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J. H. STANLEY

3,217,524

TUBE BENDER

Filed July 16, 1962

3 Sheets-Sheet 1

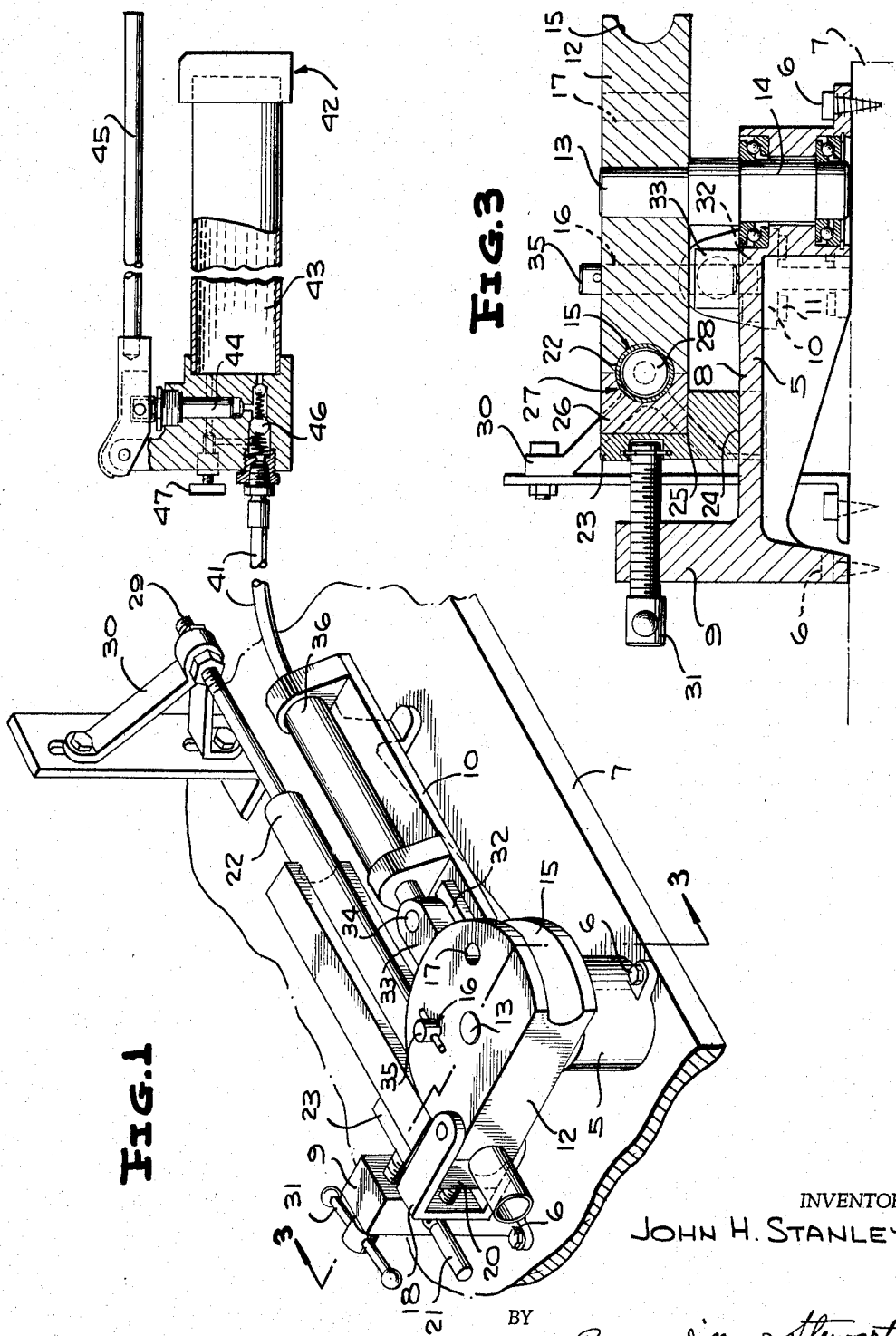


FIG. 3

FIG. 1

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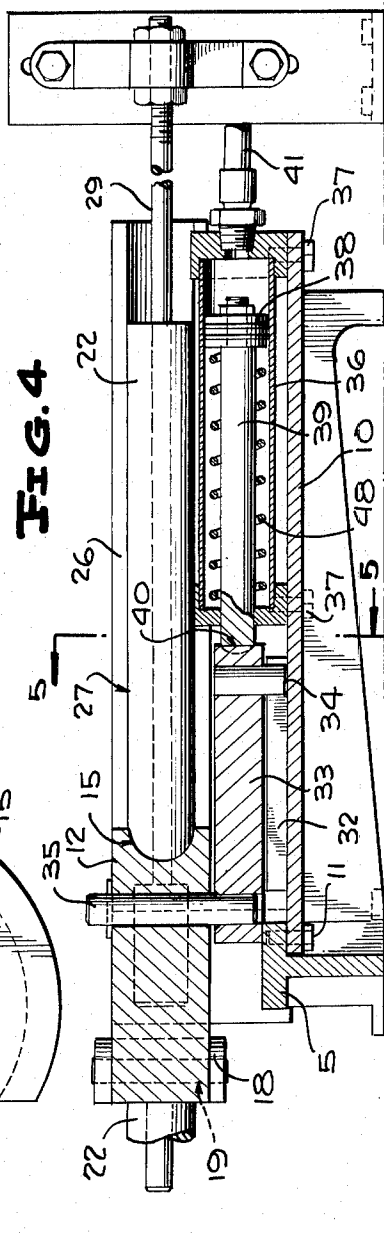
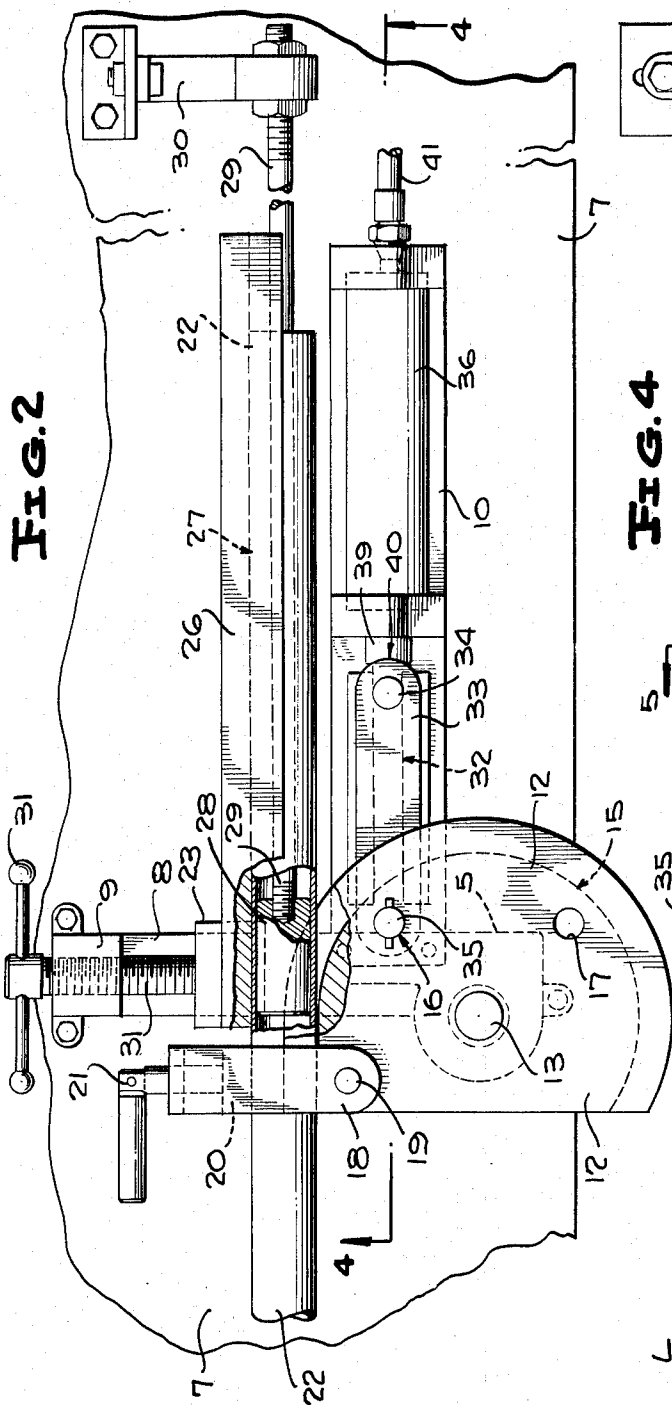
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FIG. 5

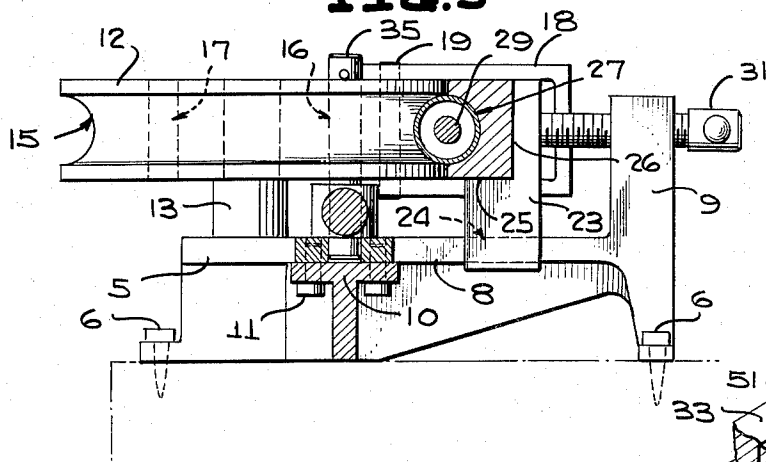


FIG. 8

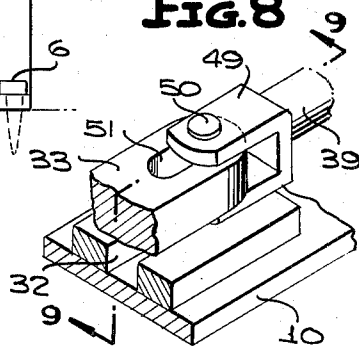


FIG.6

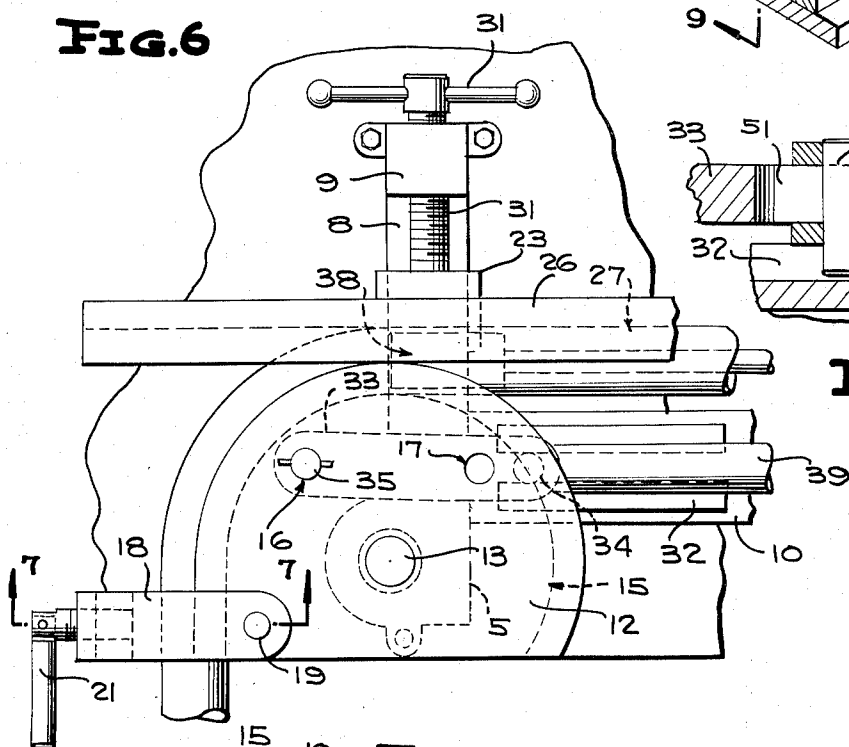


FIG. 9

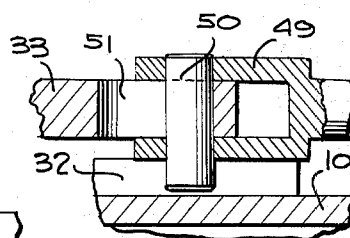
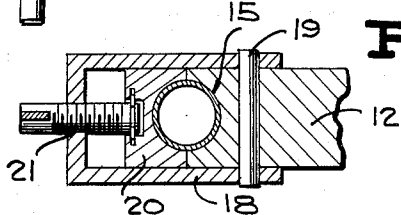


FIG. 7



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TUBE BENDER

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14 Claims. (Cl. 72-150)

The invention relates to certain new and useful improvements in tube benders and primarily seeks to provide a novel form of tube bender adapted for heavy duty work, such as the bending of stainless steel tubing of from one to two inches in outside diameter.

Tube benders are known in the art wherein are provided supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive the tube to be bent and determine the radius of the bend to be made therein, means to clamp the tube to turn with the block, grooved side block means to cooperate with the grooved radius block in enclosing the tube at the bending point and which is slidable along a support in movement with the tube portion engaged thereby during the bending process, and means for imparting turning movement to the radius block. Such known devices have not been practically adaptable to the heavy duty bending here in contemplation, unless complicated and expensive driving means and connections such as gear and rack devices were employed, because they lacked provision for necessary power application in the turning of the radius block and were confined to relatively limited angle bending, such as 90°, for example. It is therefore an object of the present invention to provide a tube bender of the character stated wherein simple and inexpensive radius block driving means are employed, in conjunction with means for transmitting movement to the radius block sufficient for the formulation of bends up to 180°.

An object of the invention is to provide an improved tube bender of the character stated wherein hand operable hydraulic actuator means is provided for imparting the desired turning movement to the radius block.

Another object of the invention is to provide an improved tube bender of the character stated wherein the means for transmitting movement to the radius block includes a turning thrust applying means removably connectable to the radius block at selective points about an arc struck generally from the turning center of the block, thereby permitting a bending of a tube in successive stages, each with a selected individual position connection of the thrust applying means with the radius block.

Another object of the invention is to provide an improved tube bender of the character stated wherein the radius block turning, thrust applying means includes an element in the form of a thrust link connectable at a thrust applying end thereof with the radius block through pivot pin and selective receiving apertures, and being mounted for straight line sliding movement at its other end in position for receiving a driving force thereagainst from a driving means.

A further object of the invention is to provide an improved tube bender of the character stated wherein the driving force applying means is in the form of a hydraulically reciprocable plunger having free thrust contact with the slidably mounted link end, without retraction effecting connection therewith, thereby to permit freedom of movement of the link independent of the plunger with a resultant facilitating of the selective connection of the link with the radius block.

A still further object of the invention is to provide an improved tube bender of the character stated wherein the thrust link and the reciprocable force applying

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plunger have a lost motion clevis-like connection, thereby to permit projection and retraction of the link by the plunger and yet also provide for movement of the link relative to the plunger in degree sufficient to facilitate the desired selective connection of the link with the radius block.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view and part schematic sectional view illustrating the invention.

FIGURE 2 is a plan view, parts being in horizontal section for the purpose of clearly illustrating the placement of the mandrel.

FIGURE 3 is a vertical cross section taken on the line 3-3 on FIGURE 1.

FIGURE 4 is a vertical longitudinal section taken on the line 4-4 on FIGURE 2.

FIGURE 5 is a vertical cross section taken on the line 5-5 on FIGURE 4.

FIGURE 6 is a fragmentary plan view illustrating the position of the cooperating parts after the completion of a 90° bend in a tube.

FIGURE 7 is a detail vertical cross section taken on the line 7-7 on FIGURE 6.

FIGURE 8 is a sectional perspective view illustrating a modified connection of the thrust imparting plunger with the thrust link.

FIGURE 9 is a longitudinal sectional view taken on the line 9-9 on FIGURE 8.

In the example of embodiment of the invention herein disclosed, the improved tube bender includes a support base 5 which may be secured at 6 on a suitable support, such as a work bench 7. The base has a laterally projecting slide table portion 8 including an upstanding bracket 9, and said base also has a longitudinally extending table portion 10 which may be integrally formed thereon or attached to the base, as at 11.

The radius block 12 is mounted on a center pin 13 rotatably supported at 14 on the base, and said block includes a grooved arcuate surface 15 struck from the turning center of the block and adapted to receive a tube to be bent and to determine the radius of the bend. The radius block is equipped with a plurality of selective apertures designated 16 and 17 and spaced about an arc struck generally from the center of the pin 13.

A U-shaped clamp-clevis 18 is pin mounted at 19 on the radius block, and a grooved clamp block 20 is slidable in the clevis by means of a captive screw means 21 to move the block 20 toward and from its tube clamping position illustrated in FIGURES 2 and 7 for clamping or releasing a tube 22 which is to be bent. A slide block supporting slide member 23 is provided and is slidably mounted at 24 on the lateral table portion 8 of the base, as clearly illustrated in FIGURE 5, said slide serving to present a supporting shoulder or seat 25 on which to slidably support the slide block 26 which is grooved at 27 to oppose the radius block groove and cooperate therewith in completely enclosing the tube to be bent at the bending point, as indicated in FIGURES 2 and 5 of the drawings.

In the heavy duty bending of tubes here in contemplation it is preferred that a mandrel 28 be presented within the tube at the bending point, as shown in FIGURE 2, the same being carried at the free end of a rod 29 which is supported in any suitable manner on the bench, as by bracket means generally designated 30.

Captive screw means 31 threaded through the bracket

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9 may be employed to project or retract the slide support 23 to present the slide block 26 in its effective, tube enclosing position illustrated in FIGURES 2, 5 and 6, or permit ready removal of said slide.

A straight-line slideway 32 is provided on the base table 10 to slidably support the thrust receiving end of a thrust link 33, the latter being equipped with a depending pin 34 engaging in said slideway in the manner clearly illustrated in FIGURES 2 and 4. The other end of the link 33 is selectively pin connected at 35 to one of the radius block apertures 16 or 17.

A hydraulic cylinder 36 is secured at 37 on the base table 10 and has a piston 38 reciprocable therein. The plunger 39 projecting from the piston and through one end of the cylinder as clearly illustrated in FIGURES 2 and 4 has free thrust socket contact at 40 with the link 33 for applying thrust thereto as the piston 38 is forced to the left as viewed in FIGURE 4. It will be apparent that thrust thus applied to the link 33 will impart turning movement to the radius block 12, but upon retraction of the piston and plunger the plunger is free to move away from or clear of the thrust receiving end of the link which is pin connected at 34 with the rectilinear slideway 32.

The cylinder 36 is connected by a duct 41 with a hydraulic force pump generally designated 42 and which may include a reservoir cylinder 43, a pump plunger 44 which may be manually reciprocated by the handle 45. Repeated oscillation of the actuator handle 45 will result in the application of repeated power impulses through the outlet controlled by the check valve 46, and free return of the power applying fluid may be permitted through the manually operable by-pass valve means indicated at 47. This bleeding back of the pressure fluid may take place upon retraction of the piston and plunger assembly 38, 39 as by action of a return spring means such as is indicated at 48 in FIGURE 4.

The plunger 39 may optionally be equipped with a clevis 49 having a pin 50 slidable in a lost motion slot 51 provided in the end of the link 33, as illustrated in FIGURE 8. This lost motion connection will function, as does the previously described mere free pressure contact at 40, as shown in FIGURES 2 and 4, to provide freedom of movement of the link 33 independent of the force applying plunger 39 such as will greatly facilitate selective attachment of the driving end of the link through the pin and aperture means 35, 16, 17 previously described.

In the operation of the tube bending apparatus, the tube is clamped to the radius block at 20, as illustrated in FIGURE 2, the mandrel 28 being in place within the tube at the bending point, and the tube 22 being enclosed between the grooved surfaces at 15, 27 in the radius block 12 and the cooperating slide 26. By manipulation of the handle 45, successive charges of the pressure fluid will be delivered through the duct 41 into the cylinder 36 and will cause the plunger 39 to apply a radius block turning force to be transmitted through the link 33 to the radius block. This force application may serve to turn the radius block from the position illustrated in FIGURE 2 to the position illustrated in FIGURE 6, thereby providing a 90° bend in the tube. If it is desired to additionally bend the tube, the piston 38 is retracted to clear the contact with the slidably mounted end of the thrust link 33 and the link is retracted, the coupling pin 35 removed from the previously selected aperture 16, and a new driving connection is made at the aperture 17. Then by reestablishing the force application by manipulation of the handle 45 in the manner previously described, the bending action can be continued beyond the previously effected 90° turn.

While preferred part forms and arrangements have been described in detail herein, it is to be understood that variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a tube bending apparatus, supporting means, a

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radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp a tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, mandrel means for internally supporting the tube during the bending process, and means including a hand operated hydraulic actuator for imparting the desired turning movement to the radius block.

2. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp a tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during the bending process, and adjustable means for imparting the desired turning movement to the radius block and including a thrust applying member selectively securable at different points along the radius block, and a hydraulic hand pump means for actuating the thrust applying member through successively applied hydraulic thrust impulses.

3. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp a tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, turning movement applying means and means for bringing about an effective turning movement applying couple between the turning movement applying means and the radius block at selective points spaced about the axis of rotation of the radius block for applying successive step turning movements thereto.

4. Apparatus as defined in claim 3 wherein the turning movement applying means includes a thrust applying member, and a hydraulic hand pump means for actuating the thrust applying member through successively applied hydraulic thrust impulses.

5. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp a tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, and turning thrust applying means removably connectable to the radius block at selective points about an arc struck generally from the turning center of the block, thereby to permit a bending of a tube in successive stages, each with a selected individual position connection of the thrust applying means with the radius block.

6. Apparatus as defined in claim 5 wherein the thrust applying means includes a thrust link mounted for rectilinear sliding movement at one end and removably and pivotally connected at its other end through pin and selective receiving hole means with the radius block.

7. Apparatus as defined in claim 5 wherein the thrust applying means includes a thrust link mounted for rectilinear sliding movement at one end and removably and pivotally connected at its other end through pin and

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selective receiving hole means with the radius block, there also being included a cylinder and a piston reciprocable therein and a rod projecting from the piston and cylinder and engaged in thrust applying contact with the slidably mounted end of the thrust link.

8. Apparatus as defined in claim 5 wherein the thrust applying means includes a thrust link mounted for rectilinear sliding movement at one end and removably and pivotally connected at its other end through pin and selective receiving hole means with the radius block, there also being included a cylinder and a piston reciprocable therein and a rod projecting from the piston and cylinder and engaged in thrust applying contact with the slidably mounted end of the thrust link and having a lost motion clevis connection with said slidably mounted link end.

9. Apparatus as defined in claim 5 wherein the thrust applying means includes a thrust link mounted for rectilinear sliding movement at one end and removably and pivotally connected at its other end through pin and selective receiving hole means with the radius block, there also being included a cylinder and a piston reciprocable therein and a rod projecting from the piston and cylinder and engaged in thrust applying contact with the slidably mounted end of the thrust link, and hydraulic hand pump means for applying pressure fluid to the piston to impart a turning movement to the radius block.

10. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp a tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, a slideway on the supporting means, a thrust link slidably mounted at one end in the slideway, selective receiving apertures spaced about the turning center of the radius block, pin means for pivotally connecting the other end of the link in a selected aperture thereby to permit a bend of a tube in successive stages each with a selected individual aperture mounting of said pin means, and means for applying radius block turning thrust to the slidably mounted end of the link, said slidably mounted link end being movable independently of said turning thrust applying means to facilitate the selective pin and aperture connection with the radius block at the other end of the link.

11. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp the tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, a slideway on the supporting means, a thrust link slidably mounted at one end in the slideway, selective receiving apertures spaced about the turning center of the radius block, pin means for pivotally connecting

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necting the other end of the link in a selected aperture thereby to permit a bending of a tube in successive stages each with a selected individual aperture mounting of said pin means, and means for applying radius block turning thrust to the slidably mounted end of the link, comprising a hydraulic cylinder and piston means and a lost motion clevis rod connecting the piston with the slidably mounted end of the link.

12. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate grooved surface in which to receive a tube to be bent and determine the radius of the bend, means to clamp the tube to turn with the radius block, grooved slide block means to cooperate with the grooved radius block in enclosing a tube at the bending point, means slidably supporting the slide block means for movement with the tube portion engaged thereby during a bending process, a slideway on the supporting means, a thrust link slidably mounted at one end in the slideway, selective receiving apertures spaced about the turning center of the radius block, pin means for pivotally connecting the other end of the link in a selected aperture thereby to permit a bending of a tube in successive stages each with a selected individual aperture mounting of said pin means, and means for applying radius block turning thrust to the slidably mounted end of the link comprising a hydraulic cylinder and piston means and a lost motion clevis rod connecting the piston with the slidably mounted end of the link, and hydraulic hand pump means for applying pressure fluid to the piston.

13. In a tube bending apparatus, supporting means, a radius block turnable about an axis on the supporting means and having an arcuate surface about which a tube may be bent, means to clamp the tube to turn with the radius block in a manner whereby as the radius block turns on its axis the tube is progressively engaged by said surface for bending the same, turning movement applying means, means for connecting the turning movement applying means to the radius block in a first position with respect to the radius block for transmitting an increment of turning movement to the radius block, and means for connecting the turning movement applying means to the radius in a second position with respect to the radius block for transmitting an additional increment of turning movement to the radius block.

14. Apparatus as defined in claim 13 in which said connecting means includes a member which in one position interlocks said radius block with said turning movement applying means to establish said first position and is movable to another position in which it interlocks said radius block with said turning movement applying means to establish said second position.

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