

Dec. 13, 1960

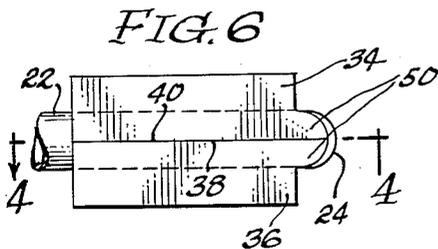
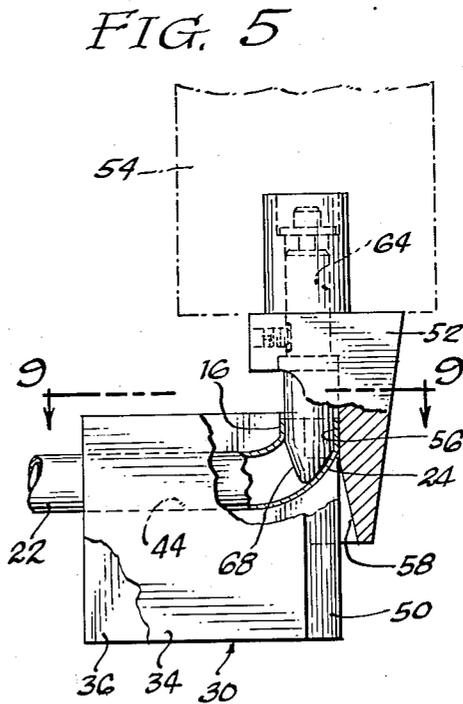
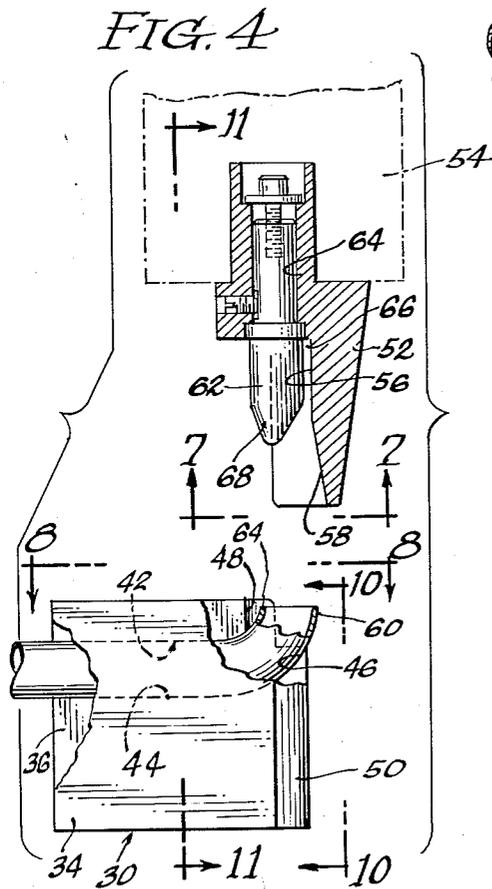
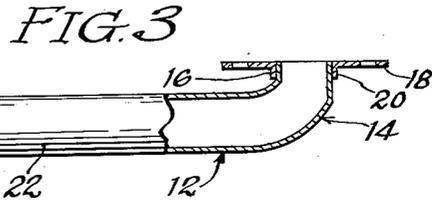
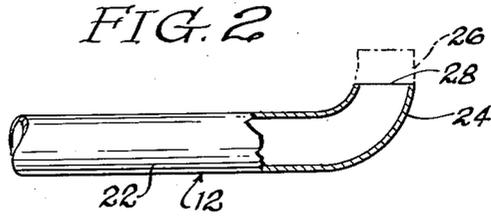
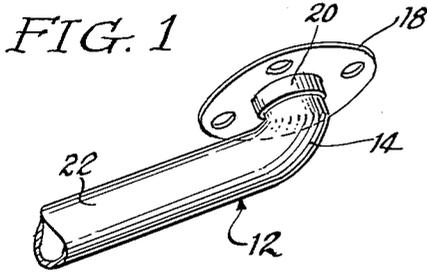
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METHOD OF AND APPARATUS FOR FORMING BENDS IN TUBING

Filed April 21, 1955

2 Sheets-Sheet 1



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METHOD OF AND APPARATUS FOR FORMING BENDS IN TUBING

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2 Sheets-Sheet 2

FIG. 7

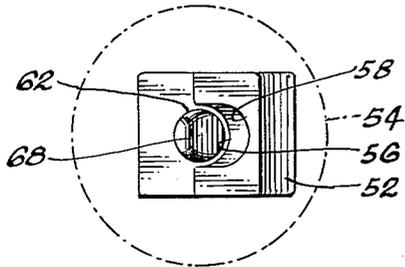


FIG. 8

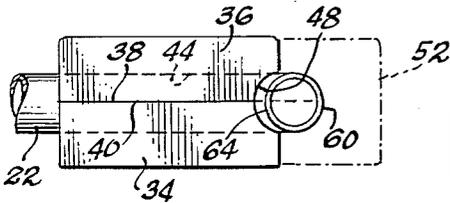


FIG. 9

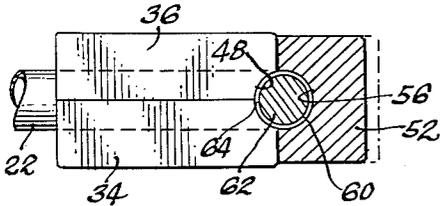


FIG. 10

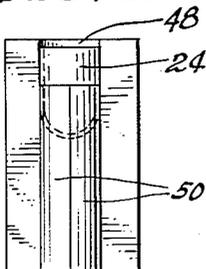
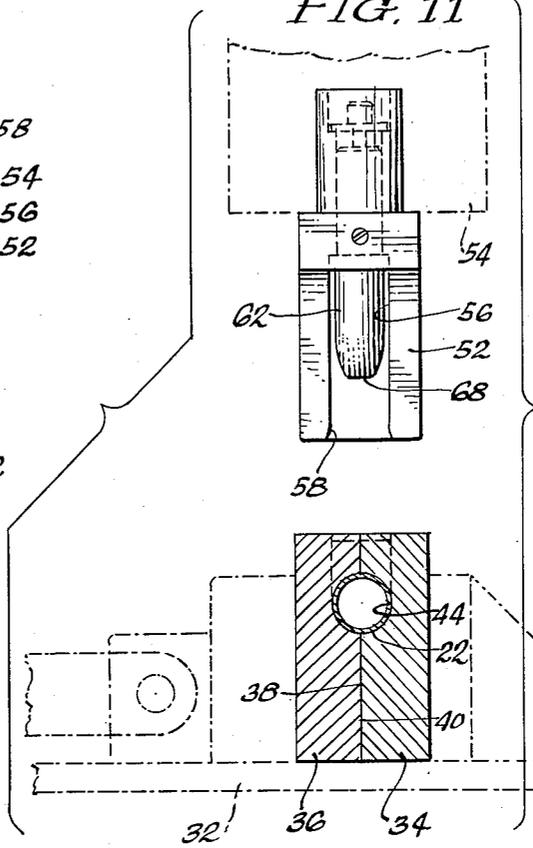


FIG. 11



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METHOD OF AND APPARATUS FOR FORMING BENDS IN TUBING

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2 Claims. (Cl. 29—157)

This invention relates to the formation of bends or elbows in tubing, particularly thin walled tubing of the type used, for example, in forming mixing tubes for gas stoves.

One principal object of the invention is to provide a new and improved method and apparatus for forming one end of a length of tubing into a bend or elbow having an extremely short yet truly straight and cylindrical terminal portion, adapted to receive a flange or other connecting element.

A further object is to provide such an improved method and apparatus whereby the elbow is formed by performing a preliminary bending operation and then further bending, sizing and shaping the end of the elbow.

It is another object to form a straight, truly cylindrical end portion on an elbow in a new and improved manner by the successive action of a die and a punch on the portions of the elbow on the outside and the inside of the bend.

A further object is to provide a new and improved method and apparatus of the foregoing character whereby a straight truly cylindrical end portion is formed on the elbow by utilizing a die to move the outside portion of the elbow inwardly of the bend, and then employing a tapered punch in cooperation with another die to move the inside portion inwardly of the bend and to form the end portion of the elbow into cylindrical shape.

Another object is to provide a new and improved method and apparatus whereby extremely sharp, straight ended bends may be formed in tubing with great facility and at low cost.

Further objects and advantages of the invention will appear from the following description, taken with the accompanying drawings, in which:

Fig. 1 is a perspective view of a length of tubing formed with a sharp straight ended bend or elbow, in accordance with the invention, the elbow being shown with a flange attached to illustrate one application of the invention;

Fig. 2 is an elevational view, partly in longitudinal section, of the tube at a preliminary stage in the method of forming the elbow;

Fig. 3 is an elevational view, partly in longitudinal section, of the finished tube with the flange attached;

Fig. 4 is an elevational view, partly in section along a line 4—4 in Fig. 6, of apparatus for forming the straight ended elbow of Figs. 1 and 3.

Fig. 5 is a view similar to Fig. 4 with the parts in the changed position to which they are moved in finishing the elbow;

Fig. 6 is a bottom view of a two-part clamping die embodied in the apparatus of Fig. 4;

Fig. 7 is a bottom view, taken as indicated by the line 7—7 in Fig. 4, of a movable die and punch embodied in the apparatus of Fig. 4;

Fig. 8 is a plan view of the two-part clamping die embodied in the apparatus of Fig. 4;

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Fig. 9 is a horizontal sectional view, taken along the line 9—9 in Fig. 5;

Fig. 10 is a side view of the fixed clamping die, taken as indicated by the line 10—10 in Fig. 4; and

Fig. 11 is a side elevational view, partly in section, along a line 11—11 in Fig. 4.

If the drawings are considered in greater detail, it will be seen that Figs. 1 and 3 illustrate a tube 12 formed with a bend or elbow 14 in accordance with the invention. It will be seen that the bend 14 is extremely sharp and is formed with an unusually short yet truly straight cylindrical end portion 16.

To illustrate one application of the invention, a flange 18 is shown mounted on the straight end portion 16. The illustrated flange 18 has a cylindrical mounting hub 20 which fits snugly over the straight end portion 16 so as to form a substantially leak-proof joint. The hub 20 may be spotwelded or otherwise secured to the end portion 16 of the tube 12 of Figs. 1 and 3.

The tube 12 of Figs. 1 and 3 finds one use as a mixing tube to mix fuel and air in a gas burner for a gas stove or the like. When so used, the flange 18 is employed to connect the end of the tube 12 to the burner. It is extremely desirable that the upturned end portion 16 of the elbow 14 be as short as possible in order that the tube 12 may require a minimum of head room. At the same time, it is necessary that the end portion 16 be truly straight and cylindrical so that the flange may be attached with a leakproof joint.

The elbow 14 is formed at one end of a straight tubing section 22 by an improved method, commencing with the initial operation of bending one end of the tube in any known or suitable manner to form an accurate, 90° preliminary bend or elbow 24, as shown in Fig. 2. This preliminary bend 24 may be less sharp than the final bend 14. An end portion 26, shown in dotted lines in Fig. 2, is then trimmed off the bend 24 along a line 28 cutting through the curved portion of the bend. Thus, the end of the bend 24 is curved, rather than straight, after the trimming operation.

As the next operation, the tube 12 is clamped in a two-part die 30 (Figs. 4 and 11), which may be held in a vise 32, shown in broken lines in Fig. 11. The vise 32 may be mounted on the bed or table of a punch press, or the like, shown only in fragmentary fashion in the drawings, as will be described shortly.

It will be seen that the die 30 comprises two complementary parts in the form of blocks 34 and 36 having interengageable surfaces 38 and 40 which define the parting plane of the die 30. The die parts 34 and 36 together define a cavity 42 whereby the tube 12 may be clamped between the die parts. It will be seen that the clamping cavity 42 is circular in cross section and is formed with a straight cylindrical portion 44, adapted to receive the straight portion 22 of the tube 12. One end of the straight portion 44 merges into a curved portion 46 which extends through an arc of substantially less than 90° and hence is adapted to receive only part of the preliminary bend 24. In this way, the end of the preliminary bend 24 projects outside the die 30.

In order to assist in forming the inside of the final straight portion 16 on the tube 12, the die parts 34 and 36 are arranged to define a generally semi-cylindrical die cavity 48 which extends at right angles to the straight portion 44 of the clamping cavity 42. The semi-cylindrical die cavity 48 is arranged so as to be spaced inwardly of the bend from the preliminary elbow 24.

To support the elbow 24 during subsequent forming operations, the die parts 34 and 36 are arranged to define a generally semi-cylindrical buttress 50 which underlies the elbow 24, as shown in Figs. 4 and 6.

A second die 52 is employed to perform a further

bending operation on the preliminary elbow 24. In this instance the die 52 is mounted on a ram 54 of a punch press or the like, the ram being shown in broken lines. Those skilled in the art will readily understand that the ram 54 carries the second die 52 for reciprocating movement. In this instance, the die 52 is movable vertically, while the straight section 22 of the tube 12 is held in a horizontal position. Thus, the die 52 is movable at right angles to the straight portion 44 of the clamping cavity 42. It will be apparent that the die 52 is movable parallel to the semi-cylindrical die cavity 48 in the first die 30.

To cooperate with the first die cavity 48 in forming the end of the preliminary elbow 24, the second die 52 is provided with a second semi-cylindrical die cavity 56 which is coaxial with and complementary to the die cavity 48. At its lower end, the die cavity 56 in the second die 52 is formed with a flaring mouth 58. Downward movement of the die 52 brings the flaring or tapered mouth 58 into engagement with an outside wall portion 60 of the preliminary elbow 24. It will be seen that the wall portion 60 is on the outside of the bend. By camming action, the tapered mouth 58 moves the outside wall portion 60 inwardly so that it may enter the die cavity 56. In this way, the further bending operation is performed on the preliminary elbow 24.

After the tapered mouth 58 on the die 52 has acted on the outside wall portion 60, a cylindrical punch 62 enters the open end of the preliminary elbow 24 and acts upon an inside wall portion 64 of the elbow, the wall portion 64 being on the inside of the bend. It will be seen that the punch 62 is rigidly mounted in a bore 64 formed in the die 52. In this way, the punch 62 is held in coaxial relation to the semi-cylindrical die cavity 56.

The diameter of the punch 62 corresponds to the inner diameter of the tube 12, while the diameter of the die cavity 56 corresponds to the outer diameter of the tube. Accordingly, a semi-cylindrical slot or clearance space 66 exists between the punch 62 and the die cavity 56. At its lower end, the punch 62 is formed with a tapered point 68 which projects downwardly into the tapered mouth 58 of the die 52.

It will be seen that the tapered point 68 of the punch 62 enters the open end of the preliminary elbow 24 after the tapered die mouth 58 has done most of its work in forcing the outer wall portion 60 inwardly of the bend. The tapered point 68 cams the inner wall portion 64 inwardly of the bend, towards the semi-cylindrical die cavity 48. As the punch 62 moves into the preliminary elbow 24, it gradually forces the inner and outer wall portions 64 and 60 into conformity with the semi-cylindrical die cavities 48 and 56. The final positions of the die 52 and the punch 62 are shown in Fig. 5. It will be seen from this view that the final, straight, truly cylindrical end portion 16 has been completely formed.

During the forming operations carried out by the die 52 and the punch 62, the buttress 50 prevents downward

displacement of the preliminary elbow 24. It will be seen that the buttress 50 corresponds in curvature to the final shape of the outside wall portion 60. Thus, the die 52 passes downwardly over the buttress 50 without encountering any obstruction.

It will now be understood that the effect of the dies 30 and 52 and the punch 62 is to sharpen the bend in the tubing while forming a straight, truly cylindrical end portion. These operations are carried out with great facility and economy. The result is an extremely sharp elbow with an unusually short yet truly straight and cylindrical terminal stub.

Various modifications, alternatives and equivalents may be employed without departing from the true spirit and scope of the invention, as exemplified in the foregoing description and defined in the following claims.

I claim:

1. In a method of forming a terminal bend in a length of tubing so that the bend will have a straight truly cylindrical terminal portion closely adjacent the straight portion of the tubing, the operations comprising bending the length of tubing through substantially 90° adjacent one end thereof, trimming the bend end of the tubing at a point along the curved portion of the tubing and closely adjacent the straight body portion of the tubing, camming the bend end of the tubing on the outside of the bend inwardly toward the inside of the bend and thereby further bending the outside of the bent tubing end, and cylindrically punching the inside of the tubing end while cylindrically retaining the outside thereof and thereby further bending the tubing on the inside of the bend and rendering the bend more abrupt while forming the tubing end into straight cylindrical shape.

2. In a method of forming a sharp elbow at one end of a straight tubing section so that the terminal portion of the elbow will be extremely short yet straight and truly cylindrical, the operations comprising bending the end of the tubing section through substantially 90°, trimming the end of the bent portion closely adjacent the straight section, pushing the portion of the bent end on the outside of the bend inwardly toward the inside of the bend and thereby further bending said portion, and pushing the portion of the tubing end on the inside of the bend toward the inside of the bend and thereby rendering the bend more abrupt while forming the tubing end into straight truly cylindrical shape.

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