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CLOSING TOOL FOR OUTSTANDING SHEET-METAL SEAMS

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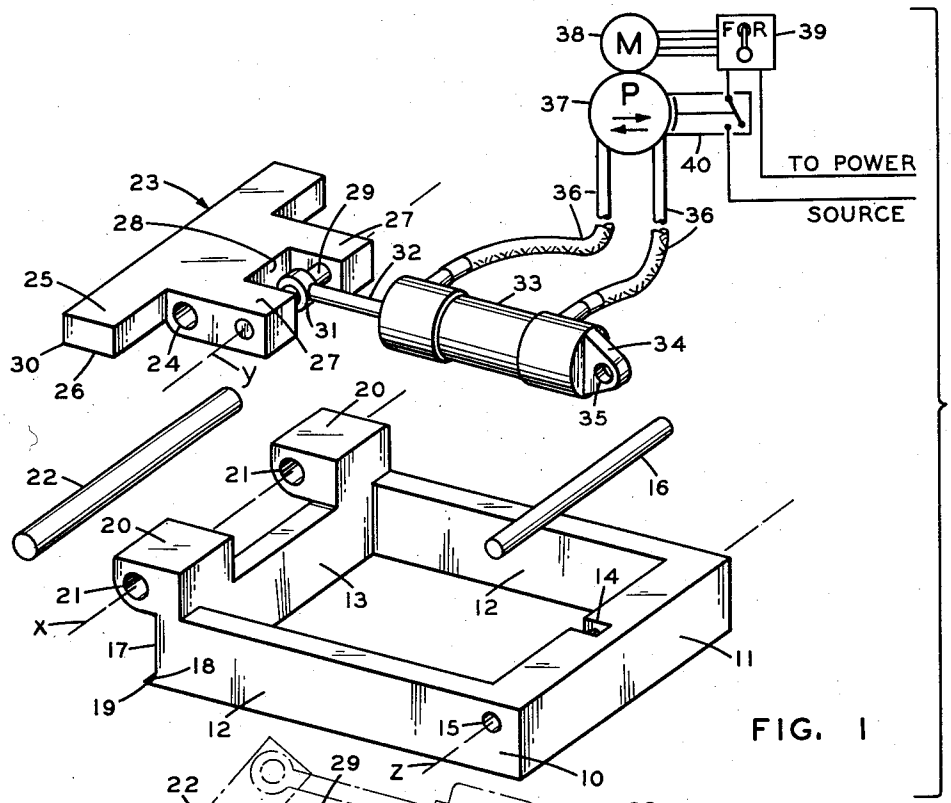


FIG. 1

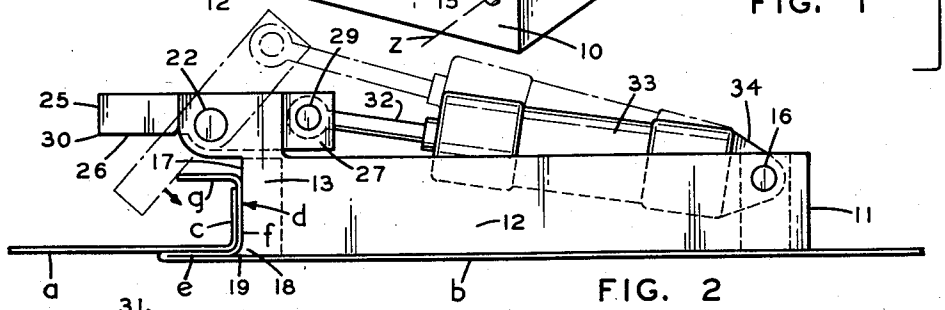


FIG. 2

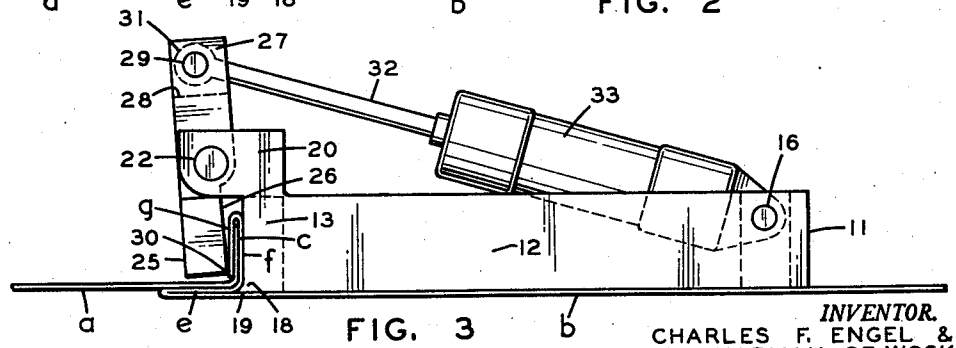


FIG. 3

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CLOSING TOOL FOR OUTSTANDING SHEET-METAL SEAMS

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2 Claims. (Cl. 113—57)

This invention relates to a new bending tool for closing outstanding sheet-metal flanges from 90° to 180° position, and in particular to a tool for closing so-called "government lock" type seams, by which adjacent sections of rectangular sheet-metal ducts are joined to each other.

The problems of closing this type of seam will be discussed hereinafter, in connection with a consideration of the accompanying drawings, in which:

Figure 1 is an exploded view showing the new tool in perspective, save for certain power and control elements therefor which are shown by symbols;

Figure 2 is a side view showing only the tool of Figure 1, assembled and in fully open position, the phantom lines showing its position in initial contact with a flange portion of a "government lock" seam. The duct sections and their flanges are shown schematically; and

Figure 3 is a side elevation corresponding to Figure 2 showing the tool in its fully closed position.

"Government lock" seams, such as shown in Figures 2 and 3, are widely prescribed in Federal specifications for the installation of ducts. Frequently it is necessary to install much of the duct work close to ceilings, beams, and other obstructions which limit the working space, particularly at the upper surface of the duct.

To close an outstanding sheet-metal flange from a 90° bend to a 180° bend has heretofore required preliminary hammering to reduce the angle to less than 90°, and then either final hammering or clinching. None of these operations can readily be performed within limited space. Their expense has been high, and uniform closing around all four sides of the duct has been impossible. When exposed, the closed seams have been unsightly; when concealed, as on the upper side of ducts, they have seldom been fully closed.

Accordingly, the purposes of the present invention include providing a power tool by which a strong, uniform, positive closing force may be readily exerted along such seams; one which is remotely controlled; which locks itself in position against the seam as it closes, then releases itself as it opens; provides the maximum of portability; and which utilizes a high mechanical advantage, despite limited space, by minimizing the overall height of the tool when in open position, so that the operator may insert his hand thereover for adjusting it in position along the seam. Additional purposes will be manifest from the following description.

Referring now to the drawings by the numbers of the detailed parts, the tool utilizes a preferably rectangular rugged steel frame generally designated **10**, in which a rectangular back bar **11**, a pair of side members **12**, and a front bar **13** are rigidly joined, as by welding. The back bar **11** and side members **12** are preferably cut from rectangular steel stock. The under sides of these members lie in a plane, for resting on top or against the outer surface of a duct section as shown in Figures 2 and 3. The frame **10** is conveniently open (that is, bottomless) and defines a space which may be about the

size of a man's hand. Preferably the height of the back bar **11** and the side members **12** is equal and fairly shallow, say 1½" to 2", in order to minimize the over-all working height.

The back bar **11** includes midway along its inner side a vertically cut notch **14**, and a horizontally drilled aperture **15**, which passes through the entire length of the back bar **11**, across the notch **14**, and defines a rear pivot axis *z*. Through the drilled aperture **15** is inserted a rear hinge pin **16**, which extends preferably the entire length of the back bar **11** and serves within the notch as the rear pivot for a linear actuator hereinafter described.

The front bar **13** is also referred to hereinafter as the "fixed bar." It is not rectangular in cross-section, although the greater part of its principal working surface, referred to hereinafter as the anvil face **17**, is perpendicular to the under side of the front bar of the frame **10** as a whole, straight from end to end, and preferably planar; as the anvil face **17** serves as a working surface against which the seam is formed. If for some purpose the seam ought to be formed at an angle apart from the perpendicular, the face **17** could be modified from the perpendicular. Similarly, certain departures from planarity, such as the presence of small grooves or some curvature, may not interfere with its functioning in the manner hereinafter described. The height of the anvil face **17** is greater than that of the outstanding sheet-metal flange hereinafter described.

As an aid to understanding the dimensional limitations of the tool, Figures 2 and 3 should be considered. Depicted in Figure 2 are adjacent duct section elements *a, b*, of rectangular duct sections to be joined together by a "government lock" seam. Each of the elements *a, b* and the successive duct elements joining therewith may have at its right end (as shown for the element *a*) a simple bent-up rectangular flange *c*, to serve as the male part of the lock to be closed. At its left end (as shown for the element *b*) the sheet-metal of each duct element is bent to form a female lock part, as follows: first, back against its outer surface, thence outward at 90° for a distance greater than the height of the flange *c*, and then again forward at 90°, providing in effect an integral bent U-channel designated *d* facing forward and lying outward of and adjacent the surface of the element *b*.

That portion of the integral channel *d* which is bent back against the duct outer surface is referred to hereinafter as the inner flange *e;* the portion adjacent it which extends outward perpendicularly to the surface of the element *b*, as the web *f*, and the portion which projects forwardly therefrom toward the open end of the duct element *b*, as the outer flange *g*. These portions connect at bend radii, the radius juncture or portion between the inner flange *e* and the web *f* being of principal significance. The height of the web *f* is greater than that of the rectangularly outward flange *c* on the duct element *a*; and the outer flange *g* of the bent U-channel *d* is of lesser length than the web *f*.

The anvil face **17** of the front bar **13** does not start at its under surface, but at a distance thereabove substantially equal to the bend radius portion between the inner flange *e* and the web *f*. Between the anvil face **17** and the under side of the tool, the front bar **13** has a concave radius portion **18** jutting forward from the plane of the anvil face **17**, its curvature corresponding to the outer side of the U-channel radius portion, and extending to an edge juncture with the under side of the front bar **13**, whereby to constitute a toe projection **19** for engaging beneath and against the outside of the channel bend, as shown.

Above the level of the anvil face **17** (and permissibly above the level of the side members **12** and the back bar **11**), the fixed bar **13** has a pair of fulcrum lugs **20**,

projecting above and forward beyond the anvil face, the lugs **20** being divided from each other, each located inwardly adjacent the outer margin defined by one of the side members **12**. Preferably the combined length of the fulcrum lugs **20** is somewhere near half the length of the fixed bar **13**.

The lugs **20** are drilled longitudinally along a fulcrum axis *x* parallel to the rear pivot axis *z*, to provide aligned bores **21**, the said axes being also parallel to the anvil face **17**. The *x* axis is forward of the anvil face **17** a distance preferably equal to at least three thicknesses of sheet-metal such as used in the duct elements *a*, *b*.

On a fulcrum pin **22** which extends through the bores **21**, is mounted a wiper lever generally designated **23**, by means of its fulcrum bore **24** drilled through its mid-portion. Projecting forwardly from the fulcrum axis *x* when the lever **23** is in the substantially horizontal open position of Figure 2, is a wiper bar portion **25** of substantially the same length as the anvil face **17** of the fixed bar **13**, the bar portion **25** having a wiper face **26** on that side which is presented downwardly when the wiper lever **23** is substantially horizontal. The wiper face **26** is rotatable downward and backward toward the anvil face **17** for closing as shown in Figure 3.

Extending aft when the wiper lever **23** is in open position as shown in Figure 2, from the fulcrum axis *x*, the wiper lever **23** has a yoke-like lever arm portion **27** including a vertical backward-facing notch **28**. The yoke portions of the arm **27** are connected by a forward actuator pivot pin **29** secured on a horizontal forward pivot axis *y* parallel to the fulcrum axis *x* and rotatable thereabout as shown in Figures 2 and **3**. When the tool is closed as shown in Figure 3, the extreme margin **30** of the wiper face **26** presses toward the anvil face somewhat above the level of the toe projection **19**.

Actuation of the wiper lever **23** is effected through an actuator rod fitting **31** pivotally mounted on the forward pivot pin **29** within the yoke of the lever arm portion **27**, under force applied by the rod **32** of a hydraulic cylinder linear actuator **33**. The rear end of the hydraulic cylinder **33** includes a backward-projecting support fin **34** horizontally drilled to provide a pivot bore **35** for mounting on the rear hinge pin **16**.

Within the actuator **33** is a conventional hydraulic piston, not shown, moving positively with the flow of hydraulic fluid from a pump hereafter mentioned through flexible high-pressure hydraulic lines or tubes **36** which connect to each end of the actuator cylinder **33** and make a circuit with such pump. The unbroken lines of Figure **2** of the drawings show the position of the tool when the piston is substantially fully bottomed toward the back end of the actuator **33**; the phantom lines of Figure 2 show its position with the actuator rod **32** partially extended; while Figure 3 shows the position with the actuator rod **32** fully extended.

The fluid which flows through the hydraulic lines **36** is moved positively in either direction by a hydraulic pump **37** powered by a reversible electric motor **38** under the control of a reversing switch **39** having three positions, forward, reverse, and off. Electrical power is supplied to the motor **38** subject to a series connection including a pressure switch **40** responsive to the hydraulic pressure within the pump **37**, so that when pressure builds up to a pre-selected level the power to the motor **38** is cut off. Such pressure build-up occurs at both the extreme positions shown in Figures 2 and 3.

The tool so described is used in the following manner: It is placed in position against the outer surface of a duct section such as the section *b*, with its anvil face **17** abutting the outer side of the web *f* and the radius portion **18** in contact with the outer side of the bend radius between the inner flange *e* and the web *f*. The wiper lever **23** is in substantially horizontal open position as shown in Figure 2. The operator then operates the switch **39** for forward position, the motor **38** turning the pump **37** to force the hydraulic fluid through the lines **36** in such direction as to extend the linear actuator rod **32**. In extending, the forward end of the actuator **33** rises as the forward pivot pin **29** is elevated above the fulcrum pin **22**, accompanying downward-and-aft rotation of the wiper bar portion **25**. As the wiper face **26** contacts the forward-projecting edge of the outer flange *g*, it exerts a force thereon perpendicular to the then position of the wiper face **26**, as shown by the small arrow in Figure 2. Such force is directed first somewhat toward the toe projection **19** and then, as the wiper face **26** gradually closes, progressively more horizontally, thus wiping the outer flange *g* downward and backward from the 90° bend shown in Figure 2 to the closed 180° bend shown in Figure 3. The forward spacing of the fulcrum axis *x* relative to the anvil face **17** (advantageously more than three metal thicknesses, so as to exert a tight closing force and accommodate some increase in metal thickness) results in the exertion of a force more backward than downward; the latter would tend to lift the tool upward. However, the toe projection **19**, extending into the area between the duct surface *b* and the inner flange *e*, effectively locks the tool therein when the wiper bar portion **25** assumes the position shown in phantom lines in Figure 2. Consequently, the tool is capable of exerting strong forces throughout the range of its closing movement without any tendency to dislodge itself from the seam. As the seam is fully closed with the outer flange *g* parallel to the web *f* and pressing the flange *c* between them, the pressure switch **40** de-energizes the motor **38**.

When the operator actuates the switch **39** to reverse position, the tool unlocks itself from the seam and the lever **23** returns to horizontal position, when the motor is again de-energized. The tool may then be readily moved along the duct surface and reactuated as many times as may be necessary to close the entire seam length.

In spaces immediately beneath ceilings, and otherwise where operating space is at a minimum, it is particularly convenient to have the wiper lever **23** horizontal when open and the actuator cylinder **33** thus lowered partly between the side members **12**. Enough space is provided between the side members **12** around the cylinder **33** to permit the operator to grasp the cylinder, utilizing it as a handle for positioning the tool when open. As it begins to close it locks itself in place; hence the operator may remove his hand before the tool reaches its maximum height shown in Figure 3.

Modifications of the specific embodiment shown and herein described will occur to those familiar with the art. Hence this invention is not to be construed narrowly, but as fully coextensive with the claims. In them, the terms "up" and "outward" mean away from the duct surface; "forward" means toward the seam and "backward" means away from it. Other terms of direction are used in their obvious relations.

We claim:

1. For locking a sheet-metal seam by bending back parallel to its web the outer flange of a bent U-channel whose inner flange lies adjacent a surface and whose web extends substantially perpendicular to such surface, a tool comprising a fixed bar having a straight portion positionable against the outer side of such web, a wiper lever having a fulcrum and being mounted thereby to the fixed bar forward of its said straight portion and above the level of such channel outer flange, the wiper lever including a wiper bar whose length corresponds substantially with that of the fixed bar, the wiper lever having an arm extending beyond the fulcrum opposite said wiper bar, further comprising a frame including side members extending backward from the fixed bar spaced from each other, and securing a rear actuator support between them and remote from the fixed bar, and actuating means supported between said spaced side members by said rear

support and said lever arm, whereby to raise somewhat upward when the wiper bar is closed downward.

2. A tool as defined in claim 1, the portion of said fixed bar so positionable against said web having at its lower edge a projection extending forwardly thereof for engaging the outside of the bend joining such channel web and its inner flange, the wiper bar having a wiper surface closable downward and backward toward the straight portion of the fixed bar at a level above said projection.

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