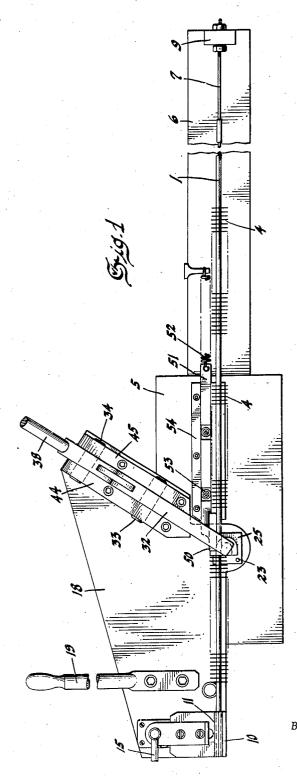
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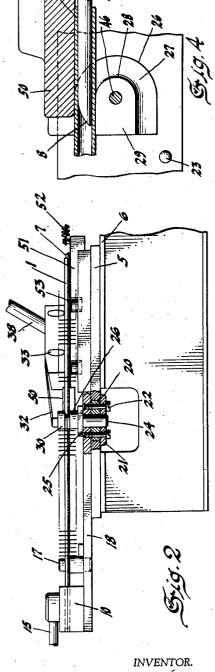
J. F. WESLEY APPARATUS FOR TUBE BENDING

Filed April 18, 1936

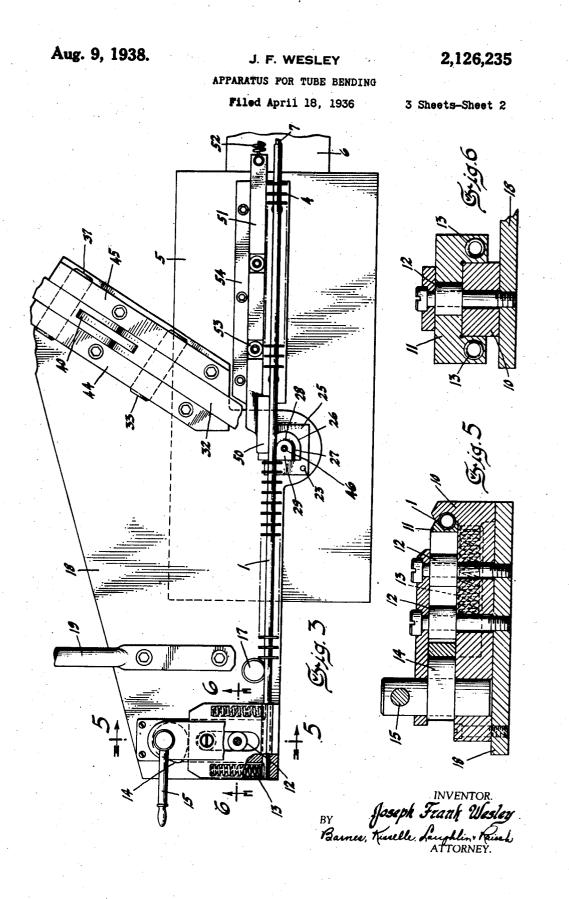
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INVENTOR. Joseph Frank Wesley Barnes, Kerelle, Laughlin + Raisch Attorney.

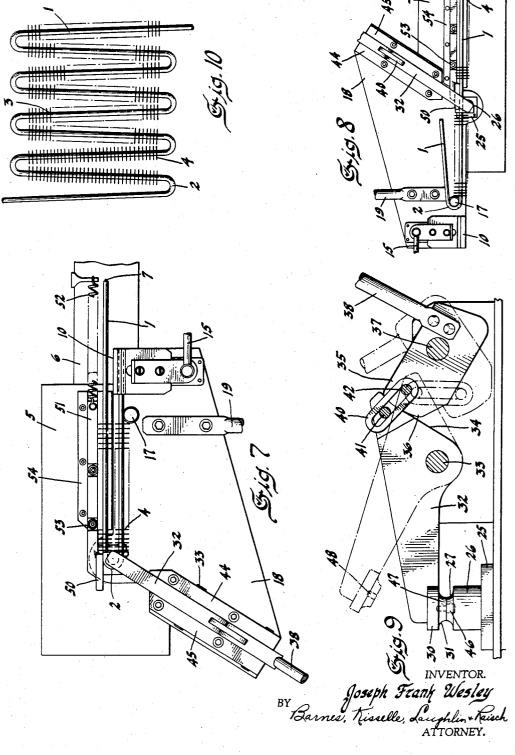


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APPARATUS FOR TUBE BENDING

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Application April 18, 1936, Serial No. 75,153

5 Claims. (Cl. 153-40)

In the accompanying drawings:

Fig. 1 is a plan view of a device constructed in accordance with the invention.

Fig. 2 is a side elevational view of a portion of the device.

Fig. 3 is a view similar to Fig. 1 but of enlarged scale showing the bending apparatus in more detail.

Fig. 4 is an enlarged view showing a part of the bending apparatus and with some parts 10 shown in section.

Fig. 5 is a sectional view taken substantially on line 5-5 of Fig. 3.

Fig. 6 is a sectional view taken substantially on line 6----6 of Fig. 3.

Fig. 7 is a view of the apparatus illustrating the same in its position after having bent a tube through substantially 180°.

Fig. 8 is a view illustrating an arrangement on the machine for making bends in a tube subse- 20 quent to the first bend therein.

Fig. 9 is a detailed view showing the former around which the tube may be bent.

Fig. 10 is a view illustrating a length of tube with several bends therein.

The apparatus may, of course, be used for bending tubing for any purpose. One such purpose is that of making a heat exchange device, as for example a condenser for a refrigerating or cooling mechanism. In Fig. 10 there is shown 30 a length of tubing I fashioned with bends 2, thus providing several runs of tubing 3 between the bends, and suitable heat transferring fins 4 may be located on the runs 3 as shown. The apparatus comprises a suitable table 5 with an ex- 35 tending part 6. An arbor 7 is fastened at one end to the extension 6 and its other end may be free so that a tube may be telescoped thereover. The mounting of one end of the arbor, as shown at 9, is preferably such as to permit of lengthwise 40 adjustment of the arbor, in order that its opposite end may be properly located relative to a former. The opposite end of the arbor is shown at 8 in Fig. 4, and it is properly formed with a curvature since the tube is to be bent adjacent 45 this end of the arbor, with the metal of the tube bending over the curved end of the arbor. A tubing of desirable length as illustrated at 1 is passed over the arbor and it may have the fins thereon as illustrated. The fins as shown are 50 disposed in groups spaced relative to each other, and the tube is to be bent at those portions between the groups of fins.

A suitable clamping means is provided for the free end of the tube, as shown in Figs. 3, 5, and 6, 55

that the walls of the tube, both inside and out-10 side of the curved formation, retain substantially their original smooth form. There is, of course, a tendency in the bending operations heretofore performed, to roughen or disrupt the smooth contour of the tube, particularly the metal on the

This invention relates to an apparatus for

It is one of the objects of the invention to pro-

vide an apparatus by means of which tubing can

be bent or formed with a curve on a radius which

is relatively short as compared to the diameter

of the tube. It is also an object of the invention to provide an apparatus for so bending a tube

bending metal stock in the form of a tube.

15 inside of the curve; what is meant is that metal on the inside of the bend form may be somewhat gathered, or perhaps the word "corrugated" applies, due to the fact that this metal is under compression. The present invention seeks to 20 avoid this gathering, corrugating or roughening

of the tube wall. Of course, the metal of which a tube is made determines largely the minimum length of the radius upon which the tube may be bent. The

25 so-called "Bundy" tube, which is now used extensively in the automotive industry, is formed of steel stock with the seams and plies thereof united by a sealing metal, as for example copper. Heretofore the bending of such tube has, from a

30 practical standpoint, been limited to bending on a radius about 1½ times the diameter of the tube. The radius referred to is figured from the center of the bend to the axis of the tube; the diameter is figured as the outside diameter of the tube. 35 By use of the present invention the radius of

- the bend may be materially reduced, and yet a practical and commercially acceptable article is provided. One example is this: A Bundy tube formed of double ply steel stock, sealed and coat-40 ed with copper, and having an outside diameter
- of 3% of an inch has been practically and successfully bent through 180° on a radius of slight-ly less than $\frac{1}{16}$ of an inch. Thus it will be noted that in this example the radius of the bend is 45 approximately that of the outside diameter of
- the tube. This, of course, is only one example and the invention is not limited thereto, as the device is capable of providing a better bend, even though the tube be bent on a relatively long ra-50 dius, and the invention may be likewise used on
- bends of even a shorter radius.
- In carrying out this invention the tube is subjected to a pulling or drawing action, that is to say, the tube is pulled or drawn lengthwise as it 55 is fashioned.

This clamping means may include a relatively fixed member 10 grooved to receive the tube, as shown in Fig. 5, and a movable clamping member 11 is similarly grooved and capable of slid-5 ing movement in which it is guided by rollers 12 located in an elongated slot therein. Spring means 13 may be arranged in bored out portions of the block 11 and may act upon the relatively fixed member 10 to normally separate these two 10 parts of the clamping means. The member 11

- may be advanced to clamping position by suitable means herein shown as being an eccentric 14 having a suitable operating handle 15 and operating on the back side of the member 11. 15 When the eccentric is rotated clockwise as Fig. 3
- is viewed the clamp opens up and the tube may be inserted; when the eccentric is rotated counter-clockwise the clamping members move together and the tube is clamped therebetween.
- 20 This clamp may be used for making the first bend in a length of tube. There is a stud 17 on the machine around which a bend of tube may be located as illustrated in Fig. 8 for taking subsequent bends in the tube, as will appear in more 25 detail later.

The clamping means and stud are mounted upon a suitable support 18 which may be equipped with an operating handle 19. The support 18 carries the former means around which the tube 30 is bent and the support is pivotally mounted on the support 5. As shown in Fig. 2 a fulcrum member 20 is located in a suitable aperture in the support 5 so that it may turn therein, a plate 21 is located on the under side of the support 5. 35 and cap screws 22 are taken through the plate 21, fulcrum member 20 and into the member 18. The former is mounted on the turning axis of the plate 18 and is arranged to turn with the plate. This former has a stud 24 located on the 40 axis and passing through suitable apertures in the member 18, support 5 and plate 21. The former may have a flange 25 for resting upon the member 18. The former has an upstanding

- body 26 with a reduced and grooved upper end 45 27, the groove being on a curve designed to substantially match the periphery of a tube to be bent, and the curve formation constituting approximately one-fourth of a complete circle. It will be noted by reference to Fig. 4 that the 50 member 26, which is part of the former, is somewhat elongated in form, having a curved surface 28 substantially on the axis and around which the tube is to be bent, and the body extends
- from the axis as at 29. A dowel pin 23 may pass 55 through the flange 25 to cause the former piece 26 to rotate with the plate 18.

The former is divided into two halves, the member 26 constituting the lower half. The upper half of the former is movable and com-60 prises ~ head 30 which may have a shape of elongated form corresponding to the member 26 and having a grooved form 31 of approximately one-fourth of a circle, and when the portion 26 and the head 30 are brought together a groove 65 is formed by the cooperating curved surfaces which may be substantially semi-circular. The head 30 is mounted so that it may be quickly raised from or lowered upon the former piece 26. For this purpose the head 30 is mounted upon an 70 arm 32 fulcrumed as at 33 and having a cam surface 34. A controlling cam-like member 35 has a cooperating cam surface 36, and it is pivoted as at 37 and is equipped to be operated on its fulcrum 37 as by means of a handle 38. As

75 the handle 38 is shifted clockwise as Fig. 9 is

viewed the cam surfaces function to rock the rocker arm 32 in a counter-clockwise direction and thus the two parts of the former are clamped together. When the handle 38 is rocked counterclockwise the holding pressure is relieved, and on 5 continued movement the rocker arm 32 is caused to rock clockwise to lift the head 30 from the former piece 26. This is accomplished by a lost play connection between the member 35 and the rocker arm. This connection may take the form 10 of a link 40 mounted on pins 41 and 42 on the rocker arm and cam 35 respectively. In the closed position of the former the link may be loose on the pins as shown by the full lines in Fig. 9. As the cam is rocked counter-clockwise 15 on its pivot point, the link, acting as a tension member, rocks the rocker arm 32 to open the former as indicated by the dotted line position of Fig. 9. The rocker arm 32 and its controlling cam are mounted for bodily movement on the 20 member 18, as for example between brackets 44 and 45 carried by the member 18.

For the purpose of stabilizing the two former members when they are brought together in operating relation, there is a pilot pin or stabilizing 25 pin preferably located on the axis. This pin is mounted in one member and arranged to engage in an aperture in the other. The pin is shown herein at 46, which may be merely tightly fitted in the former piece 26 and which has an up- 30 wardly projecting part 47 which slidably fits into an aperture 48 in the head 30. Although the head 30 comes down into contact with the former 26 while travelling in an arc, the projecting piece 46 need not be long and the pin will fit tight 35 enough in the aperture to effectively aid in holding the two former halves in proper operating relation.

There is a block or shoe 50 for engaging the tube on the side opposite that side fitted in the 40 former groove, as shown in Figs. 1 and 4. This shee may have some longitudinal extent for engaging a considerable length of the tube, as shown. Where the tube is provided with fins this block or shoe is constructed preferably so that 45 it may move as the tube is bent. For this purpose the block may be mounted on a bar 51 held retracted by a spring 52. The bar may be provided with rollers 53 for a rolling action on a backing member 54.

The operation is as follows: The arbor i is mounted in an adjusted position so that its curved surface 8 is properly located for the bending of the tube therearound. With the head 38 of the former in raised position a length of tube is 55 threaded over the arbor. This length of tube, as shown in Fig. 1, may have groups of fins thereon with spaces between the groups where the bends are to be made. At this time the support 18 is in the position as shown in Fig. 1. The protruding 60end of the tube is then clamped between the clamping members 10 and 11, and the head 30 of the former is lowered into position. The handle 19 is now grasped and the support 18 is turned 65 on its pivot in a counter-clockwise direction. In this action the former turns with the support. As the swinging of the support 18 progresses the tube is bent around the former and in this action the length of the tube which lies to the rear of $_{70}$ the former, that is that portion of the tube on the arbor, is drawn or pulled forwardly on the arbor. The block 50 holds the tube on the arbor from swinging out of alignment. Fig. 7 illustrates the relative position of the parts when the support 18 75

has been turned through substantially 180°, forming substantially a 180° bend in the tube.

In bending the tube the wall thereof, which becomes the outside wall of the bend, forms over the curved surface of the arbor. This curved surface is properly shaped for this purpose. As the tube is pulled along the arbor in this action the forward fin in a group may abut the block 50, but the block is permitted, by the spring 52,

- 10 to shift forwardly tensioning the spring as indicated in Fig. 7. Of course, a tube may be bent which is not equipped with finned stock, in which event the block may or may not be mounted for movement with the tube. After the bend has
- 15 been formed and the parts are in the position as shown in Fig. 7, the clamp 10—11 is released, the upper half of the former is raised, and the support 18 is then shifted back to the Fig. 1 position. Now where a plurality of bends are to be
- 20 made in a length of tube, as shown in. Fig. 10, the clamp 10—11 may not be used on succeeding bending operations. Instead, the previously formed bend may be placed around the stud 17, as shown in Fig. 8. Thus the stud serves to pull
 25 and draw the tube in succeeding bending operations.

It will be noted that in these bending operations the body of the tube is not held or clamped against movement, but to the contrary is per-

- ³⁰ mitted to shift or feed in a forward direction off of the arbor as the bending operation is being performed. In this way there is a minimum of compression or crowding action of the metal of the tube on the inside wall, as the tube is more
- 35 or less drawn around the former. There is, of course, a thinning of the metal constituting the outside wall of the bend, as this metal is under tension and is attenuated. By this invention both the inside and outside walls of a bend in a
 40 tube have a very smooth surface. The cross sec-
- 40 tion of a tube, taken through such a bend, may be somewhat flattened, but there is in any event a uniform appearance with no abrupt indentations which may be in the nature of partial collapsing.
- 45 No forces are applied to the tube or the portion thereof which becomes the outside wall of the bend. Thus the collapsing or partial collapsing of the tube wall, at the outside of a bend, by any such force, is eliminated. As has heretofore been pointed out, tubing can be bent on radii much
- 50 shorter than as heretofore been feasible, and yet a commercial and practical structure is obtained. I claim:

1. In an apparatus for bending stock such as tube or the like, a lower former part provided with a partial groove, an upper former part provided with a partial groove, with the partial grooves cooperating to form a groove around the surfaces of which a tube is to be bent, a rocker

- 60 arm upon which the upper former part is carried, said rocker arm having a cam surface, a pivotally mounted operating member having a cam surface, said surfaces cooperating to hold the upper former part in operating position on the lower former part, and a lost motion connec-
- 65 the lower former part, and a loss motion connection tion between rocker arm and the operating member operable to rock the rocker arm and raise the upper former part from the lower former part.
- 70 2. In an apparatus for bending stock such as tube or the like, a lower former part provided with a partial groove, an upper former part provided with a partial groove, with the partial

grooves cooperating to form a groove around the surfaces of which a tube is to be bent, a rocker arm upon which the upper former part is carried, said rocker arm having a cam surface, a pivotally mounted operating member having a 5 cam surface, said surfaces cooperating to hold the upper former part in operating position on the lower former part, and a link connecting the rocker arm and the operating member and establishing a lost motion connection and serving as 10 a tension member for rocking the rocker arm to raise the upper former part from the lower former part.

3. An apparatus for bending stock such as tube or the like comprising, a rockable member, a $_{15}$ former part non-rotatably secured to the rockable member, a second former part, said former parts adapted to cooperate and shaped to provide a forming groove around the surfaces of which the stock is to be bent, an arm pivotally 20 mounted on the rockable member for carrying the second former part, said arm being pivotal to bring the second former part into and out of operating relation with the first former part, means for holding the stock in cooperating rela-25tionship with the surfaces of said groove, operating means operatively connected with the pivoted arm and movable to swing the arm and shift the second former part toward and away from the first former part and adapted to hold the sec- 30 ond former part clamped in cooperating relationship with the first former part, and means for rocking the rockable member to effect similar rocking action of the former parts to bend the stock around the surfaces of the former parts. 35

4. In an apparatus for bending stock such as tube or the like, a former part, a second former part, said parts being shaped to provide a groove around the surfaces of which the stock is to be bent, a rocker arm upon which the second former $_{40}$ part is carried, a movable operating member, means comprising interengaging surfaces and forming an operable connection between the rocker arm and operating member, which interengaging surfaces have a cam action, whereby $_{45}$ movement of the operating member in one direction clamps the second former part against the first mentioned former part by cam action, and means operatively connecting the operating member and rocker arm for rocking the rocker 50arm upon another movement of the operating member to shift the rocker arm and move the second former part away from the first mentioned former part.

5. An apparatus for bending stock such as a 55 tube or the like comprising, a rockably mounted support, a former part fixed thereto, a second former part, means on the support carrying the second former part and operable to shift the same into and out of cooperating relationship 60 with the first former part, means for holding the stock adjacent said former parts, clamp means on the support for gripping the stock so that the stock is pulled lengthwise and bent around the former parts upon rocking movement of the sup- 65 port, and a projection on the support spaced from the former parts and adapted to be received in the bight portion of a bend in the stock, whereby in bending operations subsequent to the first, the stock is pulled lengthwise by the projection and $_{70}$ bent around the former parts upon rocking movement of the support.

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