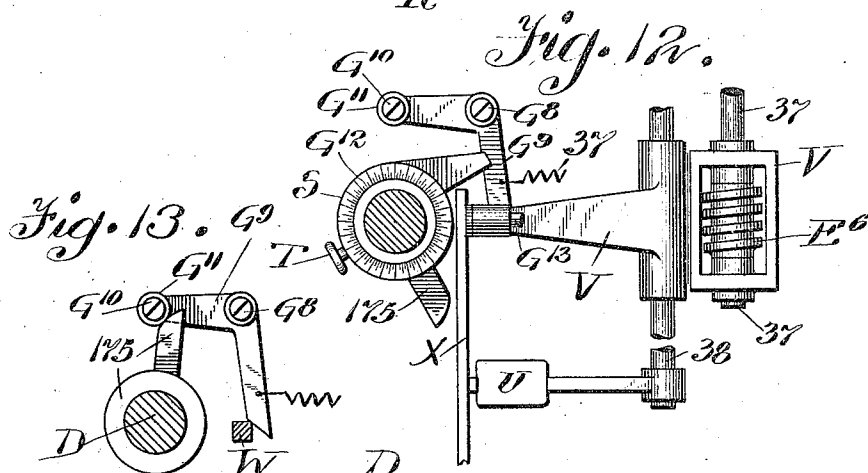


Fig. 12.

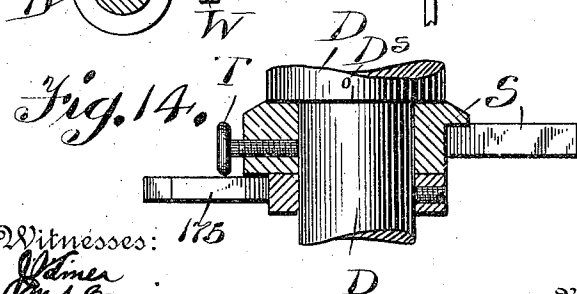


*Fig. 14.*

Witnesses: 175  
J. J. J. J.  
M. J. J. J.

 $\partial_1$ 

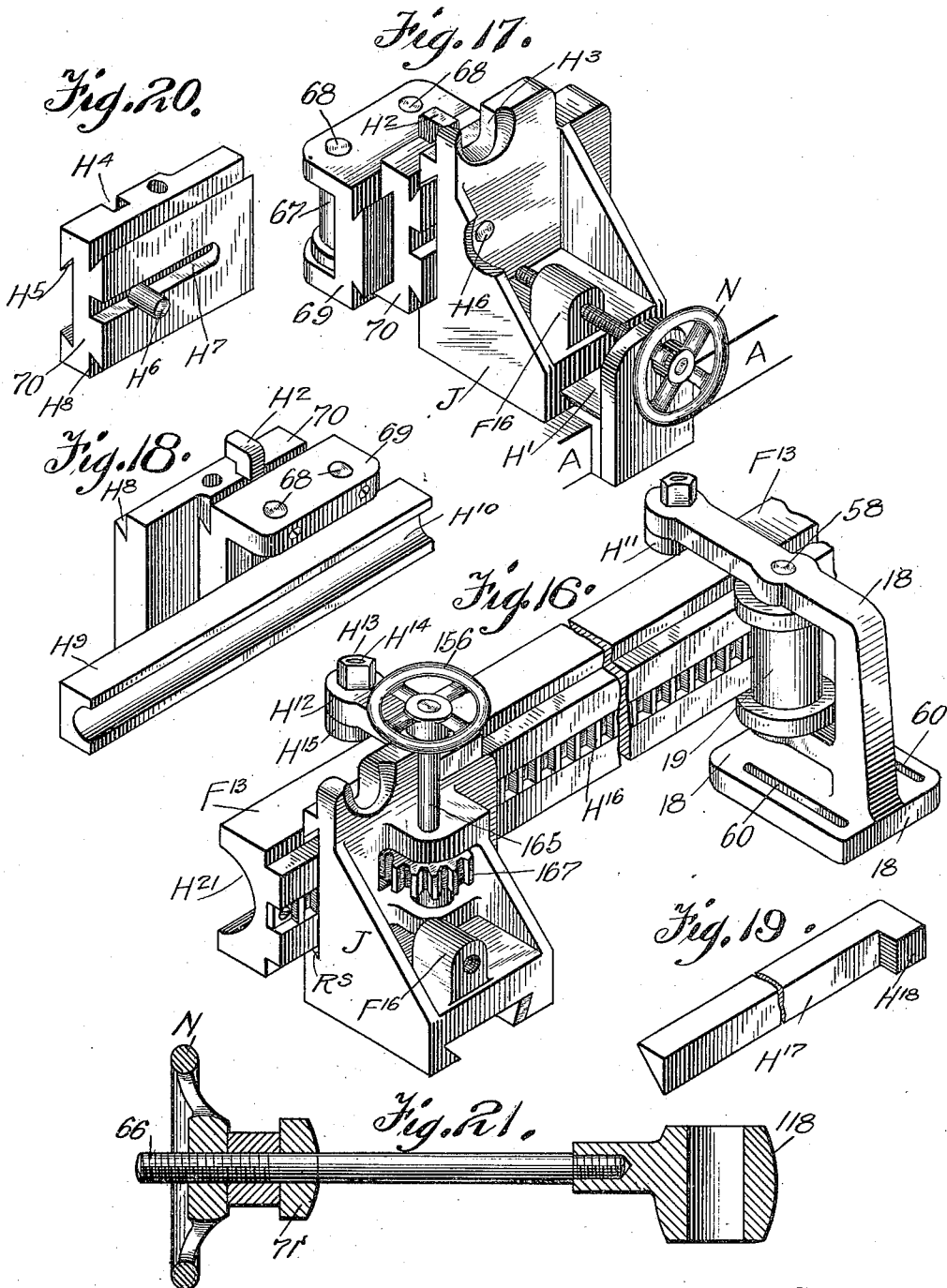
Inventor  
James H. Moore  
Attorney  
Curtis D. Brown

J. F. COX.  
PIPE BENDING MACHINE.  
APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 7.



Witnesses:  
Wm. J. Cronin

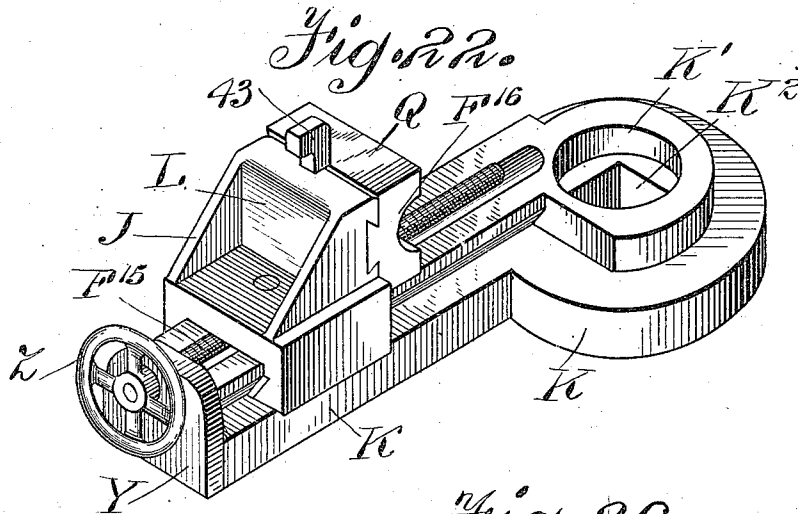
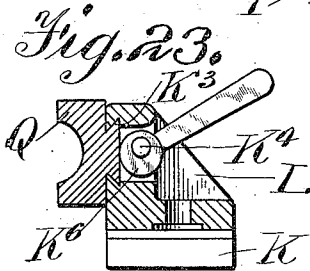
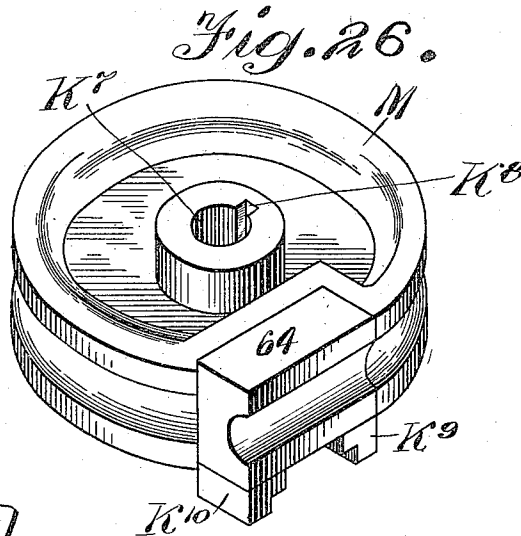
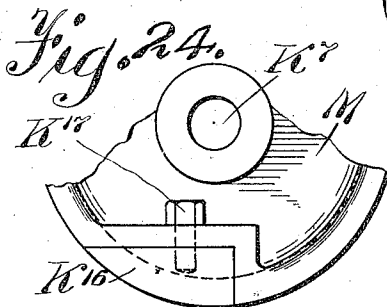
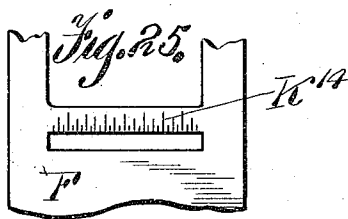
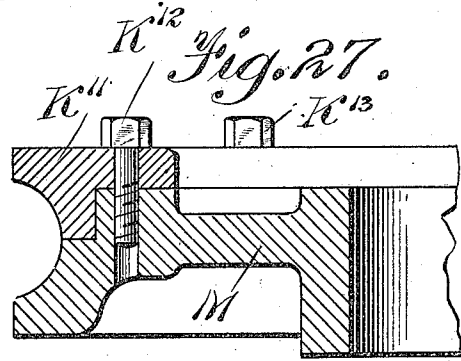
Inventor  
James F. Cox  
Attorney  
R. M. Dufour

J. F. COX.  
 PIPE BENDING MACHINE.  
 APPLICATION FILED JUNE 3, 1909.

1,013,839.

Patented Jan. 2, 1912.

8 SHEETS—SHEET 8.



Witnesses:  
*J. F. Cox*  
*M. Cronin*

Inventor  
*J. F. Cox*  
 By *Robert D. Fox*  
 Attorney

# UNITED STATES PATENT OFFICE.

JAMES FILLMORE COX, OF BAYONNE, NEW JERSEY, ASSIGNOR OF ONE-HALF TO  
MATTHEW T. CRONIN, OF BAYONNE, NEW JERSEY.

## PIPE-BENDING MACHINE.

1,013,839.

Specification of Letters Patent.

Patented Jan. 2, 1912.

Application filed June 3, 1909. Serial No. 499,868.

*To all whom it may concern:*

Be it known that I, JAMES FILLMORE COX, citizen of the United States, residing at Bayonne, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Pipe-Bending Machines, of which the following is a specification.

My invention relates to improvements in pipe bending machines.

It has for its object, among other things, to provide for readily and effectively bending pipes cold into curvilinear or segmental outline; also to effect such bending operation without the aid of a filling or core for the pipe as heretofore ordinarily required to prevent the changing of the cross-sectional outline or form of the bent or curved portion of the pipe; and to carry out these objects in a simple and expeditious manner.

My invention consists of certain instrumentalities or features substantially as hereinafter fully disclosed and defined by the claims.

The invention is fully disclosed in the following specification, of which the accompanying drawings form a part, in which the separate parts of my improvement are designated by suitable reference characters in each of the views, and in which:

Figure 1 is a front view of my improved universal bending machine. Fig. 2 is a plan view thereof. Fig. 3 is a broken partly sectional and partly side view of the gearing arrangement and friction clutch mechanism whereby the power is transmitted through a pair of miter gears and a vertical shaft to the endless chain, and also by means of a pair of beveled gears in connection with a horizontal shaft, worm and worm-wheel, to the feed-rolls. Fig. 4 is a broken detailed partly sectional view of the feed-roll mechanism as embraced in Fig. 1. Fig. 5 is a transverse section produced through Fig. 6, viewing especially the mandrel engaging hook of a follower more fully later disclosed. Fig. 6 is a broken partly sectional and partly side view of what may be termed a follower employed in connection with the endless chain of the feed-roll mechanism for the pipe or tube. Fig. 7 is a broken partly sectional and partly plan view of the undergearing for the general application of power to the various parts of the machine. Fig. 8 is a broken sectional view disclosing more

especially the shaft D and the several parts carried thereon. Fig. 9 is a fragmentary edge view of the former arranged upon the shaft D. Fig. 10 is a broken plan view, partly in section of a modification of said former and intergeared parts, whereby the power is transmitted directly to the latter. Fig. 11 is a plan view, partly in section, of the overgearing arrangement geared with the undergearing means. Fig. 12 is a fragmentary sectional and partly plan view of the automatic arrangement for disengaging the power at a pre-determined time, also the foot treadle for applying the power at the required time. Fig. 13 is a broken sectional and plan view of the safety-trip 175 in operative connection for tripping or disengaging the power upon the return action or movement of the member K. Fig. 14 is a broken partly side and partly sectional view showing more especially the graduated ring member and zero mark upon the lower portion of the shaft D. Fig. 15 is a detailed sectional view showing more especially the relative arrangement of the emergency stop X. Fig. 16 is a fragmentary perspective view showing more especially the relative arrangement of the members 18 and J and their connection F<sup>13</sup>. Fig. 17 is a detailed perspective of the member J with its attachments, as primarily disclosed in Fig. 1. Fig. 18 is a detailed perspective view showing the relative connection of the members 69 and 70 and also the relative connection of the member F<sup>13</sup> with the member 69. Fig. 19 is a detailed perspective view of the member 70. Fig. 20 is a detailed perspective view of a gib which is placed at r-s, Fig. 16, for reasons hereinafter disclosed. Fig. 21 is a sectional and partly side view of the tie-rod arrangement as embraced in Fig. 1 and further hereinafter described. Fig. 22 is a detailed perspective view of the revolving head or adjustable vise clamping mechanism as used with the former M. Fig. 23 is a detailed sectional view of the member L used in connection with the member Q. Fig. 24 is a broken detailed plan of the former M with a substitute member K<sup>10</sup> for the member 64, as when connecting the device for radial bending. Fig. 25 is a broken detailed sectional view of the member F also embodied in the machine as disclosed in Fig. 1. Fig. 26 is a detailed perspective view of the bending roll or die for determining the

radius and diameter in making bends. Fig. 27 is a detailed sectional view of the member M, showing more particularly the removable top flange as used in making die-bends beyond 180 degrees.

In the practice of my invention as shown in the accompanying drawings and specifications, I provide a main frame or bed plate A which forms the top or table of the machinery. The frame A is suitably supported at the rear end upon legs E and at the front upon a frame B itself supported upon a leg C. Connected to the leg C and legs E is a bottom frame or support 44 which in turn supports the back end of the under frame B. Suitable vertical bearings on the members A—B and 44, in alinement, accommodate a vertical shaft D on the lower end of which is placed the automatic tripping contrivance S. Upon the vertical shaft D near its upper end is placed the traveling arm K, the angular socket K<sup>2</sup> receiving the angular end F<sup>2</sup> of said shaft as shown in Fig. 9. This means of connection is provided in view of the great power necessary for rotating the traveling arm K. Above its angular portion, the shaft D is provided with a threaded portion which receives a lock nut F<sup>1</sup> Fig. 13. A recess K<sup>1</sup> is provided for the reception of this lock nut to keep the traveling arm K down properly to the shoulder on member D. The member or shaft D is further provided with a key as shown at F<sup>5</sup>, Fig. 5, at which point the shaft is turned to a smaller diameter and which is used to connect the member M or the bending wheel or die block so as to rotate with said shaft. It will be seen that, by the above arrangement, the vertical shaft D has securely connected therewith both the member M and the traveling arm K. It will also be noted that the shaft D projects beyond the member M to support the tie rod arrangement which is shown at 118.

The traveling arm K has a dovetail portion on its upper side which accommodates a head L, the head L being moved longitudinally along the projecting arm of K. Means for moving this head are provided in the form of a feed screw F<sup>15</sup> and a hand wheel Z. The traveling arm K being placed at right angles or 90 degrees to the pipe to be bent or operated upon provides a parallel clamping surface therebetween and the traveling head L which is provided with a similar grooved block Q which serves as a clamp when the head L is advanced along the traveling arm K. This block is so arranged as to slide in a dovetailed opening and is securely held in place by a key 43. Specific claims and attention, as well, is directed to this particular construction, it being regarded as the quickest and simplest change system which could be adopted. The member M is provided with a movable flange

K<sup>11</sup> securely held to the member M by suitable cap screws K<sup>12</sup> and K<sup>13</sup>. An additional or final locking device is provided in the form of an eccentric lever K<sup>5</sup>, having as its fulcrum a shaft K<sup>4</sup>. This arrangement provides for the final locking or gripping of the pipe or tubing after the sliding head L has been advanced by means of the hand wheel Z and brought into contact with the part 64.

The member M is provided with a removable block 64 in the face of which is a groove corresponding to a similar groove in the periphery of member M as shown in Fig. 48. The member M is also provided with the necessary opening or bore as shown at K<sup>7</sup> into which is also received the shaft D. The member M is further provided with a key-way K<sup>8</sup> to receive the key F<sup>6</sup> which is inserted in shaft D as shown in Fig. 30. Connected to the part 64 are two supporting blocks K<sup>9</sup> and K<sup>10</sup> which fit down upon the extending arm of K, and which serve as an additional means of both supplying power to the member M or the bending die as well as to take the strain off the key F<sup>6</sup>. The pipe or tubing to be operated upon is received into the grooved portion in the periphery wheel H.

Shafts G<sup>2</sup>, 34 and 45 accommodate a pair of twin bevel gears G and 40 between the bearing G<sup>x</sup> and B. On the outer end of each shaft G and 45 is also a bevel gear G<sup>4</sup> and 41. On the shaft 34 and just outside of the bearing G<sup>x</sup> is accommodated an intermediate bevel gear G<sup>3</sup>. Outside of the gear G<sup>3</sup> and on the same shaft is accommodated a worm wheel 42. Underneath the worm wheel is a worm E<sup>8</sup> as shown in Fig. 18. This worm wheel is accommodated or supported by a horizontal shaft 37 which in turn is supported in a gear case V with suitable bearings at either end. The gear case V has an extending arm which projects within a few inches of the shaft D, said casing also affording a bearing for a shaft 38. The shaft 38 is supported in the bottom end of the under frame B by suitable bearings in which the shaft rocks or turns, said shaft being held stationary in the casing V by means of set screws or other suitable means. The shaft 38 projects beyond its bearing, at the front end, at which point it accommodates a foot treadle U. When it is desirable to have the machine operate and to be supplied with a source of power the foot treadle is pressed down, it being stationarily connected to the shaft 38, and imparts a rocking or vertical movement by means of the shaft to the member V which brings the worm E<sup>8</sup> in mesh with the worm wheel 42. The power is then transmitted by means of a straight and cross belt A<sup>4</sup> and A<sup>5</sup> as shown in Fig. 2, to the pulleys 51, A<sup>1</sup> and A<sup>2</sup>. The pulley A<sup>1</sup> being stationary on the

shaft 37 and the pulleys or belt wheel 51 and A<sup>2</sup> being loose pulleys or idlers, it is necessary that one belt be shifted on the tight pulley A<sup>1</sup> in order to get power. A suitable shifting arrangement is provided for and shown in A<sup>3</sup> and 75 which is supported by a bracket 57 and connected to 52. The rocking movement of the member V necessitates the adoption of a universal joint between the two sections of the shaft 37 as shown in Fig. 7. The power is now applied by means of the worm E<sup>6</sup> in relation or mesh with the worm wheel 42 which transmits the power by means of the shaft 34, it being understood that the gears are keyed to the shaft. Any rotation now of the worm wheel 42 will cause a rotation of the intermediate bevel gear G<sup>3</sup> which is in mesh with G<sup>4</sup> and 41 which in turn transmits the power to G<sup>1</sup> and 40 by means of the shafts G<sup>2</sup> and 45 which, in turn being in mesh with, and actuating the bevel gear R which is properly keyed to and operates the vertical shaft D, operating the bending roll M and the traveling head or arm K, together with the parts relatively connected therewith. It being understood that the automatic stop S when set at a predetermined angle or degree and locked securely to the member D by means of a hand screw T as shown in Fig. 1 will also rotate with the said shaft D. There is shown in Fig. 1 a bearing underneath the under frame B, which is at right angles with the vertical bearing, which accommodates a horizontal shaft 39 which is securely held therein, on the end of which is supported an emergency lever X and a swinging catch or dog G<sup>14</sup> which accommodates a pin G<sup>15</sup> on one side and a small steel block W on the other side. When the arm V is caused to move downwardly by the foot treadle, the worm E<sup>6</sup> will be brought into operative connection with the worm wheel G<sup>4</sup> by means of a spring at the rear side and caused to swing forwardly and lock the arm V stationary as shown in Fig. 1, and will remain so during the course of operation until such time as it is either released by the action of the automatic stop S, or disengaged by means of the emergency lever X.

The main or bed frame A is provided with a dovetail slide H<sup>1</sup> as shown in Fig. 17. This accommodates a back rest J. This back rest also moves at right angles and on a horizontal plane by means of a hand wheel and screw in a similar arrangement as that used on the traveling head as shown herein. A suitable screw nut F<sup>16</sup> which is secured to the traveling head J, serves as a suitable means in connection with the screw for the longitudinal movement of J along the slide H<sup>1</sup>. The head J or back rest serves as a means of resistance for the pipe in the course of operation. The forward

and backward movement of this back rest J is to accommodate the different diameters of bending wheels. It is necessary in effecting some styles of bending to have various attachments for placing in the back rest J to accommodate the different classes of work as shown by the members 69 and 70 of Fig. 17. In Fig. 19 is shown an arrangement for bending die bends in the course of manufacturing brass bedsteads and similar work wherein a brass covered, iron lined tubing would be used and wherein metals having two different tensile strengths are to be dealt with at the same time.

It is necessary in making bends on some grades of material to support the piece to be operated upon beyond the center on the outside. It is therefore necessary that the member 70 as shown in Fig. 17, should slide lengthwise in the member J. In order to stop this slide at the proper point, it is necessary to provide a stop pin which is stationary in the member J, as shown in H<sup>6</sup> Figs. 19 and 26. This is done by means of slotting the back portion of the block 70 as shown by H<sup>7</sup>. As there are various attachments which are placed in the member 70 a suitable dovetailed groove is provided for this purpose as shown in H<sup>8</sup>, Figs. 19 and 26. There is also provided a key way H<sup>4</sup> into which is placed a key H<sup>2</sup> for securely holding the various attachments therein.

In bending it will be readily seen that there is more or less pressure imposed upon the back rest. This, however, causes more or less friction. It is desirous to reduce all possible friction to the minimum, and if possible to eliminate it entirely. A means for doing this is by the employment of a traveling die section or member H<sup>9</sup> which is provided with the necessary groove H<sup>10</sup> into which the pipe fits. This traveling semi-die section or member is moved with the pipe longitudinally against the rollers 67 whose shafts 68 and 68 are journaled or carried in a frame 69. This, however, cannot be used with pipe and tubing of relatively great diameter. For the larger sized pipes it is necessary to apply power direct to the traveling die section or member; as the friction between the pipe and the traveling semi-die section or member is so great at times as to result in the pulling of the pipes apart. I, therefore, provide a suitable means for this as shown in Fig. 9, whereby the member M is provided in its upper edge with gear teeth F<sup>9</sup>. The traveling semi-die F<sup>13</sup> as shown in same figure is provided with a rack F<sup>10</sup> which is secured to F<sup>13</sup> by means of suitable filister head screws, countersunk as shown by F<sup>11</sup> same figure. In the course of operation the longitudinal movement of the traveling semi-die causes the member F<sup>13</sup> to project beyond the back rest to a considerable extent,

and it is necessary, where there is no rack provided on the member  $F^{13}$  to replace or draw back into normal position, the traveling semi-die ready for the next operation.

- 5 I, therefore, provide a rack and pinion arrangement as shown in  $H^{16}$ , which refers to the rack and 176 which refers to the pinion. The rotating movement of the pinion is caused and reduced by means of the  
10 hand wheel 156 and 165 being connected therewith as shown in Fig. 22. On the larger sizes of pipe the weight of the traveling semi-die becomes considerable and increases with every larger sized diameter.  
15 The sliding of such a great weight upon the sharp edge of the bottom part of the arm V of the member J into which it travels would cause great wear. I have, therefore, provided a gib  $H^{17}$ , Fig. 20, which is  
20 placed in under the sliding complementary or semi-die at the point shown by R—S of member J, Fig. 17, which gives a flat smooth surface on which to work and eliminates all possible wear on the larger member J. A lug  
25  $H^{18}$  is provided on the gib  $H^{17}$  of Fig. 20 to prevent the gib from sliding through the member J which might occur as the result of friction.

- When the pipe is removed after it has  
30 been bent into the desired form there is a tendency for the member  $F^{13}$  to become dislodged and dropped down. I, therefore, provide an arm or member  $H^{12}$  which projects over the top of the complementary or  
35 semi-die member as shown in Fig. 16, which supports a small shaft  $H^{14}$  which is held in place by a lock nut  $H^{13}$ . This shaft accommodates a roller  $H^{15}$ . There is a similar arrangement at the rear as shown by  $H^{11}$   
40 which is supported by an arm of a member or bracket arm 18. During the bending operation, the back end of the pipe has a swinging tendency. I, therefore, provide the bracket 18 which has an upstanding  
45 roller 19 accommodated to the back end of the traveling semi-die, or member  $F^{13}$  as shown in Fig. 16. A slot 60 in each side of the bracket 18 permits moving backward and forward of the same the proper relation  
50 and adjustment to the back rest of member J.

- The pressure is so great, especially in bending pipes of great diameters, against the back rest J that there is a tendency of  
55 the same to spring away from the bending roll of member M. I therefore, provide a tie rod 66 as shown in Fig. 21 to prevent this action, said tie rod being provided with a casting 118 having a screw threaded connection  
60 therewith, said casting 118 having a bore to receive the projecting upper portion or end of the main shaft D. This shaft or rod 66 has screw threaded connection with a hand wheel N suitably limited in  
65 its movement by a screw threaded sleeve and

washer 71 thereon. It will be readily seen and understood that the member 118, being placed on the shaft D and projecting at an angle to the back rest or member J is secured with extreme rigidity. In this particular operation which is known as die-bending, the pipe to be operated upon is bent around a former or die member M. This I term as die-bending and which shall be referred to throughout this case as die-bends. By thus adopting the tie-rod system is attained one of numerous points, numbering about twenty, most essential and involved in the principle of my system of pipe and tube bending. The point I wish to make and establish now is that in order to successfully bend a pipe or tube cold, it is absolutely necessary that it be held tightly and intact to the bending die or member M and in the proper groove for the reception of the same in its periphery. It is therefore necessary that no springing back of the back rest or member J take place, which would result in producing an opening between the point of resistance and member M which would permit the pipe to spring away from the bending die M, therefore in order to prevent this, I have adopted the tie rod system. It will now be readily seen that one end of the tie rod 118 being securely fastened to the projecting end of the shaft D and the other end of the tie rod being placed in the opening  $H^3$  of the member J as shown in Fig. 17, that, when the hand wheel and the tie rod are screwed up tightly, the friction washer 71 is caused to exert pressure on the upper projecting portion thereof as will be fully apparent from Fig. 23. Also it is noted that the movement or tightening of this hand wheel N will tie, as it were, the back rest fast to the shaft D, therefore, holding the pipe or tube intact to the member M assuring extreme rigidity. Extreme rigidity at this point, as before indicated, I wish to establish as one of the most essential points involved in the principle underlying the invention. It has previously been mentioned and referred to regarding the elimination of all possible reduction of friction at the point of resistance against the back rest J and its attachments in the use of the members  $H^9$  and  $F^{13}$  as semi-dies as particularly shown in Figs. 16, 17 and 18. This is the second point I wish to establish in connection with the principle which shall be known as elimination of friction. It will be seen that we now have at the point of resistance or at the back rest J extreme rigidity combined with a frictionless movement.

In the course of bending over a form or bending-die member M the traveling head K, shown in operative connection in Fig. 2, starts by revolving in the direction indicated by the arrow therein. At the begin-

ning of the operation when the traveling head K is in its normal position and back right alongside of the back rest J the pipe or tubing is passed through the steel blocks 64 and Q, and on the mandrel and plug. The head L is moved forward causing the steel block Q to come in contact with the pipe or tubing and then the final locking lever K<sup>5</sup> is pressed downward, assuring a good rigid grip on to the pipe or tubing and preventing any possible slippage. When tubing with a very thin wall of soft material is used, it is necessary to place a plug in the end of the pipe, inside at the point of gripping, when making bends close to the end, in order to prevent the crushing of the tube or pipe. The end plug, however, not necessary in steel or iron pipes with a heavy wall as a means of securely gripping the pipe or tubing and preventing it from slipping or pulling through the clamping blocks 64 and Q, establishes the fifth point involved in the principle. The five established points involved in the principle refer to making die bends. Any slippage caused in the pipe, between the pipe and the clamping arrangement will result in the buckling and collapsing of the pipe or tubing and oftentimes causes a distinct breaking of the pipe or tubing so it will be readily understood wherein the fifth point of the principle is involved. It is not always possible to bend the thinner gages by pulling them around the bending former M by means of the traveling head K but it is possible to do so by means of the traveling head when operated in connection with the follower as the head has a tendency to pull the tubing around the former as shown in Fig. 2, when working in connection with the followers, which pushes upon the back end of the tubing, and operates therewith when power is applied to the endless chain by means of the friction clutch arrangement. The peripheral speed of the bending former is the same as the traveling speed of feet per minute, as the endless chain gives the same movement of travel to both the traveling head and the follower, but there is a slight increase and decrease of expansion and contraction in the tubing in the course of the bending operation owing to the different tempers of material, there being hard and soft spots in the pipe and tubes which occur in the milling process where they are manufactured. It is therefore necessary to provide a means for taking care of this unevenness of expansion and contraction. In order to provide for this a spring D<sup>19</sup> is arranged upon the rods D<sup>13</sup> and D<sup>17</sup>, between a casting D<sup>18</sup> and a collar D<sup>20</sup> and suitably held in place by lock or jam nuts D<sup>12</sup> and D<sup>16</sup>, whereby, as the tube in the course of action presses against the member D<sup>18</sup> and as an increase or decrease in expansion will cause

the member D<sup>18</sup> to slide backwardly or forwardly on the connecting rods D<sup>13</sup> and D<sup>17</sup>, the movement will as indicated, be compensated for by the action of the springs D<sup>12</sup>. A bushing D<sup>11</sup> is interposed between the casting D<sup>12</sup> and the mandrel 55, and is readily removable to provide for replacing the same by another, as in accommodating mandrels of different cross-sections, said mandrel also having a head D<sup>21</sup> within the tubular member 73, to which head is connected the rod L<sup>33</sup>. Also a hook D<sup>9</sup> effects connection at D<sup>10</sup> with the casting D<sup>12</sup>, said hook being adapted to have engagement with the endless traveling member 4. By providing a means of operating the follower in connection with the revolving head, I have established the sixth point involved in the principle. By providing a means of automatically taking up the difference in expansion and contraction and at the same time always supplying a steady source of power to the follower which is transmitted to the end of the tubing I have established the seventh point involved in the principle.

Fig. 18 shows the automatic stops and also the safety stop 175 previously referred to. In order to determine the angle or degree of any die bend and especially where exact duplication of bends is required, I have provided the degree graduations G<sup>12</sup>. There is a zero mark D<sup>8</sup> on the main shaft D as shown in Fig. 1, which is direct in front when the traveling head is in its normal position. In order to stop the machine at a certain degree it is only necessary to set the automatic stop with the desired degree in the proper relation to the zero mark, and when the projecting portion or arm of S in the course of rotation engages the member G<sup>14</sup>, it will trip and disengage the block W, thus releasing the projecting arm of the member V as shown in Fig. 4 and detailed in Fig. 21 which will disengage the power at the same time stopping the movement of the endless chain 4, the follower seen especially in Fig. 27, and the rotating head K, Fig. 1. In order to return the revolving head K it is necessary to first reverse the power of the machine which is accomplished by the lever 76, Fig. 2, and the connecting rod 52 and the belt shifting arrangement A<sup>3</sup> which will shift the reverse or cross belt A<sup>5</sup> from the loose pulley A<sup>2</sup> on to the tight pulley A<sup>1</sup> and the straight belt A<sup>4</sup> will then be shifted to the loose pulley 51 now that the power of the machine is reversed. In order to start the backward movement of the rotating head and to bring it back to its normal position by pressing down with the foot treadle U the worm E<sup>6</sup> is again brought in mesh with the worm wheel 42 and the power is applied at this point and securely held in mesh by the locking arrangement shown in Fig. 4, which securely holds the

projecting arm of member V and causes the reverse power to return the revolving head K. It is necessary that the head K should stop when it has reached its normal position and that the power be disengaged at the right time to prevent the traveling head coming in contact with the back rest J. I have therefore provided an automatic stopping or safety stop and arrangement as shown in Figs. 20 and 18 whereby 175 is the tripping arrangement which is secured and made stationary to the shaft D just beneath the forward automatic stops as shown in Fig. 19. A lever arrangement  $G^9$  is supported by a screw or pin  $G^8$  which is securely fastened to the bottom supporting frame 44, and acts as a pivot or fulcrum upon which the lever  $G^9$  is operated. The lever 9 is also provided at one end with a pin or screw  $G^{10}$  to carry a roll  $G^{11}$ . It will now be understood that by the arm 175 coming in contact with the roller  $G^{11}$ , the lever  $G^9$  will be caused to swing on its pivot or center  $G^8$  and cause its free end to actuate the locking arrangement W so as to disengage the power, thus stopping the rotating movement of the traveling head K when it has reached its normal position. By thus providing an automatic means of stopping the machine at a determined degree or angle of bend and also providing an automatic stopping means in the form of a safety trip, I have established the eighth point involved in the principle of my system of pipe and tube bending.

I claim—

1. A pipe bending machine of the character described, including an endless carrying member, pipe-bending means receiving the object or pipe from said endless carrying member, a follower, connecting means between said follower and said carrying member a lost-movement compensating means for said follower and a mandrel and a guide rod bearing said follower.

2. A pipe bending machine, including an endless carrying member, pipe-bending means receiving the object or pipe from said

endless carrying member, a follower, means of connection between said follower and said carrying member, and a lost-movement compensating resilient member for said follower, applied to said mandrel.

3. A pipe-bending machine, comprising a bending former, a shaft carrying said bending former, and an automatically tripping mechanism for said shaft including an arm carried by said shaft, a right angled or bell-crank lever, a vertical bearing, an additional bearing at right angles to said vertical bearing, a horizontal shaft carried by said vertical bearing and equipped with an emergency lever and a swinging dog, and treadle actuated means adapted to be engaged by said emergency lever for arresting the action of the parts.

4. A pipe bending machine, comprising a bending former, a shaft carrying said bending former, an endless carrying member, a follower, resiliently cushioned telescoped members, a hook-ended member connected to the follower proper and adapted to engage said endless carrying member.

5. A pipe bending machine, comprising a bending former, a shaft carrying said bending former, an overgearing mechanism for said shaft, an endless-carrying member, a follower, a resiliently cushioned compensating member for said follower, and means of connection between said carrying member and follower.

6. A pipe bending machine, including a bending former, a shaft carrying said bending former, an overgearing mechanism for said shaft, an undergearing mechanism connected to said overgearing mechanism, an endless carrying member, a follower, a resiliently cushioned compensating member for said follower, and means of connection between said follower and endless carrying member.

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

JAMES FILLMORE COX.

Witnesses:

JOHN J. RYAN,  
M. I. CRONIN.