

Sept. 19, 1961

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3,000,424

METHOD OF MAKING STEEL OFFSET FITTING

Filed Oct. 28, 1955

2 Sheets-Sheet 1

fig. 1. *fig. 2.* *fig. 3.* *fig. 4.* *fig. 5.*

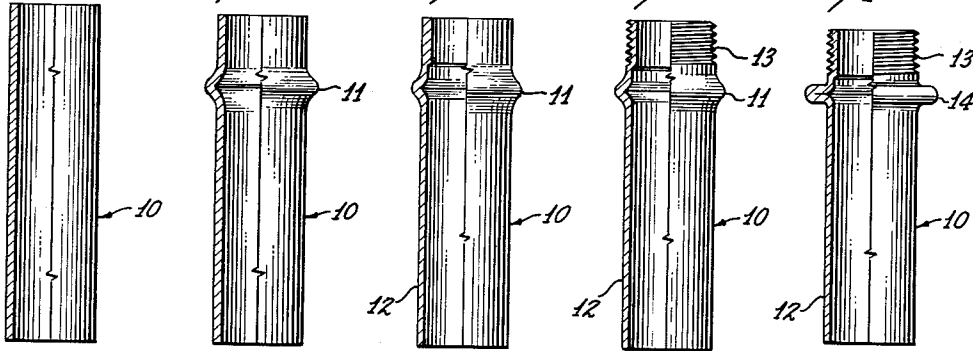


fig. 6.

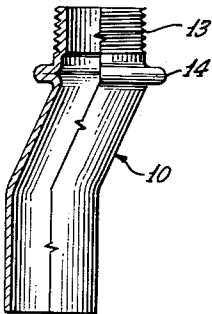


fig. 7.

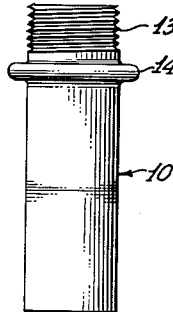


fig. 8.

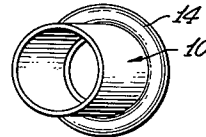


fig. 9.

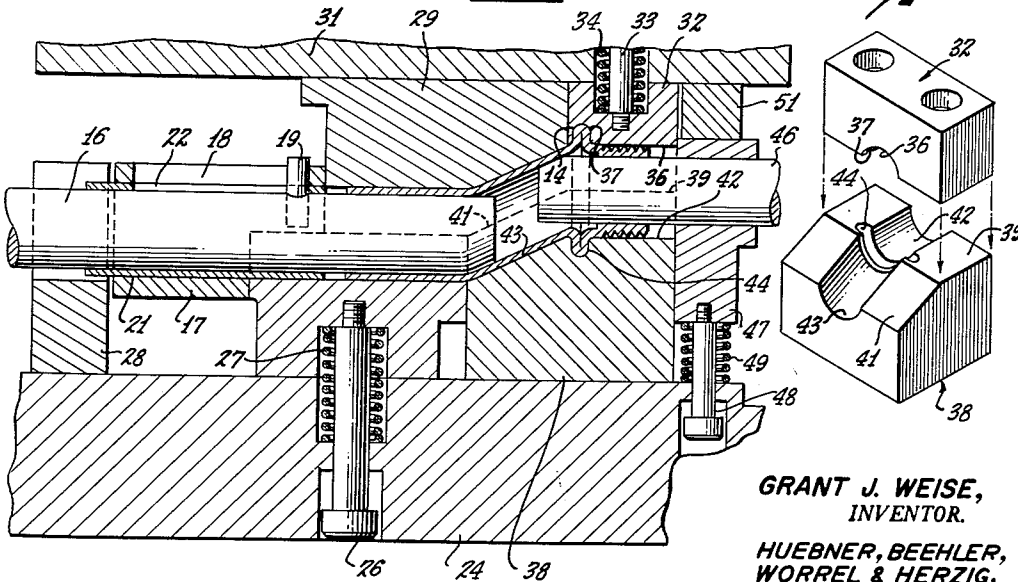


fig. 10.

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Fig. 11.

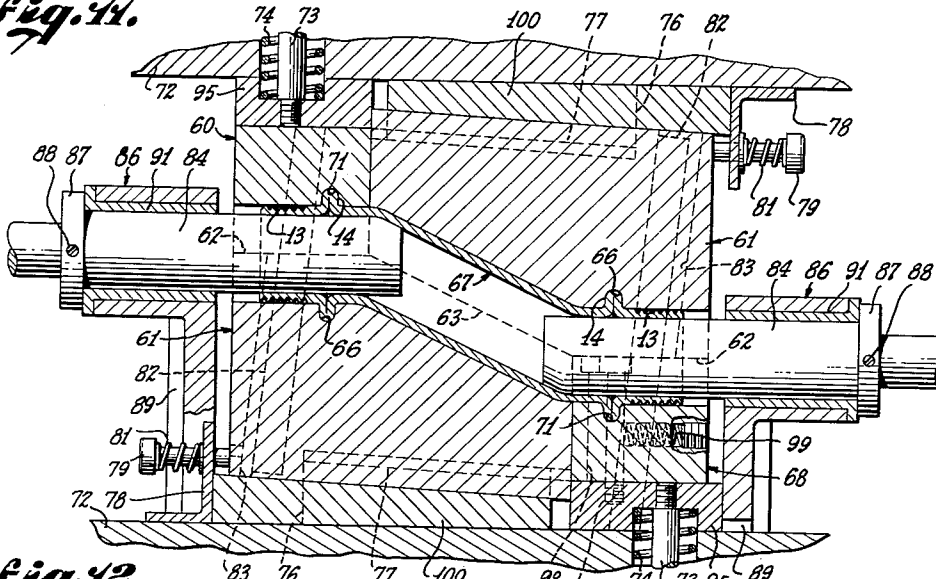


Fig. 12.

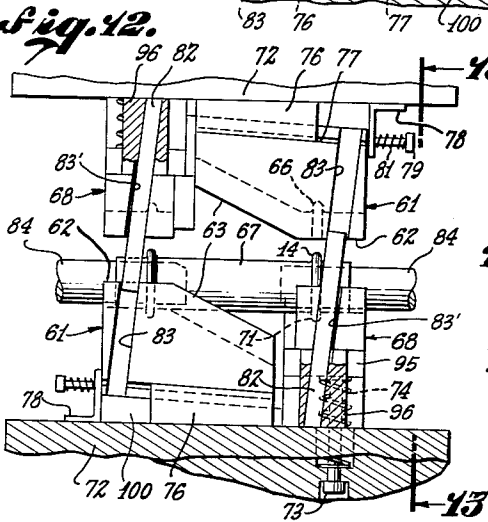


Fig. 13.

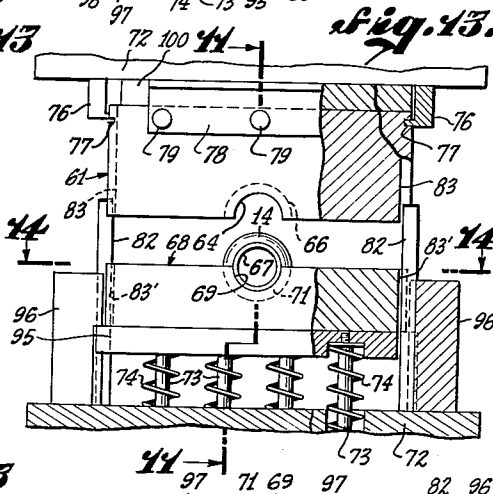


Fig. 15.

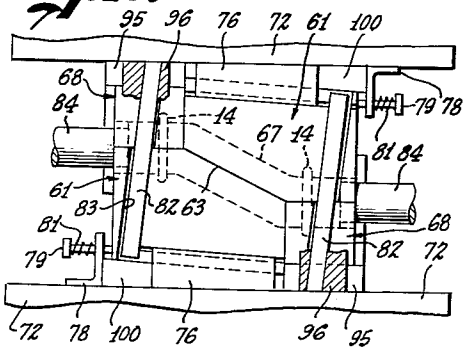
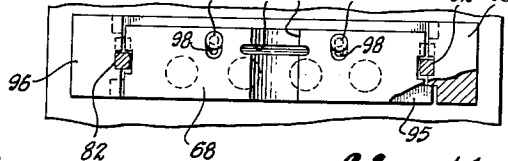


Fig. 14.



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METHOD OF MAKING STEEL OFFSET FITTING

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6 Claims. (Cl. 153-21)

The present invention relates to a method of making an offset fitting for conduit, and particularly steel offset fitting for electrical conduit.

Steel offset fittings for conduit are generally made by casting the fittings. The relatively more expensive casting operation is resorted to, instead of bending, because bending a conduit section to form the offset fitting presents serious problems. It is difficult to clamp the conduit section adequately against the pressures that are required to bend them into the offset structure. Bends of small radius are required in the offset fitting and these tend to cause rupture of the conduit wall. Thin-walled conduit bent in a small radius frequently collapses, especially when reverse bends are made close together, as in the case of conduit fittings. In addition, wrinkling may occur in making such bends in conduit sections for the production of offset fittings. Thus, although bending operations are less costly than casting operation to produce offset fittings, the latter method is employed to avoid the problems encountered in bending operations.

Accordingly, an important object of the invention is to provide a method for economically making offset conduit fittings of good quality by bending operations.

Another object is to provide an economical method for bending conduit to form tubular offset fittings of satisfactory quality.

A further object is to provide a rapid, continuous method for successfully producing steel conduit offset fittings by bending operations.

Additional objects will become apparent from the following description:

In general terms, my invention comprises upsetting a tubular conduit section adjacent an end thereof, clamping the upset end of the section and then forming an offset in the section adjacent the upset end. A thread preferably is provided on the upset end. This preferably is done after the upsetting step and prior to clamping the upset end suitably for the offsetting operation. Offset fittings with two threaded ends, both of which preferably are upset, are made in a similar manner by simultaneously operating on both ends of the fitting.

A more detailed description of a specific embodiment of the invention is given with reference to the drawings, wherein:

FIGURE 1 is a longitudinal view, partly in section, showing a section of tubular conduit;

FIGURE 2 is a similar view showing a bead formed adjacent one end of the conduit section;

FIGURE 3 is a similar view showing the conduit section after the wall thickness thereof has been reduced by drilling;

FIGURE 4 is a similar view showing the conduit section after the end thereof adjacent the bead has been threaded;

FIGURE 5 is a similar view showing the conduit section after the beaded and threaded end has been upset;

FIGURE 6 is a similar view showing the conduit section after it has been offset;

FIGURE 7 is a side view of the conduit section shown in FIGURE 6;

FIGURE 8 is a bottom view of the conduit section shown in FIGURE 6;

FIGURE 9 is an elevational sectional view showing a

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die assembly for use in production of the offset in the conduit section as shown in FIGURES 6 to 8;

FIGURE 10 is a partial perspective view showing the clamping dies of the assembly shown in FIGURE 9;

FIGURE 11 is a sectional elevational view taken on the line 11-11 of FIGURE 13 showing a die assembly for producing an offset in a fitting threaded and upset at both ends;

FIGURE 12 is an elevational view showing the die assembly of FIGURE 11 in the open position;

FIGURE 13 is an end view partially in section taken along the line 13-13 of FIGURE 12;

FIGURE 14 is a fragmentary cross-sectional view taken on the line 14-14 of FIGURE 13; and

FIGURE 15 is an elevational view showing the die assembly of FIGURE 12 in the closed position.

In the embodiment shown in FIGURES 1 to 10 of the drawings, a conduit section 10 cut to the proper length, as shown in FIGURE 1, has a bead 11 formed adjacent one end thereof by any satisfactory and convenient method such as by rolling the conduit section between rollers to form the bead. This rolling operation causes a slight decrease in the diameter of the conduit section. The bead 11 is spaced inwardly from the adjacent end of a conduit section a sufficient distance to allow space for a thread to be formed or cut on the end of the section.

In some cases it is desirable to reduce the original wall thickness of the conduit section, in others the original wall thickness is satisfactory. In the former case, the conduit section 10 is suitably clamped and the body 12 of the section is drilled or reamed to reduce the wall thickness thereof to a suitable value, as shown in FIGURE 3. The wall thickness of the body 12 of the conduit section 10 may be reduced sufficiently in some cases, so that a conduit can be slipped tightly inside the conduit section 10 after it is formed into an offset fitting.

An external thread 13 is formed or cut on the end of the conduit section 10 adjacent the bead 11. The bead 11 is then converted into an annular upset 14 by any suitable method known in the art.

Offset bends are then made in the conduit section 10, as shown in FIGURES 6 to 8, by the use of a die assembly, as shown in FIGURE 9.

The die assembly comprises a mandrel 16 slidably mounted in a bracket 17. The bracket 17 is provided with a keyway 18 to permit sliding motion therein of a key 19 tightly fitted in the mandrel 16. A sleeve 21 is mounted in the bracket 17 around the mandrel 16 and is slotted at 22 for convenient sliding movement of the mandrel longitudinally of the sleeve 21.

The bracket 17 is mounted on a bed 24 by retainer screws 26 threaded into the bracket and surrounded by coil springs 27, as indicated. A retainer block 28 also is suitably mounted on bed 24 to retain bracket 17 in position in the die assembly.

An offsetting die 29 is suitably mounted in an upper plate 31 connected to a source of pressure for offsetting the fitting 10. An upper clamping die 32 also is mounted in the plate 31 by retainer screws 33 threaded into the die 32 and surrounded by compression springs 34. A semi-cylindrical bore 36 is formed longitudinally of the die 32. Adjacent the inner end of the bore 36 is formed a semi-circular groove 37 for receiving the upset portion 14 of the conduit section 10.

A lower clamping die 38 is suitably fastened to bed 24 just below the upper die 32. The lower die 38 is provided with a horizontal face portion 39 and an inclined face portion 41. Both the horizontal face portion 39 and the inclined face portion 41 are provided with semi-cylindrical bores 42 and 43, respectively, running longitudinally of the lower die 38. Adjacent the inner end of the

bore 42 in the horizontal portion 39 is formed a groove 44. The bore 42 and the groove 44 in die block 38 are dimensioned to register with the bore 36 and the groove 37, respectively, in die block 32 to form a cylindrical bore and a circular groove, respectively. In addition, the bores 36 and 42 are designed to accommodate the threaded end 13 of the conduit section when the die blocks are in the closed position, and in this position the grooves 37 and 44 are designed to accommodate the upset ring 14 to tightly clamp the end of the conduit section 10 between the clamping die blocks 32 and 38.

A mandrel 46 is mounted in a bracket 47, which in turn is attached to plate 24 by retaining screw 48 surrounded by a compression spring 49, as indicated. A spacing block 51 is mounted above bracket 47 on plate 31.

Offset bends are made in a conduit section at the stage of fabrication shown in FIGURE 5, in accordance with one embodiment of my invention, by opening the die assembly of FIGURE 9 and placing the threaded, upset end of the conduit section 10 on the end of mandrel 46. The upset ring 14 is positioned in the groove 44 in the lower die block 38 and the threads 13 are positioned in the semi-cylindrical groove 42 formed in the horizontal face 39 of the die block 38.

Mandrel 16 is slid forward in sleeve 21 positioned in bracket 17 until key 19 abuts the forward end of the keyway 18. The die assembly is then closed by bringing pressure to bear on plate 31 and die 29.

In so doing, the clamping block 32 comes into registry with the conduit section, engaging the thread 13 and the upset ring 14, while the body 12 of the conduit section is engaged in an inclined portion of block 29 corresponding to the inclined portion 41 of block 38 and in a horizontal semi-cylindrical groove in a horizontal portion of die 29 corresponding to a horizontal semi-cylindrical groove in a horizontal portion of the bracket 17. As the die assembly is closed, the body 12 of the conduit section 10 is bent downward at an annular region adjacent the upset ring 14 and upward at an annular region adjacent the end of the mandrel 16. The result of these bending forces acting on the body 12 of conduit section 10 is to offset the body at an angle corresponding to the angle of inclination of the inclined face portion 41 of the die 38, as best shown in FIGURE 9.

During this offsetting operation, the mandrels 16 and 46 prevent the body 12 of the conduit section from collapsing in the offset portion and assist in the distribution of the compressive and extensive forces acting on the wall of the body. Also, the portion of the body 12 clamped between die 29 and bracket 17 is initially free to slip and accommodate the conduit section 10 and its body to an overall shortening in the length of the conduit section. Rupturing of the wall of the conduit section is in this manner prevented.

Another embodiment of the invention, as applied to the production of offset conduit sections provided with a threaded portion at each end thereof, will be described in connection with FIGURES 11 to 15 of the drawings. The die assembly for this modification is shown in open position in FIGURES 12 and 13. The upper half of the die assembly is made to have substantially the same structure as the lower half thereof but differs in that it is directionally reversed.

Each half of the die assembly consists of a die block 61 having a horizontal portion 62, and an inclined portion 63, and resembles die block 38 of the previous embodiment shown in FIGURES 9 and 10. Horizontal die block portion 62 is provided with a longitudinal semi-cylindrical groove 64 and an annular groove 66 to accommodate a threaded portion 13 and an upset annular portion 14, respectively, of either end of a conduit section 67. The conduit section 67 has a thread 13 and an offset ring 14 at each end thereof, as shown.

Each half of the die assembly also contains a clamping

block 68 provided with a longitudinal semi-cylindrical bore 69 and a semi-circular groove 71 corresponding to the bore 36 and the groove 37 of clamping die 32 shown in connection with the previous embodiment in FIGURES 9 and 10. The die block 68 in each half of the die assembly are slidably supported on plates 95 attached to plates 72 by retaining screws 73 surrounded by compression springs 74 in the manner previously described in connection with the previous embodiment.

The die blocks 61 in each half of the die assembly are slidably mounted in blocks 76 suitably fastened to plates 72. The die blocks 61 are slidable in blocks 76 in tongue-in-groove arrangements 77. Angle irons 78 fastened to plates 72 serve as stops for the outward sliding movement of die blocks 61. The outward movement of die blocks 61 toward angle irons 78 is cushioned by pins 79, urged against the faces of the die blocks by springs 81. The springs 81 also serve to return the die blocks 61 to their original inward position.

The movement of die blocks 61 inward toward each other during the closing movement of the two halves of the die assembly are guided by guide rods 82 attached to the bracket guides 96. The guide rods 82 are slidable in grooves 83 formed in the sides of die blocks 61, and grooves 83' formed in the sides of die blocks 68.

Mandrels 84 are slidably mounted in brackets 86 and project inwardly therefrom a distance determined by stop collars 87 fastened to the mandrels by set screws 88. The brackets 86 are in turn vertically slidable in a slide arrangement 89. Sleeves 91 are mounted in brackets 86 to provide smooth sliding surfaces for mandrels 84 in the sleeves.

The offset bends are made in a conduit section 67 adjacent the annular offset rings 14 at each end in a manner similar to that described above in connection with the conduit section 10, that was threaded and upset at only one end thereof. With the die assembly in the open position, shown in FIGURES 12 and 13, the conduit section 67 is placed upon the lower half of the assembly with the annular upset rings 14 in registry with the semi-circular grooves 66 and 71 of the die blocks 61 and 68, respectively. At this point, the conduit section 67 is straight and positioned horizontally.

The mandrels 84 are inserted in either end, or in both ends of the conduit section 67, by sliding the mandrels through the sleeves 91 until the stop collars 87 contact the outer ends of the brackets 86.

Pressure is then brought to bear on either plate or both plates 72 to close the die assembly, as shown in FIGURE 15. During the closing movement of the two halves of the die assembly, the die blocks 61 are guided diagonally toward each other and the die blocks 68 are guided toward each other by guide rods 82 in grooves 83. The die blocks 61 are simultaneously moved inward laterally toward each other by sliding in the tongue-in-groove arrangements 77. This latter movement is facilitated by the tapered plates 100.

After grooves 66 and 71 engage beads 14 at each end of the conduit section, during the die closing operation, the die blocks 68 move in unison with the die blocks 61. The movement of blocks 68 is facilitated by the rod and groove connection 82, 83' between blocks 68 and plates 95. Plates 95, which are served by the springs 74 around screws 73, move up and down between guides 96. The rods 82 are anchored in the guides 96.

Bolts 97 interconnect blocks 68 to plates 95 through slots 98 of the blocks 68. This interconnecting means permits blocks 68 to slide on plates 95. Loaded compression springs 99 serve to return blocks 68 to their original outward positions when the die assembly is opened.

As the offset bends adjacent the annular upset portions 14 are formed, the overall length of conduit section 67 is shortened. This shortening effect is taken care of by the laterally inward movement toward each other of the die blocks 61 and 68. The die blocks 61 also slide

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at angles to the horizontal in blocks 76 to compensate for side thrust as the walls of the conduit section are offset at an angle to the horizontal.

During this offsetting operation, one end, such as the right end, of the conduit section is lowered whereas the opposite end is elevated. To compensate for these effects, the brackets 86 slidably holding the mandrels 84 are provided with vertical slides 89 to permit downward and upward sliding, respectively, of the brackets.

Upon closing of the two halves of the die assembly, as shown in FIGURE 15, the bending operations performed in the conduit section 67 are uniform with elongation and compression stresses evenly distributed around both ends of the conduit section. This even distribution of these stresses minimizes the danger of rupture of the conduit section walls. It also results in a uniform, high quality product, wherein the walls are not collapsed or wrinkled in any degree that might be objectionable in the appearance or usefulness of the offset fitting.

In the two embodiments of the invention described above, namely, the one with reference to the conduit section threaded at one end, and in connection with the conduit section threaded at both ends, certain designs of die assemblies have been described. These die assemblies have been provided for the purpose of producing uniform quality offset fittings in quantity production. It will be understood, however, that various changes, modifications, and variations in the design and construction of these die assemblies can be used and that the methods of making the offset fittings can be varied within the skill of the art without departing from the spirit of invention.

Although the invention has been described above as applied to steel offset fittings, it will be understood that the invention also can be applied to the production of offset fittings made of other ferrous and non-ferrous metals, or their alloys. When making offset fittings from these other metals or alloys, various changes, modifications, and variations in the die assemblies and in the methods described above will naturally be desirable for optimum results. Accordingly, it is understood that such applications of the invention to various metals and alloys and employing such changes, modifications, and variations in the method and in the design and details of the die assemblies illustrated and described above may be made within the scope of the appended claims without departing from the spirit of the invention.

What I claim is:

1. The method of forming an offset conduit fitting from a thin walled tubular conduit section, comprising the steps of: internally supporting the end portions of said section against inward deformation, relatively moving at least one of said end portions laterally of the longitudinal axis of said section while holding the axes of said end portions at all times parallel to each other while leaving

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at least one of said end portions free to move axially toward the other and clamping the intermediate portions of the section whereby said section is bent to offset form without elongation of the portion thereof between said end portions.

2. The method defined in claim 1 including the step of confining the entire outer surface of said end portions of said section against outward deformation during the lateral movements of said end portions.

3. The method defined in claim 1 including the step of rigidly holding one of said end portions in fixed position during said relative lateral movement of the other of said end portions.

4. The method of forming an offset conduit fitting from a thin walled tubular conduit section, comprising the steps of: internally supporting the end portions of said section against inward deformation, relatively moving said end portions laterally of the longitudinal axis of said section while holding the axes of said end portions at all times parallel to each other and forming the intermediate portions of the section by confining the entire outer surface thereof.

5. The method of claim 4 including the step of providing for movement relatively of one end of the section towards the other.

6. The method of forming an offset conduit fitting from a thin walled tubular conduit section, comprising the steps of: internally supporting the end portions of said section against inward deformation, relatively moving said end portions laterally of the longitudinal axis of said section while holding the axes of said end portions at all times parallel to each other, moving said end portions relatively toward each other whereby said section is bent to offset form and applying clamping force to the intermediate portion of the conduit section in a direction normal to the axis of the intermediate portion of the section when formed.

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