April 30, 1968 F. R. WILSON ET AL 3,380,283

TUBE BENDING TOOL

Filed Jan. 11, 1965 3 Sheets-Sheet 1

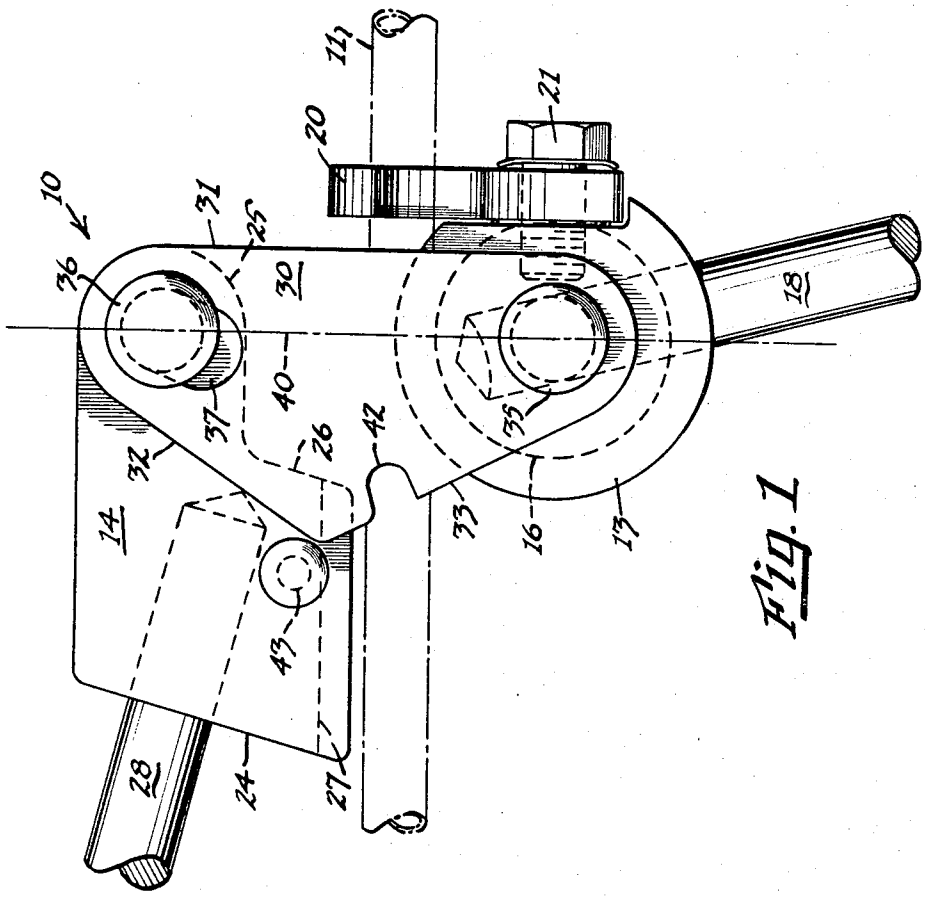


Fig. 1

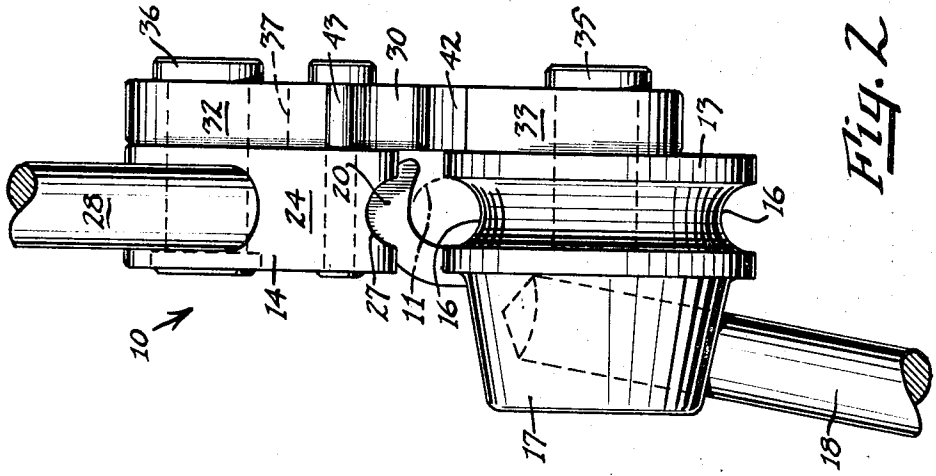


Fig. 2

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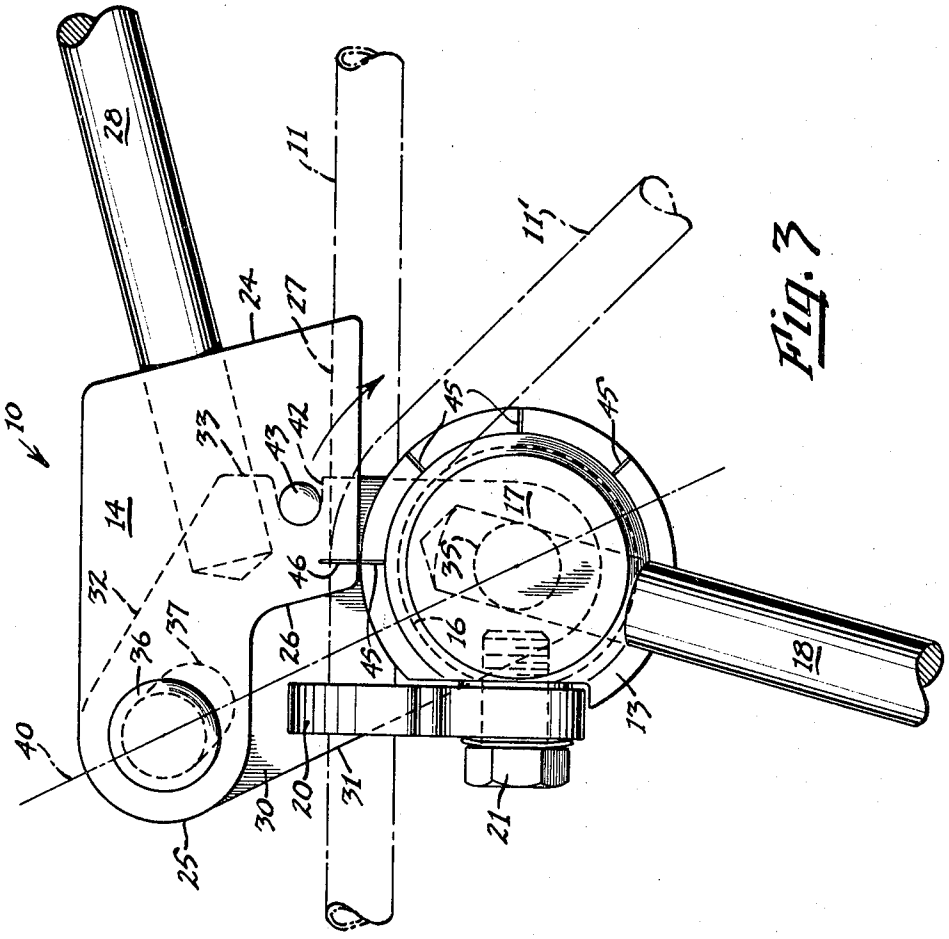


Fig. 3

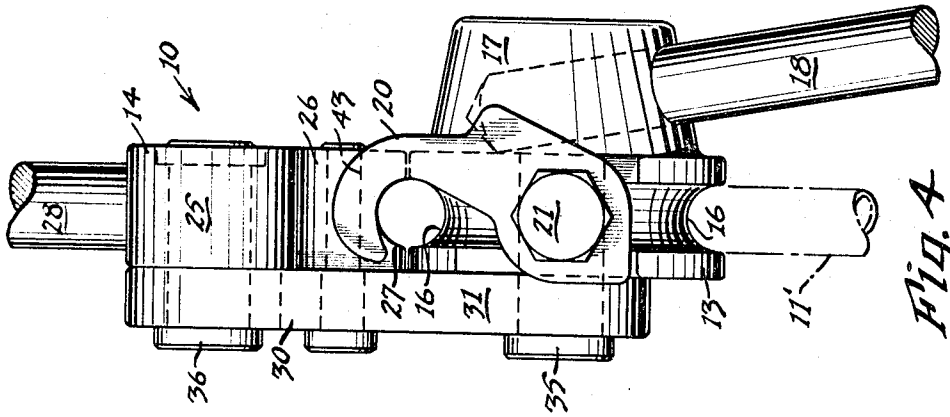


Fig. 4

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TUBE BENDING TOOL

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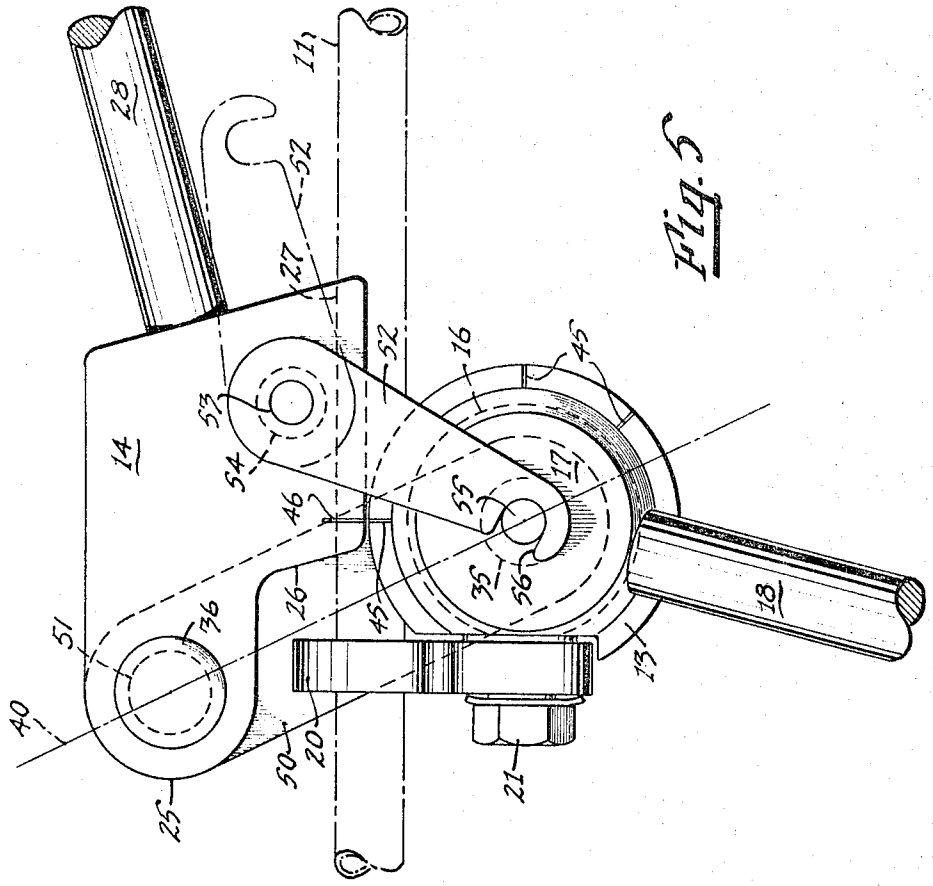


Fig. 5

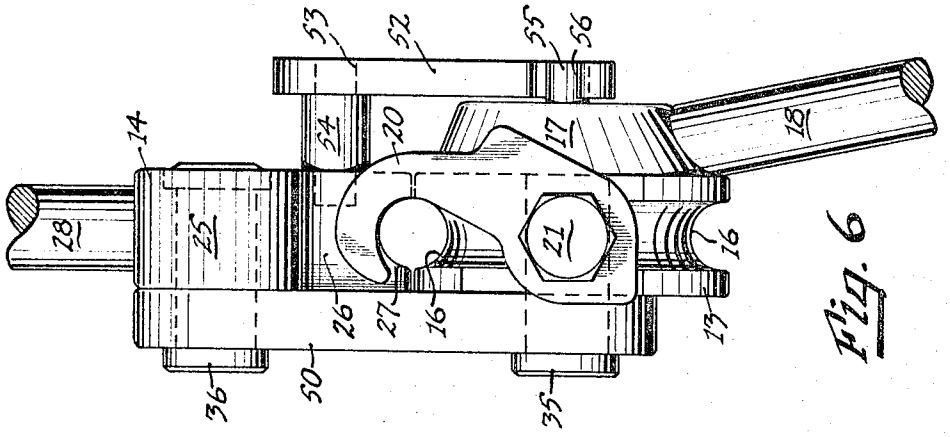


Fig. 6

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TUBE BENDING TOOL

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6 Claims. (Cl. 72—387)

ABSTRACT OF THE DISCLOSURE

A tube bending tool including a shoe, a circular arbor and an elongated link pivotally connected by pins at opposite ends of the link to the shoe and arbor, respectively; the distance between the pivot pins being greater than the sum of the radius of the arbor seat and the distance between the shoe pin and the longitudinal axis of the shoe seat, and releasable means for locking the shoe and arbor in a closed position in which the arbor seat and shoe seat engage the tube.

This invention relates to a tube bending tool, and more particularly to a portable hand tool for bending a tube.

Heretofore, portable tube bending tools have included an arbor and a shoe pivotally connected to the arbor for rotation about the arbor to bend a tube. However, in order to open the tool to receive the tube, the shoe has to be pivoted relative to the arbor, so that the handle on the shoe is swung upwardly and away from the tube. This type of tool operates satisfactorily where plenty of room for pivoting the shoe and shoe handle is available. However, such a tool could not be used where the available space is limited, since the tool could not be opened and closed to receive and release the tube.

It is therefore an object of this invention to overcome the above disadvantages by providing a tube bending tool in which the shoe and the arbor may be moved away from each other for receiving the tube without rotating the shoe relative to the arbor.

Another object of this invention is to provide a portable tube bending tool which may be operated in limited spaces.

A further object of this invention is to provide a portable tube bending tool including a shoe and an arbor, and a link pivotally connecting the shoe and the arbor in offset relationship so that the shoe and arbor may be swung toward and away from each other between a closed and an open position, without changing the angular relationship of the shoe and the arbor.

A further object of this invention is to provide a portable, manual, tube bending tool which may be operated with a minimum of head space.

Another object of this invention is to provide a portable tube bending tool including means for locking the shoe relative to the link in closed tube bending position for establishing a predetermined fixed radial position of the shoe relative to the arbor.

Another object is to provide a portable tube bending tool in which the shoe and arbor are each pivotally connected to a link that in one position of the link relative to the shoe and arbor separates the same so as to permit insertion of a tube therebetween and in another position closes the shoe against the tube, and there being a means to releasably lock the pivotal position of the shoe relative to the link when the shoe is in such closed position.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings, wherein:

FIGURE 1 is a side elevation of the invention in open position;

FIGURE 2 is a front end elevation of the invention disclosed in FIGURE 1;

FIGURE 3 is an elevation of the opposite side of the invention in closed position;

FIGURE 4 is a rear end elevation of the invention disclosed in FIGURE 3;

FIGURE 5 is a side elevation of an optional form of the invention in closed position; and

FIGURE 6 is a rear elevation of the invention disclosed in FIGURE 5.

Referring now to the drawings in more detail, the tool **10** for bending an elongated tube or rod **11** includes a circular arbor **13** and a shoe **14**. The arbor **13** is provided with an annular recess or seat **16** having a cross section adapted to conform in size and shape to the cross section of the tube **11**, as disclosed in FIGURES 2 and 4. Fixed to one side of the arbor **13** is a housing **17** in which is dependingly mounted an elongated lower or arbor handle **18**.

Pivotally mounted on the rear end or edge of the arbor **13** is a hook **20** secured by a pivot pin or bolt **21**. The length and size of the hook **20** are such that when it is swung to operative position, disclosed in the drawings, it will engage the top of the tube **11** when the tube **11** is received in the arbor seat **16** in its initial or stationary position. The portion of the tube **11** to the rear of the arbor **13** is held in this stationary position by the hook **20** during the bending operation, disclosed in FIGURE 3.

The shoe **14** has a front end or face **24** and a rear end **25** having a lower cut-out portion **26** adapted to clear the hook **20** when the tool is in its operative closed position, as disclosed in FIGURE 3. The bottom of the shoe **14** comprises a straight elongated seat **27** having an arcuate cross section adapted to oppose the arbor seat **16** and engage the top portion of the tube **11**, as disclosed in FIGURES 3 and 4. Rigidly secured in the shoe **14** and extending forwardly from the front face **24** is the elongated upper or shoe handle **28**. The handle **28** extends generally forwardly, but diverges slightly from the tube **11** in order to provide leverage and gripping room for manipulating the shoe handle **28**.

Connecting the arbor **13** and the shoe **14** together is a link or link bar **30** having a rear end or face **31**, an inclined upper forward face **32** and a lower inclined face **33**. A lower pivot pin **35** pivotally connects the lower end of the link **30** to the arbor **13** so that the pivotal axis of the pin **35** coincides with the center of the circular arbor **13**. An upper pivot pin **36** is fixed in the rear portion of the shoe **14** and extends through an elongated slot **37** in link **30** in slidable and pivotal engagement therewith. For the purposes of this invention, the longitudinal axis **40** of the link **30** will be considered as the line of centers extending through the pivotal axis of the lower pin **35** and the pivotal axis of the upper pin **36** when the pin **36** is seated in the upper portion of elongated slot **37**, as disclosed in FIGURES 1 and 3.

Formed in the lower front face **33** of the link **30** is an open ended locking slot **42** which is adapted to receive in closed position, as indicated in FIGURES 3 and 4, a locking pin **43** fixed in the lower portion of the shoe **14**. The axis of the elongated slot **37** is directed generally toward the slot **42** and the latter is of a sufficient angle and length to permit the pin **43** to be easily inserted and removed from slot **42** when the shoe **14** is pivoted about the pin **36** between its open position disclosed in FIGURE 1 and its closed position disclosed in FIGURE 3.

The operation of the invention is disclosed in the drawings, particularly FIGURES 1 and 3. Assuming that the tool **10** includes a circular arbor **13** having the appropriate seat **16** for receiving a correspondingly sized tube **11** for bending, the handle **18** is grasped by one hand of the

operator, for example, his left hand and the upper handle **28** is grapsed by the right hand and the shoe **14** is moved to the open position disclosed in FIGURE 1. It will be noted that the upper pivot pin **36** is raised to the disclosed upper position in the slot **37** to provide the maximum space between the seats **16** and **27**. In this initial position, the hook **20** will be hanging down from its pivot pin **21** in an inoperative position, not shown. The tube **11** is then inserted longitudinally between the seats **16** and **27** so that it rests upon the upper portion of the arbor seat **16**. Alternatively, the tube may be inserted laterally from the side opposite link **30** by rotating the tube a few degrees in a counterclockwise direction from the position shown in FIGURE 1, in which case the tube will readily pass sidewards between the lower corner of cut-out portion **26** and arbor **13** because the latter are then spaced apart a distance slightly greater than the diameter of the tube. The hook **20** is then rotated upwardly and over the top of the tube **11** to hold the tube **11** in its initial stationary position illustrated in FIGURES 1 and 2.

The tool is then closed by thrusting the handle **28** rearwardly causing the link **30** to pivot about the pivot pins **35** and **33** and also to swing rearwardly to the closed position illustrated in FIGURE 3, with the shoe seat **27** engaging the top portion of the tube **11**. In moving the shoe **14** rearwardly, the pivot pin **36** moves toward the bottom end of slot **37** so that the locking pin **43** will ride downwardly over the upper forward face **32** of the link **30** and continue down the lower forward face **33** until the pin **43** is seated in the slot **42**, as indicated in FIGURE 3. The rearward movement of the shoe **14** is continued until the pin **36** again is seated in the upper portion of slot **37**, as illustrated in FIGURE 3. With the shoe **14** locked in the closed position of FIGURE 3, the operator presses downwardly on the upper handle **28** in a clockwise direction, as viewed in FIGURE 3, to cause the shoe **14** to bend a portion **11'** of the tube **11** between the seats **16** and **27** to any desired position, such as illustrated in FIGURE 3.

In order to determine the degree of bending, radial gauge marks **45** may be provided on the side face of the arbor **13** and an indicator mark **46** may be formed on the same side face adjacent the bottom of the shoe **14** as disclosed in FIGURE 3. Thus, as the shoe is rotated, the indicator mark **46** will designate the degree of bend when it registers with each successive gauge mark **45**, depending upon the calibration of the marks **45**.

After the tube **11** has been bent to the desired angle, such as tube portion **11'**, the movement of the handle **28**, and consequently the shoe **14**, is reversed until it reaches the initial closed position disclosed in FIGURE 3. The handle **28** is then pulled forwardly, initially moving the shoe **14** to disengage the locking pin **43** from slot **42**, and then rotating the link **30** to its open position, disclosed in FIGURE 1. The hook **20** is then counter-rotated to disengage the tube **11** and the bent tube is removed.

It will be noted that as the handle **28** is rotated in its closed position to bend tube **11**, the thrust of the shoe **14** will be such as to cause the upper pivot pin **36** to remain in the upper portion of elongated slot **37** and also to thrust the locking pin **43** against the closed side of the slot **42**, so that the shoe **14** will remain in locked position during the bending operation.

It will be further noted by observing the closed position of FIGURE 3 and the open position of FIGURE 1 that the handle **28** and the shoe **14** maintain the same relative rotational or angular position with respect to the arbor **13** and the handle **18**. The only head space required for the shoe **14** and the handle **28** will be equal to the difference in the spacing between the arbor seat **16** and the shoe seat **27** in closed and open positions. Thus, because the length of the link **30** permits the pivotal axis of the upper pin **36** to be offset longitudinally from the axis of the lower pivot pin **35**, the tool **10** may be opened and closed without the necessity of swinging the shoe **14** and the shoe handle **28** upwardly about the pivot pin **36**, which would require substantial head room. Therefore, the bending tool **10** can be employed for bending tube **11** in limited spaces, areas with limited room and areas not readily accessible for manipulation of the tool by hand.

In the modification of the invention shown in FIGURES 5 and 6, link **50** is substituted for link **30** of FIGURE 1 and it has a circular opening **51** instead of an elongated slot **37** for receiving the pivot pin **36**. Also, pin **43** and slot **42** are omitted. Instead, a hook **52** is pivotally mounted on a pin **53** which is secured to the forward end of shoe **14** and which has an enlarged central portion **54** for spacing hook **52** from shoe **14**. Housing **17** has a pin **55** extending therefrom on the center of circular arbor **13** and hook **52** has a slot **56** for engaging pin **55**.

To operate thhis form of the invention, hook **52** is initially swung upwardly to the dotted position shown in FIGURE 5, at which time shoe **14** may be moved forwardly for rotating link **50** to a position corresponding with FIGURE 1 in which the longitudinal axis **40** is perpendicular to the axis of tube **11** in the stationary position of the latter. With the parts in this position, tube **11** may be inserted laterally between the shoe and arbor and into the seat **16** of the latter. After hook **20** is swung over the tube, the shoe **14** may then be moved rearwardly to the position shown in FIGURE 5 and hook **52** swung downwardly to engage pin **55** in slot **56**. This locks shoe **14** in its angular relationship with link **50** and the shoe may now be operated for bending the tube.

After the bend is completed, hook **52** is again swung into the position shown in the dotted line in FIGURE 5, shoe **14** is moved forwardly and the tube may then be removed from the bender.

This arrangement not only provides an optional method of locking the angular relationship between the shoe and link **50** during the bending operation but also ties the shoe and arbor together so that there is a connection between the shoe and arbor on each side thereof, link **50** providing the connection on the opposite side. This imparts considerable rigidity to the assembly and prevents any springing action that would tend to separate the shoe and arbor during the bending operation.

It will be apparent to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A tool for bending a tube comprising:

(a) an arbor having a seat for receiving said tube, said seat being circular in the bending plane of said tube,

(b) means adjacent one end of said arbor for holding one portion of said tube in a stationary position relative to said arbor,

(c) a shoe having a seat with a longitudinal seat axis in said bending plane, said shoe seat opposing said arbor seat for engaging said tube,

(d) a link having a longitudinal link axis, an upper end and a lower end,

(e) a first pin pivotally connecting said lower end on said link axis to said arbor at the center of said circular seat,

(f) a second pin pivotally connecting said upper end on said link axis to said shoe to permit relative pivotal movement between said link and said shoe,

(g) the distance between said first and second pins on said link axis being greater than the sum of the radius of said arbor seat and the distance between said second pin and said seat axis,

(h) said shoe being movable between an open position in which said link axis is perpendicular to said seat axis, and a closed position in which said link axis forms an acute angle with said seat axis and said shoe seat and arbor seat engage said tube,

(i) handle means for moving said shoe between said open and closed positions, and for rotating said shoe in closed position around said arbor in said bending plane,

(j) a first locking member on said shoe,

(k) a second locking member on said link adapted to operatively engage said first locking member when said shoe and link are in closed position, and

(l) means for releasably maintaining said first and second locking members operatively engaged.

2. The invention according to claim **1** in which said one end of said arbor is said rear end, said link having a front edge, said second locking member comprising an open slot in said front edge, said first locking member comprising a locking pin projecting from said shoe for engagement with said open slot when said shoe is rotated to said closed position, said releasably maintaining means comprising an elongated slot in said link for receiving said second pin to facilitate the engagement and dis-engagement of said locking pin with said open slot.

3. The invention according to claim **2** in which said elongated slot extends in a direction generally toward said open slot.

4. The invention according to claim **2** in which said elongated slot extends at an acute angle with said link axis.

5. The invention according to claim **2** in which said elongated slot has one end remote from said arbor, and said second pin is in alignment with said link axis when said second pin is received in said remote end.

6. The invention according to claim **2** in which, when said shoe is in said closed position engaging a tube, only a portion of said shoe seat projects toward a said holding means from a line perpendicular to said seat axis passing through the center of said circular seat, and the entire shoe seat is on the opposite side of said line from said holding means when said link axis is perpendicular to said seat axis.

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