March 18, 1941. P. L. IRVING ET AL 2,235,072

APPARATUS FOR PRODUCING RETURN BEND FITTINGS

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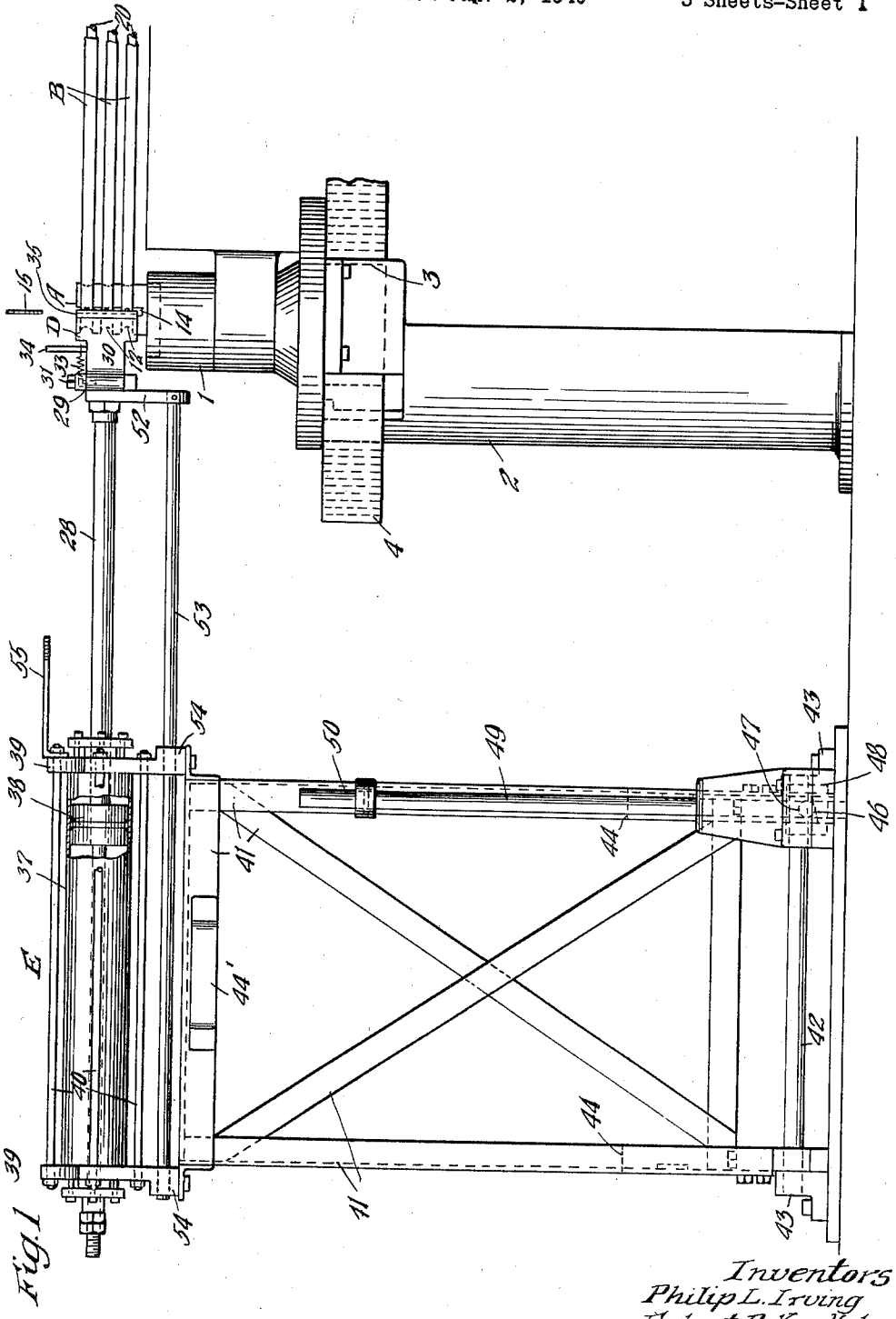


Fig. 1

Inventors
Philip L. Irving
Erhart P. Kunkel
By George S. Haught Atty.

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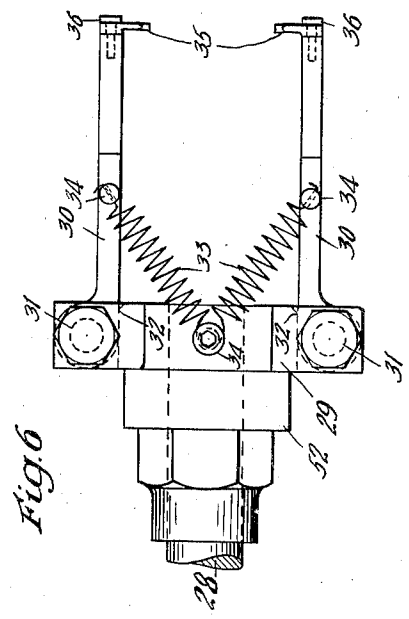


Fig. 6

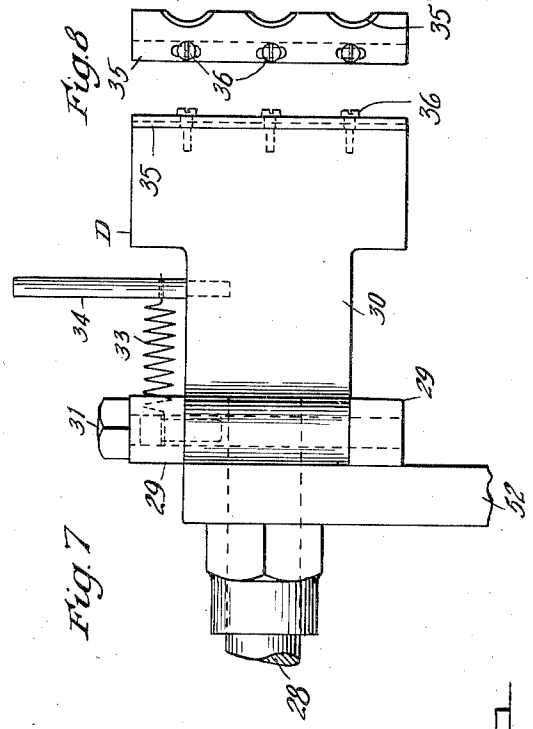


Fig. 7

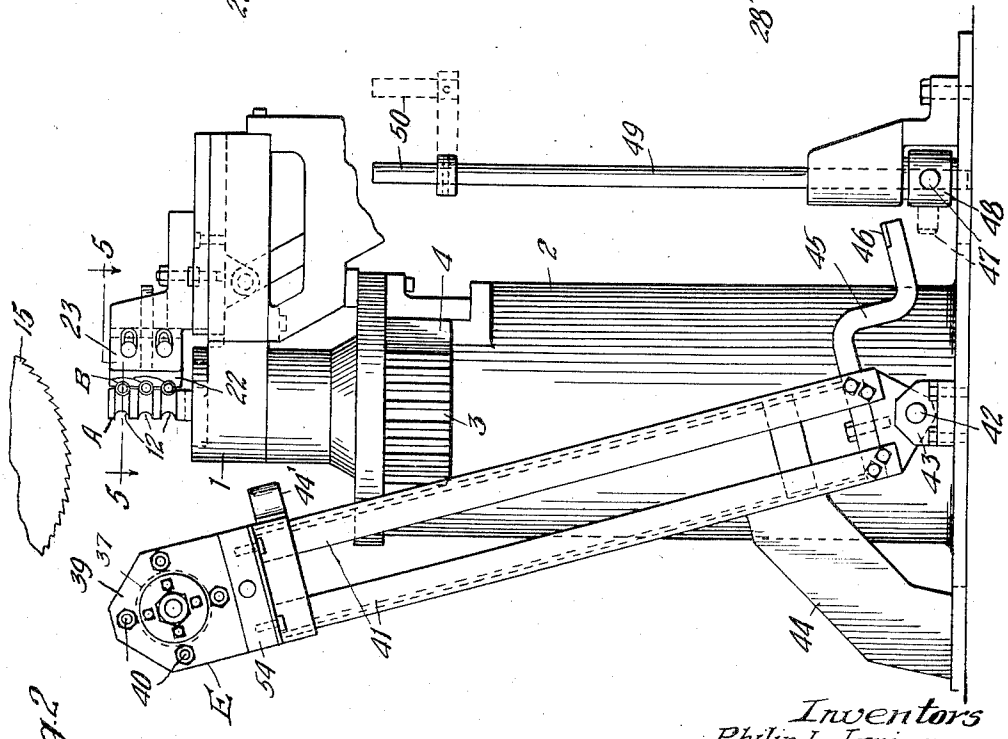


Fig. 2

Inventors
Philip L. Irving
Erhart P. Kunkel
By George S. Knight Atty.

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Fig. 3

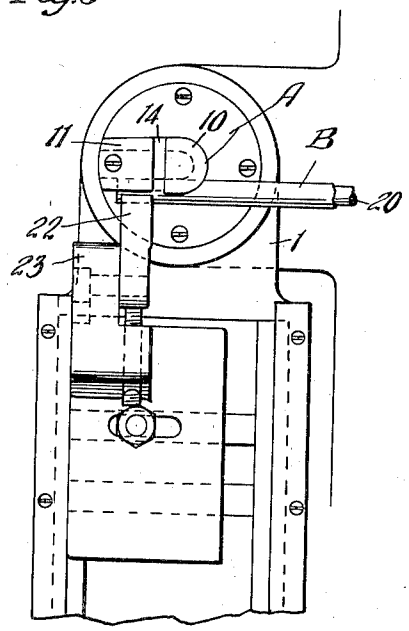


Fig. 9

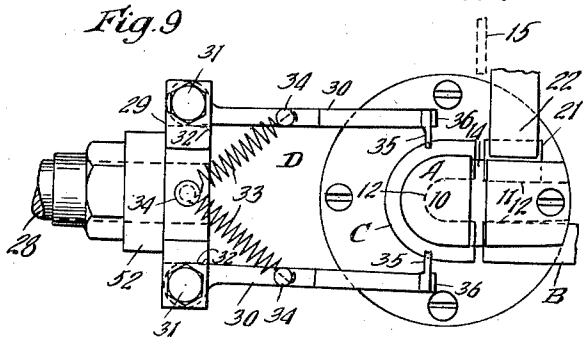


Fig. 10

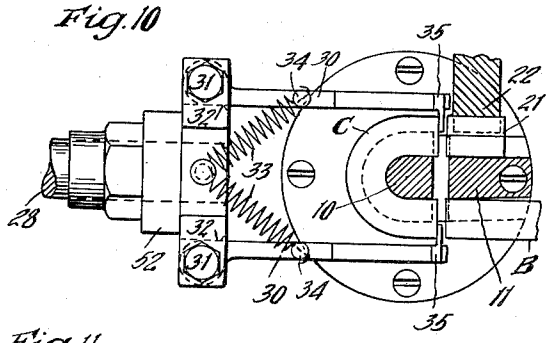


Fig. 11

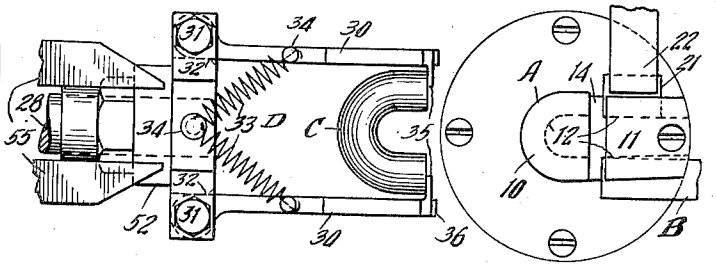


Fig. 4

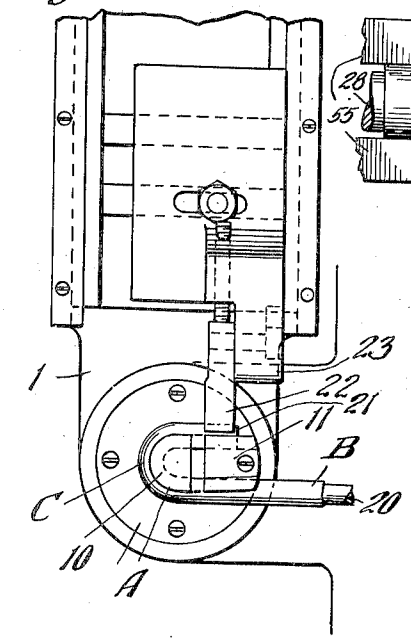
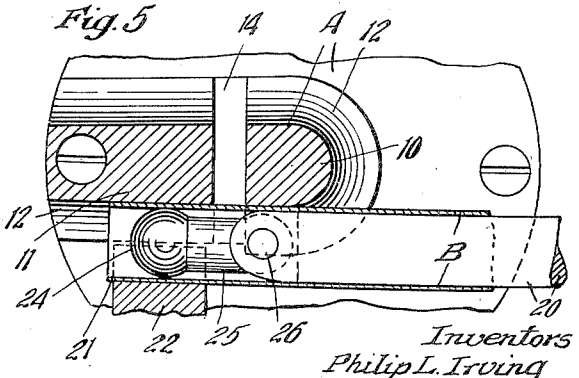


Fig. 5



Inventors
Philip L. Irving
Erhart P. Kunkel
By George S. Haught
Atty.

Patented Mar. 18, 1941 2,235,072

UNITED STATES PATENT OFFICE

2,235,072

APPARATUS FOR PRODUCING RETURN BEND FITTINGS

Philip L. Irving and Erhart P. Kunkel, Port Huron, Mich., assignors to Mueller Brass Co., Port Huron, Mich., a corporation of Michigan

Application January 2, 1940, Serial No. 311,976

5 Claims. (Cl. 153—2)

Our invention relates to improvements in the art of bending of metal tubing and has more particular relation to the formation of pipe fittings such as return bends, elbows, and the like, from straight tubing. Our invention is especially adapted to the formation of solder type fittings from copper tubing, and to the successive forming and severing of such fittings from long lengths of tubing.

Among the objects of our invention is the reduction in the cost of production of fittings, especially return bends, from lengths of tubing, and we accomplish this by facilitating the removal and discharge of the fittings from the forming mechanism by a method employing positive, quick acting power mechanism, instead of the slow and uncertain manual methods commonly employed in these operations.

Another object is the elimination of the danger of physical injury to the operator occasioned by the manual removal of the formed fittings from the forming mechanism.

Other objects of our invention will appear hereinafter.

Referring to the accompanying drawings,

Fig. 1 is a view in elevation of an ejecting mechanism in operating relation to the tube bending mechanism, by which the return bend fittings are formed and severed from the tube lengths;

Fig. 2 is an end elevation of the mechanism shown in Fig. 1, the ejecting mechanism being shown as swung out of alignment with the forming mechanism to permit the insertion of tube lengths from which the return bends are formed;

Fig. 3 is a top plan view of the turret on which the bending form and tube clamping mechanism are mounted, these parts being shown in position corresponding to the beginning of the forming operation;

Fig. 4 is a similar view of the parts shown in Fig. 3, but in position corresponding to the completion of the forming operation;

Fig. 5 is an enlarged detail partly in section on a line corresponding to the line 5—5 of Fig. 2, showing a tube length on a mandril and clamped against the bending form ready to be given a U-bend;

Fig. 6 is an enlarged detail plan of the ejector device shown in Fig. 1 in engaging position with respect to the forming mechanism;

Fig. 7 is a view in elevation of the ejector device shown in Fig. 6;

Fig. 8 is a detail view of one of the fingers carried by the ejector device for engaging the formed or bent tube after it has been severed from the tube length;

Figs. 9, 10, and 11 are detail views in plan of the ejector device and forming mechanism in different relative positions to illustrate the several steps in the method of ejecting the formed articles, Fig. 9 showing the ejector approaching and beginning engagement with the severed return bend, Fig. 10 showing the ejector having completed engagement with the ends of the return bend, and Fig. 11 showing the ejector device withdrawing the formed return bend from the forming mechanism to release it for discharge into a suitable receptacle.

U-shaped or return bend pipe fittings of the solder type, especially those made of copper, are formed from long lengths of tubing by machines which bend the end portion of the tubing into a U-form and then cut the formed article from the length. The tubing is then fed forward and the operations are repeated until the length of tube is used up, whereupon another long length of tubing is inserted into the machine and the operations repeated as before.

The machine which we have illustrated in the drawings is of the type which has a bending form or block A conformed to the shape of the bend to be made and to which the tube B is clamped and around which it is drawn when the bending form is rotated. In the present instance, this machine is arranged to simultaneously form three return bends from three separate lengths of pipe or tubing, but it is understood that in principle the operations are the same whether a single or a plurality of articles are formed, and that the number of articles simultaneously formed is in practice governed by the size of the fitting to be produced.

The bending form A is carried upon a turret 1 which is rotatable horizontally upon a vertical axis and which is mounted upon a base or standard 2 as part of the frame of the whole machine. The turret and the bending form are rotated by suitable power mechanism such as hydraulic means, through the gear 3 and rack 4, Figs. 1 and 2. The bending form A, as shown more clearly in Fig. 5, has a forming portion 10 and a clamping portion 11, the forming portion being rounded or curved to form a U-shaped bend in the tube. The faces of the forming and clamping portions 10 and 11 of the bending form have channels or grooves 12 for the tubing, these channels being conformed to the circumference of the tube and of a depth substantially equal to the radius of the tube, so that the groove embraces substan-

tially one-half of the circumference of the tube. The bending form also has a transverse vertical slot 14 which separates the clamping and forming portions and into which a saw or cutter 15 enters to cut the tube and sever the U-shaped portion C from the length.

The long lengths of tubing B from which the return bends C are formed and severed, are carried on long mandrils 20 extending the length of the machine frame. The tubes are slipped onto these mandrils from the forming end of the machine. At the rear end of the machine, the tubes and mandrils are connected to suitable hydraulic mechanism which after each forming operation advances them forward into position for the next forming operation. The forward portions of the tubes are thus positioned alongside the bending form in the grooves thereof. The extreme end portions 21 of the tubes overlie the clamping portion 11 of the bending form and are gripped between said clamping portion 11 and a clamping jaw member 22 which is correspondingly grooved and which is slidably mounted on an arm 23 extending outwardly from and movable with the turret 1. Suitable hydraulic actuating mechanism operates the clamping jaw towards and from the tube to grip and release as the operations require.

Each of the mandrils has at its end a ball member 24 on a short stem 25 hinged at 26 to the mandril (Fig. 5). These ball members serve as dies to maintain the roundness of the tubing and prevent buckling as the tubing is bent around the bending form. The mandrils are advanced with the tubing so that the ball dies occupy the positions within the clamped end portions 21 of the tubes where they are held until the clamps close. They are then retracted sufficiently to clear the slot 14 and held stationary while the tubing is drawn over them in the process of bending the tubing around the bending form.

The cutting of the tubes is accomplished by means of a circular saw 15 illustrated diagrammatically in Figs. 1, 2 and 9, which is carried by suitable operating mechanism and is adapted to be brought down into the slot 14 in a plane transversely of the longitudinal axis of the tubes. The saw cuts across the body of the tubes and also the end portions 21 which become waste ends. The saw cut thus determines the length of the legs of the formed return bends C. The saw is of sufficient thickness so that the cuts through the portions 21 and the tube bodies are of appreciable width to provide space for the entry of the ejector mechanism.

The extreme power necessary to bend the tubing leaves the return bends C tightly wedged in the grooves of the bending form. Heretofore the practice has been for the operator to manually pry the return bends loose from the bending form and remove them, so that the next forming operation could be carried out. The manual removal of the U-bends from the machine not only is costly because slow and uncertain, especially where several return bends were simultaneously formed as in the present machine, but it actually endangers the operator's hands by subjecting him to too close proximity to the mechanism, particularly the cutting saw.

In accordance with our invention, we provide a method of ejecting the formed return bends which can be carried out by suitable power-actuated ejecting mechanism under the control of the operator, whereby immediately upon the completion of the forming and cutting operations the several formed return bends are simultaneously withdrawn from the bending form and discharged clear of the machine. This method provides for the extremely fast and positive removal of the formed return bends without the necessity for the operator leaving his control position.

Our method involves the engagement of the ends of the legs of the return bends and the simultaneous application of power substantially equally to both of these leg ends to forcibly withdraw and dislodge the return bends from the bending form and carry them sufficiently clear of the machine to discharge them into a suitable receptacle. The mechanism for carrying out this method comprises an ejector device which is arranged to be reciprocated towards and from the bending form, and which is adapted upon its forward stroke to engage the return bends, and upon its return or retraction stroke to dislodge the return bends from the bending form and pull them away from the end of the machine sufficiently so that they will drop into a suitable receptacle.

The ejector comprises a tube engaging device D carried on the end of the piston rod 28 of the power-actuating mechanism E by which it is moved towards and from the forming machine. The ejector device consists of a head or cross member 29 which has two parallelly disposed plates 30 spaced apart and hinged at 31 to swing outwardly. The hinges are formed to provide stops 32 which hold the outer ends of the plates 30 spaced apart a slightly greater distance than the width of the return bend. The plates are yieldingly held against the stop by springs 33 which are attached to pins 34 on the plates and on the head. At their outer ends the plates carry fingers 35 which are directed inwardly toward each other and which are of proper thickness to freely enter the saw cut which severed the return bends C from the tube. The inner ends of these fingers are spaced apart a lesser distance than the width of the return bend so that as the ejector device approaches the return bends (Fig. 9) the edges of these fingers ride on the return bends and spread the plates 30 apart until the fingers reach the saw cut at the ends of the return bend legs. They then ride off the ends of the return bend legs and under the influence of the springs 33 are forced into the saw cuts in position to engage said ends (Fig. 10). Upon retraction of the ejector device (Fig. 11), the fingers apply a positive force equally to both legs of the return bends in a direction outwardly and away from the bending form. The fingers have curved notches 35' in their edges, conforming to the curvature of the circumference of the tubing. The fingers are adjustably secured by the screws 36 to the edges of the plates 30 and may be readily removed and replaced by other fingers adapted to the number and size of the return bends.

The piston rod 28 extends into the end of a cylinder 37 and is secured to a piston 38 actuated by fluid pressure such as compressed air in the cylinder. The piston is reciprocated in the cylinder and thereby imparts the forward and retraction or withdrawal strokes to the ejector device.

The cylinder and its heads 39 are held in assembled relation by means of the rods 40 extending between the heads. The heads 39 are extended below the cylinder to form feet which are secured at the upper end of a frame or standard 41 which supports the power-actuated ejector mechanism at the proper level with respect to the bending form. In order to prevent rotation of the ejector device, the member 29 is con-

nected by an arm **52** to a guide rod **53** which slides in bearings **54** in the extensions of the cylinder heads. The operating position of the ejector mechanism is substantially in line with the bending form and the long lengths of tubing in the forming machine. The frame or standard **41**, however, is pivoted at **42** in a base member **43** so that the whole ejector unit can be swung laterally out of alignment with the bending machine sufficiently to enable new lengths of tubing to be inserted into the forming machine. The standard **41** has a stop arm **44** which serves as a stop to limit the swing of the frame and support it in that position while the operator is replenishing tube lengths in the machine. On the front side the frame has an outstanding similar stop **45** which holds the frame and the ejector unit in its operating position in alignment with the forming machine. This latter stop arm has an inclined cam **46** which cooperates with a locking device to hold the unit in alignment. This locking device consists of an upright shaft **49** having at its lower end a link **48** in which a pin **47** is carried and which engages the cam **46** when the operator rotates the shaft **49** (Figs. 1 and 2). A convenient handle **50** is provided for the operator at the upper end of the shaft **49**. At the upper portion of the standard **41** a handle bar **44'** is provided which the operator may conveniently grasp to bodily swing the standard and ejector unit to either of its positions.

Any suitable means may be provided by which the operator is enabled to control the fluid pressure in the power-actuating cylinder **37**.

At one end of the cylinder stripper plates **55** are mounted and located at the end of the retraction stroke of the ejector device. These strippers are in the form of cam-shaped plates (Fig. 11) which engage the pins **34** and act to spread the hinged plates **30** of the ejector device apart sufficiently so as to definitely release any return bends that may be carried outwardly by the ejector device, thus freeing the ejector device for the next operation.

The operation of the mechanism is as follows: Assuming that the forming mechanism has been charged with long lengths of tubing and that the ejector mechanism has been swung back into operating alignment with the tube forming mechanism. The bending form A to which the end portion of the tubing B is clamped, is rotated by the turret **1** to bend the tubing around the form A and thereby form U-shaped bends or portions C. Upon the completion of this forming operation, the circular saw or cutter **15** is brought into the slot **14** and cuts transversely through the tubing to sever the U-portion from the tube length and to sever the waste-end portion **21**. The saw is then retracted to its upper position. The formed and severed U-bends are now ready to be removed from the bending form so that the bending form can be reversely rotated in position to clamp the end portions of the tube lengths and repeat the next forming operation. The operator supplies fluid (air pressure) to the cylinder E, which projects the ejector mechanism D toward the bending form A. As the ejector mechanism approaches the bending form, the fingers **35** ride on the U-bends, spreading the plates **30** apart against the tension of the springs **33**; and as the fingers pass the severed ends of the U-bends, they enter the saw slot in the tubing and under the influence of the springs **33** engage the ends of the U-bend legs. The operator then reverses the fluid pressure in the cylinder **37** and reverses the movement of the ejector mechanism. This retracts or withdraws the ejector mechanism from the bending form A and the fingers pull the formed U-bends from the bending form and carry them clear of the forming mechanism. The bending form A is then returned to its original position and the operation of forming the U-portions at the ends of the tubing and the ejection thereof from the machine is again repeated. The operation of the ejector mechanism is positive and is sufficiently rapid so that there is no delay between the successive forming operations of the tube-forming mechanism.

One embodiment of our invention has been described and illustrated in connection with the formation of that type of pipe fitting generally known as return bend or U-shaped fittings. It is obvious, however, that the construction, operation, and arrangement of parts may be changed to adapt them to the production of other forms of fittings from tubing without departing from the spirit of the invention; and it is to be understood that our invention includes such changes in construction, operation, and arrangement of parts as fairly fall within the scope of the appended claims.

We claim:

1. In a machine of the class described, the combination of a pipe bending mechanism having a forming block and power means for successively bending the end portion of a pipe length around said block to form a U-shaped bend, means for cutting said U-shaped bend transversely to sever it from the pipe length, and power-actuated ejector mechanism for ejecting said U-shaped bend from said forming block and including fingers adapted to enter the cut and engage the ends of said U-bend, and fluid operated means for actuating said fingers to dislodge the U-bend from the forming block.

2. In a machine for producing return bend fittings successively from a long length of tubing, the combination of a bending form, power-actuated means for successively bending the end portion of the tubing around said bending form to form a U-shaped bend in the tube, means for successively cutting the U-shaped bend from the tube length and forming a space between the severed ends, an ejector having fingers for entering said space and engaging the ends of said U-shaped bends, and power means for moving said ejector away from the bending form to dislodge the bends from said bending form.

3. In a power-actuated machine for bending tubing, the combination of a forming member, means for bending tubing around said forming member to form U-shaped bends, a cutting device operative in a plane transverse to the axis of the tubing to sever the U-shaped bend from the tubing, an ejector movable toward and from the bending form and including a member having yielding arms arranged upon the forward stroke of said ejector to be positioned adjacent the legs of the U-shaped bend, fingers carried by said arms adapted to be moved by said yielding arms into engagements with the severed ends of said U-shaped bend and pull the bend away from the bending form upon the return stroke of said ejector, and power means for actuating said ejector.

4. The combination of a power-actuated tube bending machine for successively forming and cutting U-shaped bends from a long length of tubing having a forming die around which the tube is bent, and a power-actuated ejector de-

vice positioned in operating relation to the forming die and adapted to be moved toward the forming die into engagement with the U-shaped bends and away from the said forming die to remove the formed bends therefrom, said ejector device including a pair of spaced-apart arms and means at the end of said arms adapted to ride on said formed bends and engage the severed ends thereof during the forward movement of the ejector, and to apply sufficient force to dislodge the formed bends from the die during the return movement of said ejector, and means supporting said ejector device for movement into and out of operating position to permit the insertion into the forming machine of long lengths of tubing.

5. The combination of a power-actuated tube bending machine for successively forming and cutting U-shaped bends from a long length of tubing having a forming die around which the tube is bent, and a power-actuated ejector device positioned in operating relation to the forming die and adapted to be moved toward the forming die into engagement with the U-shaped bends and away from the said forming die to remove the formed bends therefrom, said ejector device including a pair of spaced-apart arms and means at the end of said arms adapted to ride on said formed bends and engage the severed ends thereof during the forward movement of the ejector, and to apply sufficient force to dislodge the formed bends from the die during the return movement of said ejector, and means operable during the return movement of said ejector for spreading the arms to release the formed bends withdrawn from the die.

PHILIP L. IRVING.
ERHART P. KUNKEL.