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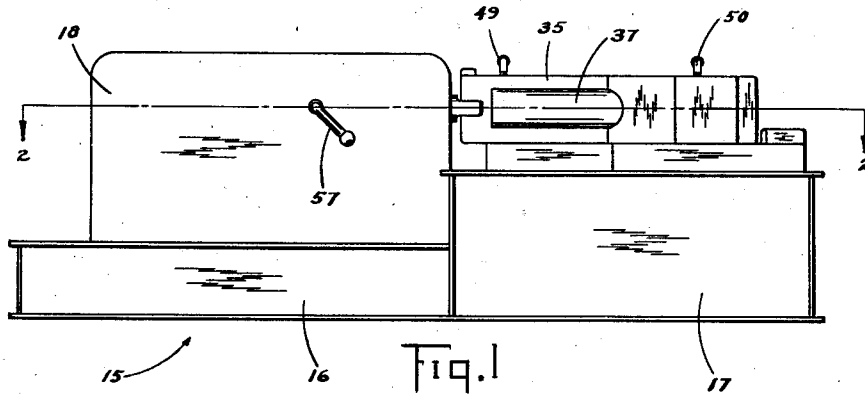
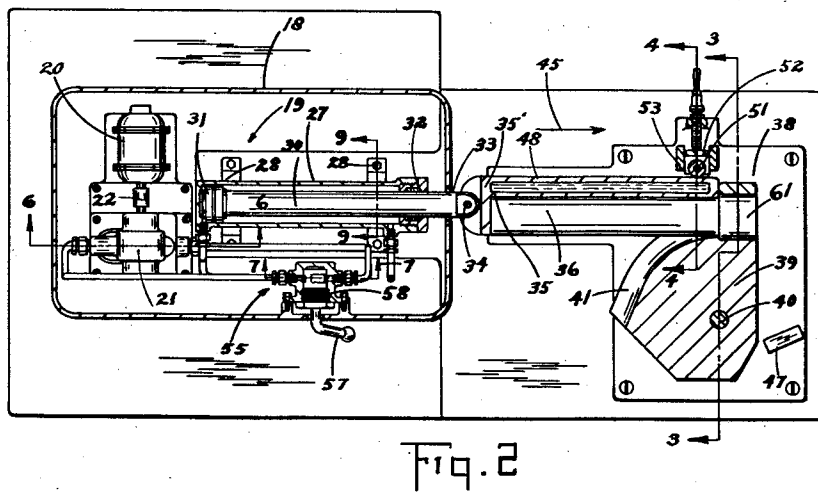
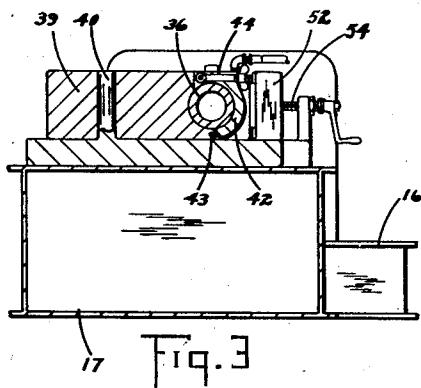
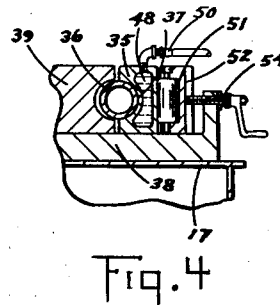
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2,357,006

TUBE BENDING MACHINE

Filed Oct. 27, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

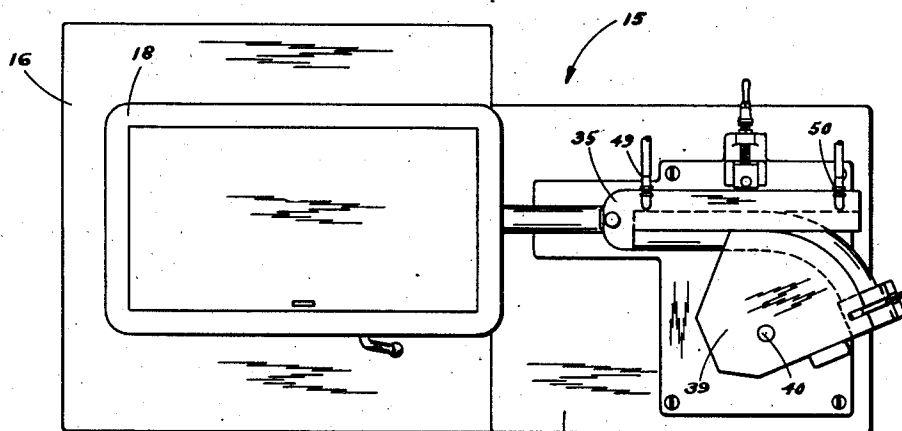


Fig. 5

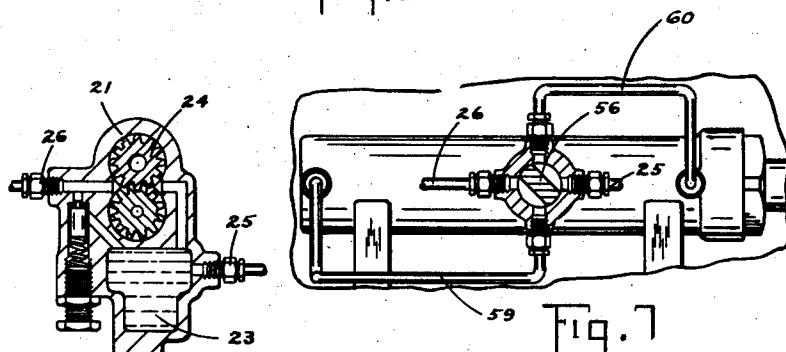


Fig. 6

Fig. 7

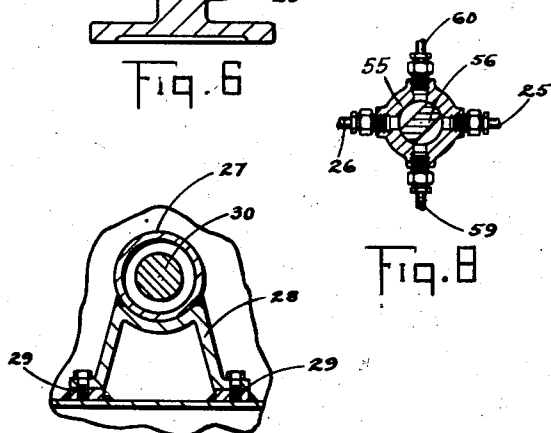


Fig. 8

Fig. 9

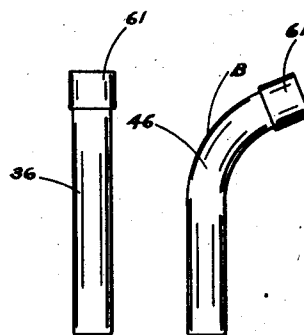


Fig. 10

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TUBE BENDING MACHINE

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5 Claims. (Cl. 153—40)

The present invention relates broadly to tube bending machines and more particularly to devices of this character especially designed for bending tubes forming a part of the wheel knuckle of an airplane landing gear.

An important object of the invention is to provide a device of this character that will efficiently bend a tube to the desired angle without disturbing its internal or external diameter or otherwise distorting said tube during the bending operation. This is especially important in the manufacture of tubes forming a part of wheel knuckles of airplane landing gears where it is essential that the strength of the tubes remain at a certain standard at all times.

Another object of the invention resides in the provision of a tube bending machine embodying novel means for effecting travel of the tube as it moves toward the bending roller.

A further object of the invention is to provide a tube bending machine having the above characteristics that is relatively simple in construction, inexpensive to operate and containing a minimum number of parts that will need replacing because of wear.

Other objects and advantages more or less ancillary to the foregoing reside in the specific construction and aggroupment of the elements peculiar to this structure, as will become apparent from a more complete examination of this specification.

In the drawings:

Fig. 1 is a side elevational view of a tube bending machine embodying the features of the present invention.

Fig. 2 is a horizontal sectional view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken substantially on line 3—3 of Fig. 2.

Fig. 4 is a fragmentary vertical sectional view taken substantially on line 4—4 of Fig. 2.

Fig. 5 is a top plan view illustrating the position of the machine at the completion of a bending operation.

Fig. 6 is a vertical sectional view of a conventional pump used with the machine and is taken substantially on line 6—6 of Fig. 2.

Fig. 7 is a detail sectional view of the valve mechanism and is taken substantially on line 7—7 of Fig. 2.

Fig. 8 is a view similar to Fig. 7 with the valve in a reverse position.

Fig. 9 is a detail sectional view taken substantially on line 9—9 of Fig. 2.

Fig. 10 is an elevational view of a tube prior

to and after it has passed through the bending machine.

Referring to the drawings for a more detailed description thereof, a tube bending machine in accordance with the present invention is generally designated by the reference numeral 15 and comprises a pair of bases 16 and 17, the base 17 being preferably disposed at a higher level than base 16. A casing 18 is mounted on the base 16 and houses the apparatus 19 shown in Fig. 2, said apparatus forming the means for effecting travel of the tube, by pushing the same during the bending operation.

The apparatus 19 includes a motor 20 and pump 21 connected by means of a shaft 22, the motor driving the pump through said shaft in a conventional manner. The pump, which is of conventional construction, is shown in Fig. 6 and comprises the usual reservoir 23, meshed gears 24 and inlet and outlet connections 25 and 26, respectively. The motor 20 and pump 21 are secured to the base 16 in any manner well known in the art.

Also mounted within the casing 18 is a cylinder 27, the same being supported on spaced standards 28 bolted or otherwise secured to the base 16 as indicated at 29. A rod 30 carrying a piston 31 is adapted to reciprocate within the cylinder 27 being guided through a suitable bushing 32 which acts as a seal for said cylinder. As will hereinafter appear, fluid from the pump 21 enters the cylinder on either end of the piston to drive said rod in the tube bending operation.

The end of the rod 30 opposite the piston 31 extends through an opening 33 formed in an end wall of the casing 18 and carries a clevis 34 for attachment to the closed end 35' of the tube housing 35, the latter being formed with a semi-cylindrical shaped portion 37 for housing the tube 36. A plate 38 is attached to the upper face of base 17 and supports the tube housing 35 whereby it is free to move longitudinally with the rod 30.

A forming block 39 is mounted on a pivot pin 40 adjacent the free end of housing 35 said block being of the general contour best shown in Figs. 2 and 5 of the drawings. The edge of block 39 adjacent the housing 35 is grooved as indicated at 41 to adapt itself to the contour of the tube 36 and when said tube is initially positioned prior to the bending operation, the parts are in the relation shown in Figs. 1 and 2. Thus for a portion of its length, the tube is supported between the housing 35 and block 39 as is best illustrated in Fig. 4. One end 61 of the tube is securely

locked to the block 39 by means of a clamp 42 pivotally connected at 43 to said block. A bolt and wing nut type of fastener 44 serves to releasably hold said clamp in locked engagement with said tube.

From the construction above described it is believed that the operation of the device is readily obvious. When initially positioning the tube, the piston 31 and rod 30 are entirely retracted within the cylinder 27 with all moving parts being in the position shown in Fig. 2. The tube is then locked in position by the clamp 42, and a valve (to be later described) is opened admitting fluid in back of the piston to urge the rod 31 outwardly. The tube has, of course, been preheated to the required degree best suitable for bending, and with the tube housing 35, is pushed in the direction of the arrow 45. The front end of the tube being clamped to the block 39 will cause said block to move on its pivot 40 and the former will be forced to follow the direction of travel of the block until it assumes substantially the shape shown at 46 in Fig. 10 of the drawings. A stop member 47 limits the forward travel of block 39 and notifies the operator that the bending operation is complete.

A feature of the present invention embodies the use of a cooling medium for tempering a certain area of the tube to prevent stretching of the metal as said tube is pushed forwardly during the bending operation. In previous practice the metal has stretched during the bending operation to such an extent that the area designated B in Fig. 10 of the drawings has presented a flattened surface which is highly objectionable from a structural standpoint. The housing 35 is formed with a compartment 48 in the form of a jacket having inlet and outlet connections 49 and 50, respectively, whereby a continuous flow of a cooling medium through the jacket is attained. As before indicated, the tube 36 is pre-heated to a degree suitable for bending prior to its placement in the housing 35, however, the action of the cooling medium will chill that area of the tube in contact with the groove 37 of housing 36 to such an extent that a pulling or stretching of the metal is substantially eliminated as the tube is moved with the block 39. Thus the bent tube will retain its outward cylindrical shape and the internal diameter thereof will be substantially unaffected.

A roller 51 is suitably journaled in a frame 52, the latter being held between a pair of supports 53. The roller 51 is urged into contact with the housing 35 by means of the threaded crank arm 54 and bears upon said housing to aid in maintaining frictional contact of the tube 36 with the block 39. When removing the bent tube, the crank arm 54 is rotated to release pressure of the roller on the housing so that the latter can be moved away from the block 39 to permit sufficient clearance for passage of the tube.

The valve mechanism for controlling the passage of fluid to the cylinder 27 is generally designated by the reference numeral 55 and is of the four-way type. Plug 56 is rotated by means of a handle 57 from the outside of casing 18, said plug being mounted in a suitable housing 58. When desiring to admit fluid in back of the piston 31 to urge the rod 30 and housing 35 in the direction of the arrow 45, the operator will rotate the plug 56 to the position illustrated in Fig. 7. Fluid will then be pumped through outlet 26 and enter cylinder 27 through line

59. After the operation is begun, and the piston and rod have moved to the other end of cylinder 27, the fluid will be exhausted through line 60 and returned to the pump through inlet connection 25. For retracting the rod, the position of the valve is changed to that shown in Fig. 8 and it will be observed that fluid is admitted to the cylinder through line 60 and exhausted through line 59.

Although the foregoing description is necessarily of a detailed character, in order to completely set forth the invention, it is to be understood that the specific terminology is not intended to be restrictive or confining and it is to be further understood that various rearrangements of parts and modifications of structural detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

20 I claim:

1. A tube bending machine of the character described, comprising, a pair of bases arranged in different horizontal planes, a casing mounted on one of said bases, a cylinder supported within said casing, a rod carrying a piston on one end operable within said cylinder, the other end of said rod extending through said casing, a tube supporting housing mounted on the other of said bases, said housing being connected at one end to the extending end of said rod, tube bending means at the other end of said housing and movable therewith, and means for operating said rod to push said tube housing whereby to bend the tube carried thereby.

2. A bending machine of the character described, comprising, a power actuated slidable block adapted to receive the element to be bent, a rotatable die opposite said block having a forming surface corresponding to the desired bend to be imparted to said element, said die being shaped and disposed in a manner affording contact of said surface with said element upon rotation of said die, and means for securing the front end of said element relative to the power stroke of said block to the corresponding front end of the forming surface of said die for imparting rotation to said die upon the slidable movement of said block.

3. A tube bending machine of the character described, comprising, a pair of bases arranged in different horizontal planes, a casing mounted on one of said bases, a cylinder supported within said casing, a rod carrying a piston on one end operable within said cylinder, the other end of said rod extending through said casing, a tube supporting housing mounted on the other of said bases, said housing being connected to the extending end of said rod and formed with a semi-circular groove for receiving the tube, a forming and bending block pivotally mounted adjacent the forward end of said housing and formed with a complementary semi-circular groove, said tube being initially confined between said housing and block, and means for actuating said rod to move said housing away from said casing, whereby contact of said tube with said forming and bending block will cause said block to swing on its pivot to bend the tube carried thereby.

4. A tube bending machine of the character described, comprising, a base, a housing on said base for supporting a tube to be bent, said housing being formed with a semi-circular groove for receiving the tube, a forming block pivotally mounted on said base adjacent the forward end

of said housing and formed with a complementary semi-circular groove, said tube being initially confined between said housing and block, and means for simultaneously moving said housing and tube whereby contact of said tube with said forming block will cause said block to swing on its pivot for bending the tube carried thereby.

5. A tube bending machine of the character described, comprising, a base, a housing on said base for supporting a tube, said housing being formed with a semi-circular groove for receiv-

ing the tube, a forming block pivotally mounted on said base adjacent the forward end of said housing and formed with a complementary semi-circular groove, means on said block for clamping the forward end of said tube, said tube being initially confined between said housing and block and clamped at one end to said block, and means for pushing said housing and tube whereby said clamped end will cause said block to swing on its pivot to bend the tube carried thereby.

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