June 6, 1950 G. E. LUCE 2,510,183

TUBE BENDING MACHINE

Filed April 16, 1948 2 Sheets-Sheet 1

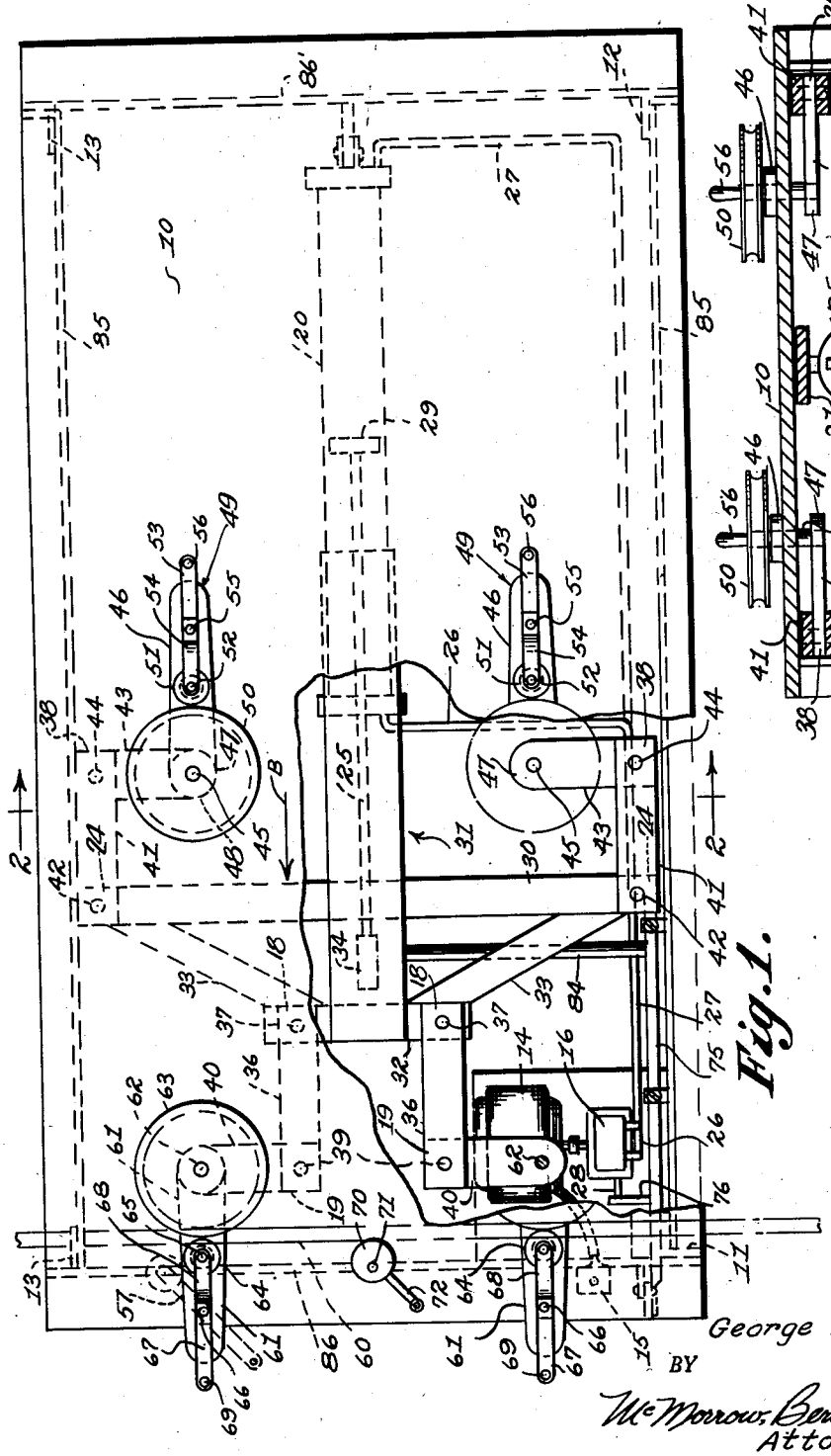

Fig. 1.

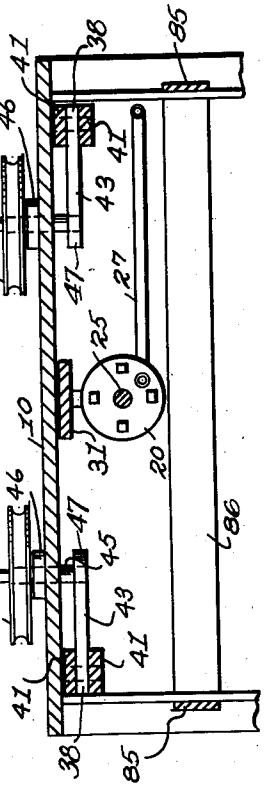

Fig. 2.

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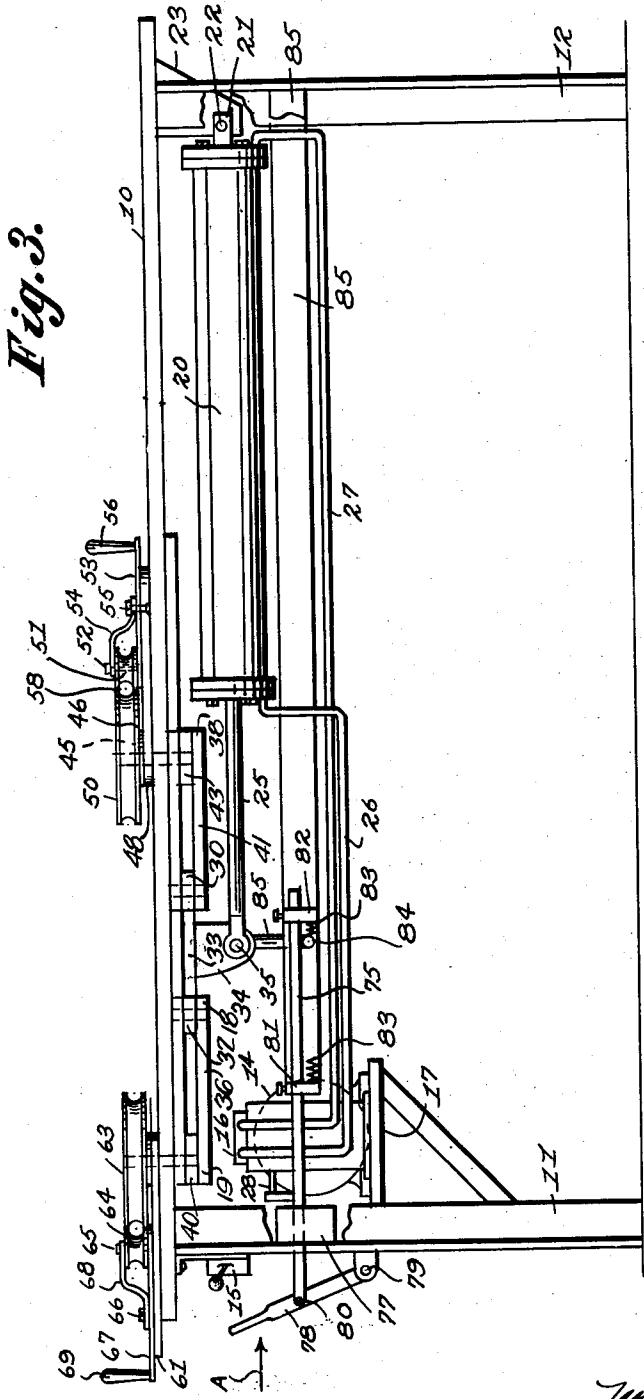

Fig. 3.

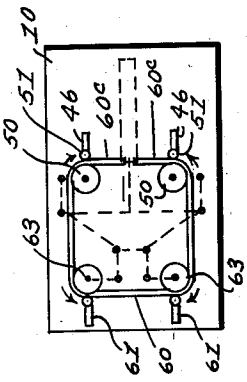

Fig. 6.

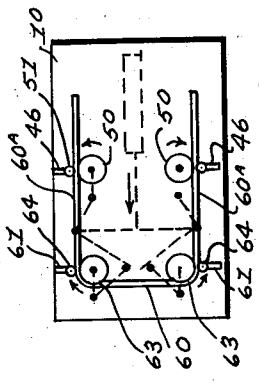

Fig. 5.

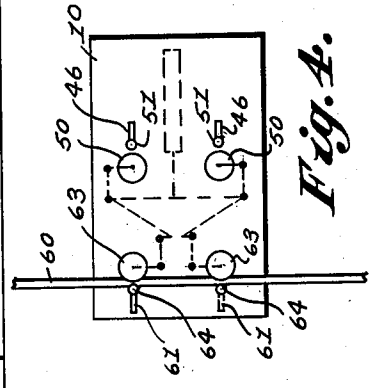

Fig. 4.

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TUBE BENDING MACHINE

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6 Claims. (Cl. 153—46)

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This invention relates to tube bending machines.

An object of the invention is the provision of a machine for bending tubes to form rectangular frames in which grooved rolls are mounted at the corners of a rectangle to receive a tube during the bending operation with an oscillated arm pivoted at the inner ends thereof on a vertical axle of each roll and carrying a grooved roller adapted to ride around a portion of the periphery of the associated roll for causing bending of the tube, a lever pivoted on each arm and carrying the roller adapted to be rocked manually for shifting the rollers away from the associated rolls to permit the application of the tube, simultaneous oscillation of the arms being effected through the medium of a power driven device.

A further object of the invention is the provision of a machine for bending tubes into rectangular frames in which a power driven device moves a grooved roller around a roll for forming a bend in the tubing while manual means is employed for shifting the roller away from an associated roll during the application of the tubing or a section of the tubing to a roll, a roll and associated roller being employed for each bend at a corner of a frame to be manufactured, arms carrying the rollers through an arc of approximately ninety degrees during the bending operation. The power driven device includes a hydraulically actuated piston for operating a plurality of cranks which are rigid with the respective arms carrying the rollers.

The invention is best understood from a consideration of the following detailed description in connection with the accompanying drawings forming part of the specification, nevertheless, it is to be understood that the invention is not confined to the disclosure but is susceptible of such changes and modifications as shall define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Figure 1 is a plan view of a table with parts broken away showing my tube bending machine supported thereby,

Figure 2 is a transverse vertical section of the machine and table taken along the line 2—2 of Figure 1,

Figure 3 is a longitudinal side view of the machine and table with parts broken away, and

Figures 4, 5 and 6 show more or less diagrammatically three of the stages of the operations

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of my tube bending machine and the relative positions of the operative elements.

Referring more particularly to the drawings, 10 designates a table top which is supported by angle iron legs 11, 12 and 13. An electric motor 14 is set in operation by a switch 15 for driving a hydraulic pump 16. The motor and pump are mounted on a bracket 17 secured to the leg 11.

A cylinder 20 has a closed outer end provided with ears 21 pivoted at 22 on a plate 23 depending from the under face of the top 10. The cylinder is disposed centrally and longitudinally of the table. The inner end of the cylinder 20 is closed except for a central passage which receives a piston rod 25 and may be supported by a bracket (not shown) depending from the under face of the top 10. A pipe 26 connects the inner end of the cylinder with the pump 16 while a pipe 27 connects the rear or outer end of said cylinder with the pump. A valve operating rod 28, when reciprocated, controls a valve (not shown) within the pump for cutting off the flow of a fluid to one of the pipes 26 or 27 while releasing the fluid to the other pipe. Thus, a piston 29 in the cylinder will reciprocate the rod 25 in opposite direction depending upon the flow of the fluid in the pipes. The valve (not shown) in the pump may be of the conventional type for controlling the flow of fluids to and from the pump to the ends of the cylinder.

A crosshead 30 is disposed transversely of the table 10 at the under face thereof and connected to a reciprocating bar 31. A cross-bar 32 parallel to crosshead 30 is secured to said crosshead by braces 33. A bracket 34 attached to and depending from the bar 31 has pivoted connections at 35 with the piston rod 25. Parallel links 36 are attached pivotally at 37 to the ends 18 of the bar 32. The outer ends 19 of said links 36 have pivotal connections at 39 with the outer ends of associated arms or cranks 40. All of the links 13, bars 31 and arms 40 just described are disposed below the table top 10.

Links 41 are pivoted at 42 on the ends 24 of the crosshead 30. An arm 43 each is pivotally connected to the outer end 38 of each link 41 as shown at 44. An axle 45 rises from the free end 47 of each arm 43 to which is secured the inner end 48 of an arm 46. The connected arms 43 and 46 form in effect a bell crank generally indicated at 49.

A grooved roll 50 is mounted on each axle 45 and is disposed in a horizontal plane. A grooved roller 51 is mounted on an axle 52 carried by a lever 53 and an end of a bracket 54. The other

end of the bracket is attached to the lever 53 by a bolt 55 which is secured to the arm 46 and which forms a pivot for said lever. A handle 56 provides a manual means for rocking the levers 53. It will be noted from Figure 3, that the grooves in the rolls 50 and the rollers 51 are semi-circular in cross-section so that the space 58 between a roll and a roller is substantially circular for receiving neatly a piece of tubing 60, Figures 1 and 4 to 5, inclusive.

The arm 40 is connected to an arm or crank 61 and these connected arms form a bell crank. An axle 62 rises from the arm 40 and joins the inner ends of the arms 40 and 61 for rotatably supporting a roll 63 having a peripheral groove identical with that shown in roll 50 of Figures 2 and 3. A roller 64 identical with that shown at 51 in Figure 3 is mounted on an axle 65. This roller has a peripheral groove which cooperates with the groove in the roll 63 to receive neatly the pipe 60. A bolt 66 pivots a lever 67 on the arm 61 and cooperates with the axle 65 for securing a supporting bracket 68 for the roller 64 on said lever. A handle 69 rocks the lever 67 outwardly, for example, on each arm 61 to the position indicated in broken lines at 57.

An eccentric disk 70 is pivoted on a bolt 71 secured to the table top 10. A handle 72 is adapted to rock the disk 70 for pressing against the pipe 60 when said pipe is being bent and for retaining it in the grooves of the rolls.

The valve actuating rod 28 is secured to a reciprocative rod 75 by a member 76. The rod 75 is mounted in a guide 77 fixed to the leg 11. A lever 78 pivoted at 79 on ears projecting from said leg is connected at 80 with the outer free end of the rod 75 for reciprocating said rod.

Spaced stops 81 and 82 are adjustably secured to the rod and each stop carries a spring 83 adapted to be engaged by a horizontal portion of a bar 84 which has a vertical portion 85 secured rigidly to the depending bracket 34. The stops limit the inward and outward movements of the piston in the cylinder 20 while the springs 83 cushion the piston and the piston rod 25 at the ends of the strokes of said piston. Since the lever 78 operates the rod 75 and likewise the valve operating means 28 for controlling the flow of fluid to the opposite ends of the cylinder 20, the stops 81 and 82 will be shifted in accordance with varying positions of the piston 29.

The legs of the table are braced by longitudinal bars 85 which are secured to the pair of legs 13 and the pair of legs 11 and 12. The transverse bars 86 connected between the pairs of legs 11, 13 and 12, 13 also aid in stabilizing the legs of the table.

The operation of my machine is as follows: With the elements of the machine shown in the various positions in Figures 1, 2 and 4, the levers 67 are rocked to the dotted line position at 57 shown in Figure 1 so that the tubing 60 may be applied to the grooves in the rolls 63. The levers 67 are then returned to operative positions shown in full lines, or rather positions a little outside the full line positions wherein rollers 14 are disposed in advance of the positions of arms 61. The tubing is then held in position in the grooves of the rolls 63 by the disk 70 and cooperating rollers 64, the latter, due to their advanced positions, being adapted to exert a pushing and bending action on tubing 60 without danger of rollers 64 slipping inwardly past rolls 63 during the bending operation. At this time the valve actuating rod 28 is in a neutral position and fluid pressure from the pump 16 has been cut-off to the cylinder 20.

The lever 78 is now moved in the direction indicated by the arrow A in Figure 3 so that the valve in the pump will be opened to the pipe 27 for supplying fluid under pressure to the outer end of the cylinder 20, thereby causing the piston 29 to be moved inwardly for shifting the crosshead 30 in the direction of the arrow B in Figure 1. This action rocks the pairs of bell cranks which include the arms 61 and 46 through the respective links 36 and 41 thereby carrying the respective levers 67 and 53 to the positions indicated in Figure 5 from the position illustrated in Figure 4. However, it must be borne in mind that the levers 53 must be rocked to move the rollers 51 away from the rolls 50 in order that the bent ends 60*a* of the tubing may be forced against the grooves in the rolls 50, spaces being thus provided between rollers 51 and bending rolls 50 and the arms 60*a* of tubing 60 being temporarily lifted over rollers 51 and their handles 56 and then lowering tube arms 60*a* to seat them exteriorly in the grooves of rolls 50. As the rollers 64 then revolve around rolls 63, due to partial rotation of arms 61, the tubing 60 is bent as shown in Figure 4.

The lever 78 (Figure 3) is thereafter moved in the opposite direction indicated by the arrow A so that the rod 28 will cause a reverse operation of the valve in the pump 16 and the pipe 26 will conduct fluid under pressure to the inner end of the cylinder 20 thereby forcing the piston 29 towards the outer end of the cylinder for reversing the positions of the arms 46 and 61 from the positions of Figure 5 into the positions of Figure 6, the precaution being observed of first advancing rollers 51 slightly so that they will produce a pushing action during operation. As shown in Figure 6, the rollers 51 with arms 46 will revolve around the respective rolls 50 with rollers slightly in advance of the latter for bending the sections 60*c* at right angles to the sections 60*a* of the tubing about rolls 50 to finally arrive at the position illustrated in that figure, thus completing the manufacture of the rectangular frame of tube. The arms 61 at this time have returned to the initial positions shown in Figure 4. The various levers 67 and 53 and the lever 72 are rocked in the proper outward directions and rollers 51 and 64 swung or rotated clear of frames 60, 60*a* and 60*c* and rolls 50 and 63 and the arms 60*a* and the ends 60*c* temporarily expanded and warped by hand and lifted to release the frame. The valve in the pump 16 will be shifted to the neutral position so that the machine will be ready for succeeding bending operations.

It will be noted that when the rod 75 is reciprocated the stops 81 and 82 are shifted away from the rod 84 for setting the valve in the pump in a new position. Thus, in Figure 3, the valve will be in a neutral position, so that when the lever 78 is rocked in the direction indicated by the arrow A, the stop 82 will be moved in the same direction away from the rod 84. On the other hand, said rod will be moved in the opposite direction and towards the stop 81 when the piston 29 actuates the rod.

The rolls 50 and 63 with the peripheral grooves form in effect dies around which selected portions of the tubing are bent by the bending fixtures or rollers 51 and 64 which may be moved to inoperative positions by the respective levers 67 and 53 to permit the application of the intermediate portion of the tubing 60 to the dies 63

and the bent sections 60a to the dies 50. These levers also release the bending fixtures for the removal of the completed frame so that subsequent tubings may be applied to the bending machine. The frames are employed in the manufacture of chair seats.

What I claim:

1. A mechanical movement for a bending machine and the like, including the combination with a reciprocable drive means, a transversely-extending crosshead connected thereto and reciprocated thereby, and a support for the drive means and the crosshead, of a group of shafts rotatably mounted on said support in two pairs spaced apart and disposed in parallel relation, a pair of opposite and outwardly-projecting arms individually secured on one pair of shafts, a second pair of opposite and inwardly-projecting arms individually secured on the other pair of shafts, a pair of links pivotally connected to corresponding opposite portions of the crosshead and to the outer ends of the first-mentioned pair of outwardly-projecting arms, and a second pair of links pivotally connected to other corresponding portions of the crosshead, said one pair of shafts being partly rotated in opposite directions to each other and the second pair of shafts being simultaneously rotated individually in opposite directions with respect to the shafts on the same sides of said reciprocating drive means.

2. A tube bending machine comprising a table, a plurality of grooved rolls rotatably mounted on the table, a roll located at each corner of a parallelogram, a pair of the rolls receiving an intermediate portion of a tube to be bent, a bell-crank pivoted on the table adjacent each roll, a grooved roller on an arm of each bell crank, a crosshead, means connecting the other arms of the bell crank with the crosshead, means for reciprocating the crosshead for rocking the bell cranks simultaneously, the arms carrying the rollers of one pair of the bell cranks extending in an opposite direction to that of a corresponding pair of arms of the other bell cranks so that one pair of arms will move the associated rollers through an arc around the cooperating rolls for pushing and thereby bending portions of the tube when the crosshead is shifted in one direction, the other arms and associated rollers moving idly around the other rolls in an opposite direction for engagement with the tube for pushing and thereby bending the ends of the tube inwardly toward each other on the adjacent rolls when the crosshead is shifted in the opposite direction during return movement of said one pair of arms and its associated rollers to initial idle positions.

3. A tube bending machine comprising a table, pairs of shafts spaced apart and carried by the tables, the shafts being so arranged that one shaft is located at each corner of a rectangle, a bell crank secured to each shaft, a grooved roll mounted on each shaft, the grooves in one pair of rolls receiving an intermediate portion of a tubing to be bent, a roller mounted on an arm of each bell crank and provided with a peripheral groove, one pair of the rollers cooperating with the first-mentioned one pair of rolls for pushing and thereby bending portions of the tubing on said rolls when the bell cranks are rocked, the tubing being received between the grooves in the first-mentioned rolls and cooperating rollers, the roller-carrying arms of one pair of bell cranks extending in an opposite direction to that of the roller-carrying arms of the other bell cranks, means for rocking the bell cranks simultaneously in opposite directions, means connecting the other arms of the bell cranks with the rocking means for rocking the pairs of arms simultaneously in opposite directions, the mentioned pairs of rollers alternately bending portions of the tubing on the adjacently-disposed pairs of rolls during rocking of the bell cranks in said opposite directions.

4. A tube bending machine comprising a table, pairs of shafts spaced apart and carried by the table, the shafts being arranged so that one shaft is located at each corner of a rectangle, a bell crank secured to each shaft, a grooved roll mounted on each shaft, the grooves in one pair of rolls receiving an intermediate portion of a tubing to be bent, a roller mounted on an arm of each bell crank and provided with a peripheral groove, one pair of the rollers cooperating with the first-mentioned pair of rolls for pushing and thereby bending portions of the tubing on said rolls when the bell cranks are rocked, the tubing being received between the grooves in the first-mentioned rolls and cooperating rollers, the roller-carrying arms of one pair of bell cranks extending in an opposite direction to that of the roller-carrying arms of the other bell cranks, means for rocking the bell cranks in opposite directions, link means connecting the other arms of the bell cranks with the rocking means for rocking the mentioned pairs of arms simultaneously in opposite directions, the mentioned pairs of rollers alternately bending portions of the tubing on the adjacently-disposed pairs of rolls during rocking of the bell cranks in opposite directions, and a freely rockable lever on each roller-carrying arm for supporting the rollers, the levers when rocked moving the rollers away from the associated rolls to provide clearances when a portion of the tubing is being applied to said rolls.

5. A tube bending machine comprising a table, pairs of shafts spaced apart and carried by the table, the shafts being arranged so that one shaft is located at each corner of a rectangle, a bell crank secured to each shaft, a grooved roll mounted on each shaft, the grooves in a pair of rolls receiving an intermediate portion of a tubing to be bent, a roller rotatably mounted on one arm of each bell crank and provided with a peripheral groove, one pair of the rollers cooperating with the first-mentioned pair of rolls for bending the tubing on said rolls when the bell cranks are rocked, the tubing being received between the grooves in the first-mentioned rolls and cooperating rollers, the roller-carrying arms of one pair of bell cranks extending in an opposite direction to that of the roller-carrying arms of the other bell cranks, means for rocking the bell cranks in opposite directions, link means connecting the other arms of the bell cranks with the rocking means for rocking the mentioned pairs of arms simultaneously in opposite directions, the pairs of rollers alternately bending portions of the tubing on the adjacently-disposed pairs of rolls during rocking of the bell cranks in opposite directions, said rolls and roller-carrying arms being located above the table, and the rocking means for the bell cranks and the other arms of the bell cranks being located below said table.

6. In a bending machine, a plurality of pairs of dies, a bending fixture for each die, means moving a pair of the bending fixtures in opposite directions through an approximate arc of 90°

around associated dies to form a pair of bends from an intermediate portion of the tubing, means idly moving the other pair of bending fixtures in opposite directions around a portion of the periphery of the associated dies so that said last-mentioned fixtures will be in position to engage the bent portions of the tubing, means for simultaneously actuating the pairs of the moving means alternately in opposite directions for causing one pair of the fixtures to bend portions of the tubing on a pair of the associated dies while the other pair of fixtures is shifted inoperatively, the actuating means causing reverse movements of the fixtures so that the last-mentioned fixtures will bend the free portions of the tube while the other fixtures will be moved to inoperative positions, and means for moving the fixtures in retracted relation with the dies.

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