March 5, 1946. A. L. KIBLER 2,396,182

TUBE BENDING MACHINE

Filed Sept. 2, 1944

FIG. 1.

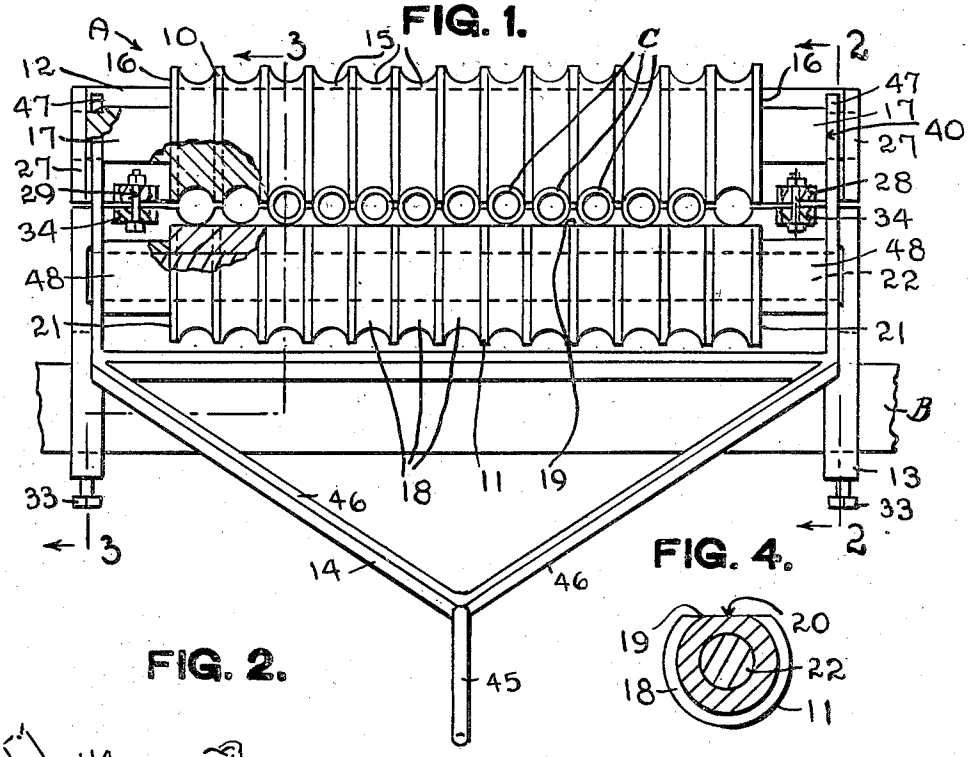



FIG. 4.




FIG. 2.

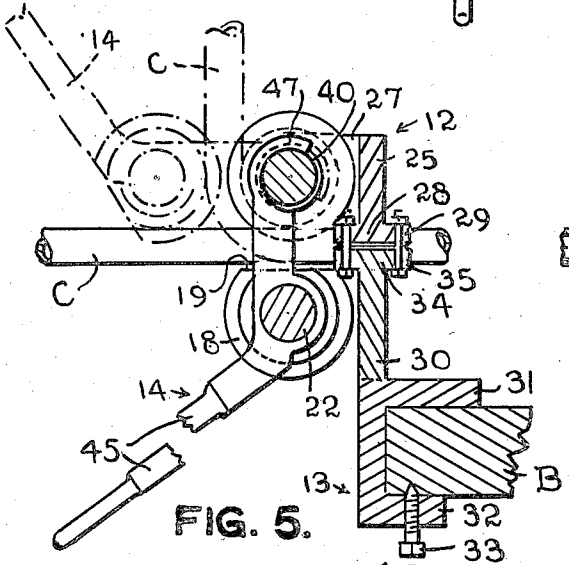



FIG. 3.

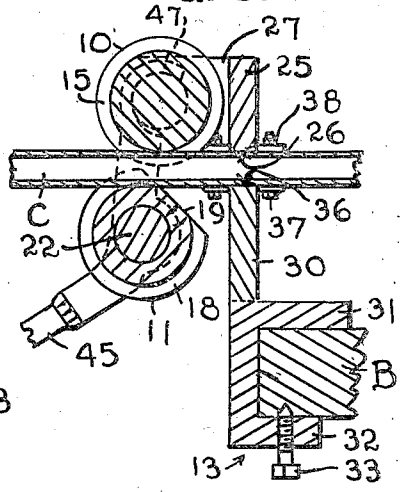
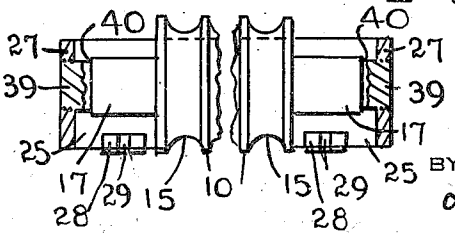



FIG. 5.




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## TUBE BENDING MACHINE

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Application September 2, 1944, Serial No. 552,492

3 Claims. (Cl. 153—46)

This invention relates to metal bending and more particularly to a machine for curving one or more lengths of metal, such as tubing, by means of a pivoted sweep device.

Control equipment, such as control boards, for governing and recording the pressure, flow, temperature, liquid level, etc. of fluids, usually employ a plurality of instruments, from which conduits extend to various machinery, reservoirs, instruments, etc. Usually there is a large number of such conduits and they all frequently extend from the control board at the same curve (for convenience, space conservation, and the like).

An important object of this invention is to provide a machine for simultaneously curving a plurality of lines, pipes, tubes or conduits (hereinafter referred to generally as tubes), so that they will all have substantially the same curvature.

Another important object is to provide such a machine, which will curve the tubes without any material change in the transverse cross section of the tubes.

Still another object is to provide such a machine which comprises but few parts, all being sturdy, and which may be manually manipulated by one operator.

Other objects and advantages of the invention will be apparent during the following detailed description of the invention, taken in connection with the accompanying drawing, forming a part of the specification, and in which drawing:

Fig. 1 is a front elevation of the novel machine, with tubes in place, prior to curving; parts being broken away to better illustrate portions of the assembly.

Fig. 2 is a vertical section, substantially on the line 2—2 of Fig. 1.

Fig. 3 is also a vertical section with a portion of the machine, moved into operative position, but otherwise on substantially the line 3—3 of Fig. 1.

Fig. 4 is a transverse section of a lower forming roller of the novel machine.

Fig. 5 is a fragmentary partial elevation and partial section of the upper forming roller thereof.

In the drawing, wherein for the purpose of illustration is shown a preferred embodiment of the invention, and wherein similar reference characters designate corresponding parts throughout the several views, the letter A may designate the novel machine; B, a support therefor; and C, tubes to be operated upon by the machine A.

The novel tube bending or curving machine A includes two formers 10 and 11, a carriage 12, means 13 to secure the carriage 12 to a support B, and lever means 14 for moving the former 11, and constituting a pivoted sweep device.

One of the formers 10 which may comprise an elongate cylinder, is provided with a plurality of spaced-apart transverse grooves 15, all substantially alike and each forming nearly a semicircle in transverse section. It is not necessary that these grooves 15 be continuous for they may extend only partly around the former 10. However, it has been found more expedient to form the grooves as circles. The ends 16 of the former 10 may be flat and from these ends extend arms 17 having circular peripheries and the axes of the arms substantially coincide.

The movable former 11 may be likewise fashioned from a cylinder and is provided with a plurality of spaced-apart transverse grooves 18, all substantially alike and each forming nearly a semicircle in transverse section. These grooves 18 are not continuous, since the thickness of the cylindrical former 11 is reduced, from end to end by a substantially flat surface 19. Portions of this surface 19 merge into the grooves 18. It will be seen, as in Fig. 4, that the center 20 of this surface 19 is nearer the longitudinal axis of the former 11 than is the lowermost portions of the grooves 18, for a purpose later detailed. Extending from the opposite ends 21 of the former 11 is a shaft or axle 22 which extends through the former 11 and on which the former 11 may rotate. The number and spacing of the grooves 18 correspond with the grooves 15.

For supporting the fixed former 10, the carriage 12 is provided, and this carriage is also adapted to carry the means 13 to secure it to a support B. This carriage 12 includes a substantially vertical wall 25 having a plurality of spaced-apart, nearly semi-circular openings 26 in its lower edge, corresponding in number, size, and spacing with the grooves 15 and 18. From the upper portion of each end of the wall 25 extends forwardly a pair of brackets 27 and, at the lower portion of each end of the wall 25 extends forward and rearward feet 28 having slots 29 extending inwardly from their outer ends.

A second vertical wall 30 is provided, having means 13 at its lower end to attach the carriage to the support B. This means 13 may be a pair of facing, substantially horizontal arms 31 and 32 extending rearwardly of the lower end of the wall 30. The arm 31 is adapted to extend along the upper surface of the support B and the arm 32 along its lower surface, with set screws 33 car-

ried by the arm 32 to firmly secure it to the support B, as in Figs. 1 and 2. However, any suitable securing means 13 may be employed. The upper end of the wall 30 is provided with feet 34, similar to the feet 28, having similar slots 35, and with openings 36, similar to the openings 26. Through the slots 29 and 35 extend bolts 37, having nuts 38 so that the carriage 12 may support the tubes C, by gripping like portions of the tubes, disposed within the openings 26 and 36, upon tightening of the nuts 37 upon the bolts 36.

To the brackets 27 are rigidly secured, as by welding, the free ends 39 of the arms 17. It will be noted, in Fig. 5, that the free ends 39 are reduced in cross section over the other portions of the arms 17, whereby there are shoulders or abutments 40, at the juncture of these ends 39 and the other portions of the arms.

The disposition of the former 10 with reference to the carriage 12 is such that the former 10 is forwardly of the carriage 12 and the bases of the grooves 15 substantially align with the bases of the openings 26 at all times. This is apparent, since the former 10 is secured to the wall 25, by way of the brackets 27.

The lever means 14 for moving the former 11 in arcs of various degrees, may include a forward handle portion 45 and two arms 46 forking therefrom terminating at their free ends in curved portions or hooks 47. To the arms 46 are secured, in any approved way, the ends of the shaft 22; spacing collars 48 being employed, if desired, about the end portions of the shaft 22, between the former 11 and the arms 46. Any approved means may be employed to attach the shaft 22 to the arms 46 as by overturning the extremities of the shaft after the latter is extended through suitable perforations in the arms 46.

The hooks 47 are adapted to embrace portions of the arms 17 at the reduced portions 39 thereof with the hooks 47 limited in sidewise movement by the shoulders 40. Thus, the arms 17, in effect, support the former 11, by means of the lever structure 14.

The length of the lever structure 14 is very important, particularly the shortest distance from the axes of arms 17 to the axes of the shaft 22. That is, when the hooks 47 are embracing the arms 17 as described and the movable former 11 is directly below the fixed former 10, as in Fig. 2, the substantially flat surface 19 will be spaced from a tube C, which tube is in contact with the surface of a groove 15 but, when the former 11 is moved in an arc so that the grooves 18 will rotate, the surfaces of the latter will engage the tube C. The flat surface 19 is necessary so that there be some way (clearance) to manipulate the former 11 and lever means 14 so as to hook the latter on the arms 17 of the fixed former, with the two formers at opposite sides of the tube C. Thus, the distance between the surface 19 and outer face of the under side of a tube C must be sufficient to enable the hooks to be hooked into place. On the other hand, in the event the movable former 11 is hung upon the arms 17 of the fixed former 10 before the tube C is inserted, then there should be some clearance between the tube and at least one former, so as to reduce friction, and this flat surface 19 provides such clearance.

With the desired number of tubes C clamped in the openings 25 and 26, and extending beneath the former 10 and in contact with the surfaces of the grooves 15 thereof, the former 11 may be manually rotated to substantially the position shown in Fig. 3, whereupon movement of the handle portion 45 upwardly will cause the former 11 to rotate over the surfaces of the tubes C and the tubes will be curved as desired, depending upon the arc of movement of the lever means 14. In dots-and-dashes in Fig. 2 is shown movement of the lever means 14 and former 11 to cause a substantially 90° curve in the tube C.

Upon unhooking the former 11, after rotating it in the opposite direction so as to bring the flat surface 19 uppermost, it may be removed with the lever means 14, the carriage then disassembled, by removing the nuts 38 and bolts 37 and the bent tubes C removed. They will all have the same degree of curvature and if all were initially disposed with ends in the same horizontal plane, the curves or bends will all be in the same relative position in each tube.

It is apparent, that a second curve or bend may be made at a selected portion of the tube length, such as to provide a U-bend, simply by moving the tube forwardly in the machine and again manipulating the lever means 14 and former 11.

Because of the few parts, and sturdy construction, eliminating gears, ratchet means, links and reducing the number of pivots to a minimum, breakage is reduced, yet one or a number of tubes may be curved with a simple movement of the lever means 14.

Various changes may be made to the form of the invention herein shown and described without departing from the spirit of the invention or scope of the claims.

What is claimed is:

1. In a machine for forming curves in rigid tubes, a carriage including a pair of spaced apart forwardly-extending brackets, a vertical wall secured to and extending below said brackets and provided with a plurality of spaced-apart, substantially semi-circular openings at its lower end, and a vertical wall below said first named wall and provided with complementary substantially semi-circular openings at its upper end, means for detachably securing said walls together with the surfaces of said opening in intimate contact with said rigid tubes; an elongate, stationary, horizontally-disposed former provided with a plurality of spaced-apart, like grooves, extending transversely thereof, and an arm extending from each end of said former, with the axes of said arms in alignment; means fixedly securing said arms to said brackets; an elongate, movable, horizontally-disposed, former, provided with a plurality of spaced-apart, like grooves, extending transversely partly about said last-named former, a substantially flat surface extending from one end to the other end of each of said last-named grooves, with said surface merging into the bases of said last-named grooves and extending longitudinally across said movable former, and an axle extending from each end of said movable former, the grooves of said fixed former being in alignment with the grooves of said movable former; and a forked lever, pivoted intermediate its ends to said axle, and having hooked ends extending about portions of said arms, the length of said lever being such that, when said hooked ends embrace said arms and said movable former is directly below said fixed former, said substantially flat surface will be spaced from the tubes, in contact with portions of the surfaces of said first named grooves, and when said movable former is rotated to move said flat surface away from said tube, portions of the surfaces

of said last named grooves will contact portions of said tubes.

2. In a machine for forming curves in rigid tubes, a carriage including a pair of spaced apart forwardly-extending brackets, a vertical wall secured to and extending below said brackets and provided with a plurality of spaced-apart, substantially semi-circular openings at its lower end, and a vertical wall below said first named wall and provided with complementary substantially semi-circular openings at its upper end, means for detachably securing said walls together with the surfaces of said openings in intimate contact with said rigid tubes; an elongate, stationary, horizontally-disposed former provided with a plurality of spaced-apart, like grooves, extending transversely thereof, and an arm extending from each end of said former, with the axes of said arms in alignment; means fixedly securing said arms to said brackets; an elongate movable, horizontally-disposed, former, provided with a plurality of spaced-apart, like grooves, extending transversely partly about said last-named former, a substantially flat surface extending from one end to the other end of each of said last-named grooves, with said surface merging into the bases of said last-named grooves and extending longitudinally across said movable former, the center of said surface being nearer the longitudinal axis of said movable former than is the lowermost surface of said last-named grooves, and an axle extending from each end of said movable former, the grooves of said fixed former being in alignment with the grooves of said movable former; and a forked lever, pivoted intermediate its ends to said axle, and having hooked ends extending about portions of said arms, the length of said lever being such that, when said hooked ends embrace said arms and said movable former is directly below said fixed former, said substantially flat surface will be spaced from the tubes, in contact with portions of the surfaces of said first named grooves, and when said movable former is rotated to move said flat surface away from said tubes, portions of the surfaces of said last named grooves will contact portions of said tubes.

3. In a machine for forming curves in rigid tubes, a carriage including a pair of spaced apart forwardly-extending brackets, a vertical wall secured to and extending below said brackets and provided with a plurality of spaced-apart, substantially semi-circular openings at its lower end, and a vertical wall below said first named wall and provided with complementary substantially semi-circular openings at its upper end, means for detachably securing said walls together with the surfaces of said openings in intimate contact with said rigid tubes; an elongate, stationary, horizontally-disposed, former provided with a plurality of spaced-apart, like grooves, extending transversely thereof, and an arm extending from each end of said former, with the axes of said arms in alignment; means fixedly securing said arms to said brackets; an elongate, movable, horizontally-disposed, former, provided with a plurality of spaced-apart, like grooves, extending transversely partly about said last-named former, a substantially flat surface extending from one end to the other end of each of said last-named grooves, with said surface merging into the bases of said last-named grooves and extending longitudinally across said movable former, from end to end thereof, the center of said surface being nearer the longitudinal axis of said movable former than is the lowermost surfaces of said last-named grooves, and an axle extending from each end of said movable former, the grooves of said fixed former being in alignment with the grooves of said movable former; and a forked lever, pivoted intermediate its ends to said axle and having hooked ends extending about portions of said arms, the length of said lever being such that, when said hooked ends embrace said arms and said movable former is directly below said fixed former, said substantially flat surface will be spaced from the tubes in contact with portions of the surfaces of said first named grooves, and when said movable former is rotated to move said flat surfaces away from said tubes, portions of the surfaces of said last named grooves will contact portions of said tubes.

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