Dec. 3, 1963 L. DARD 3,112,787

APPARATUS FOR BENDING TUBES, BARS AND METAL SECTION

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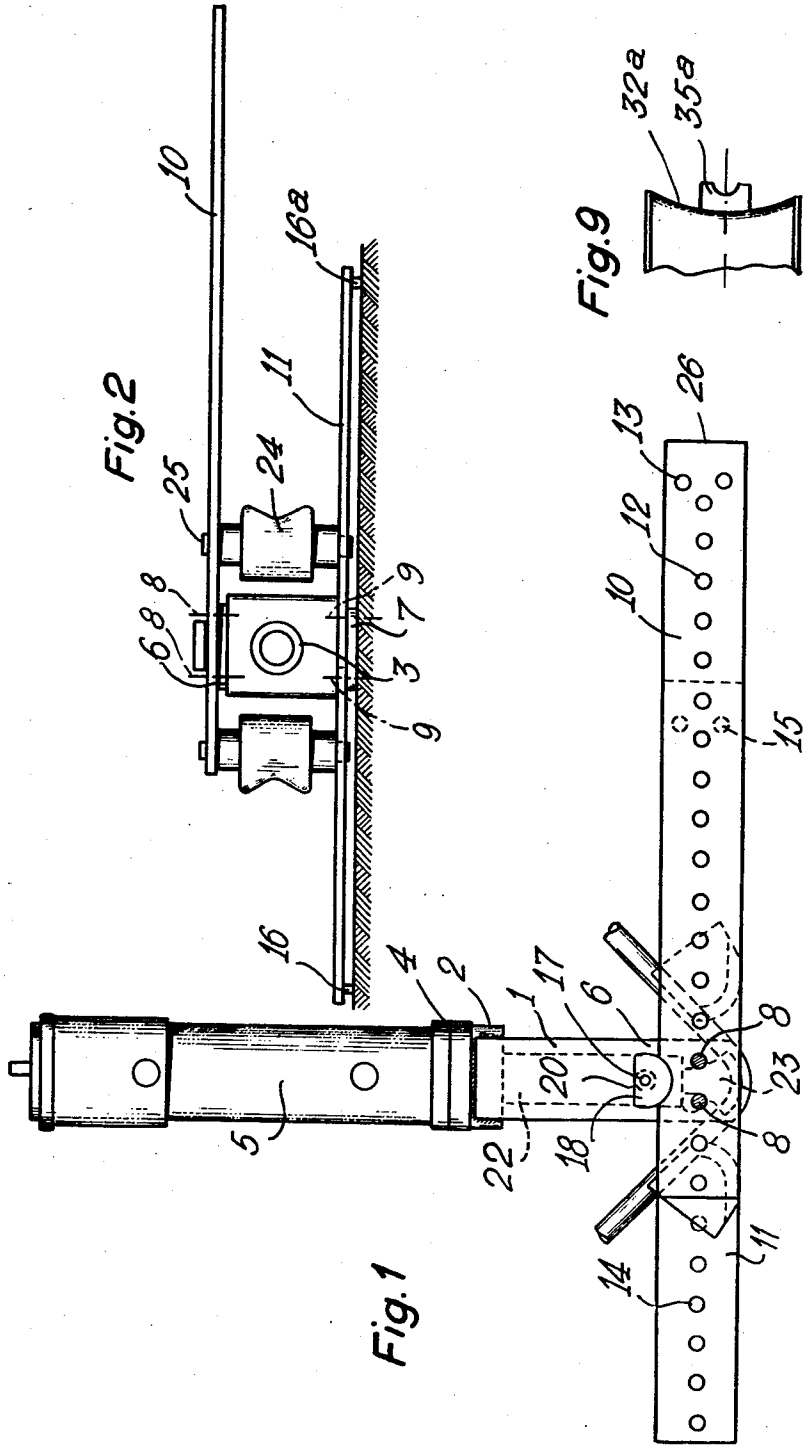


Fig. 1

Fig. 2

Fig. 9

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APPARATUS FOR BENDING TUBES, BARS AND METAL SECTION

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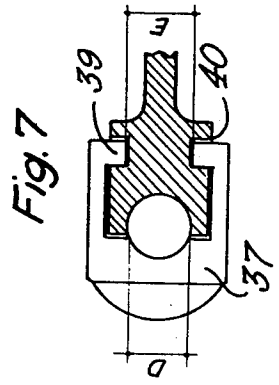


Fig. 7

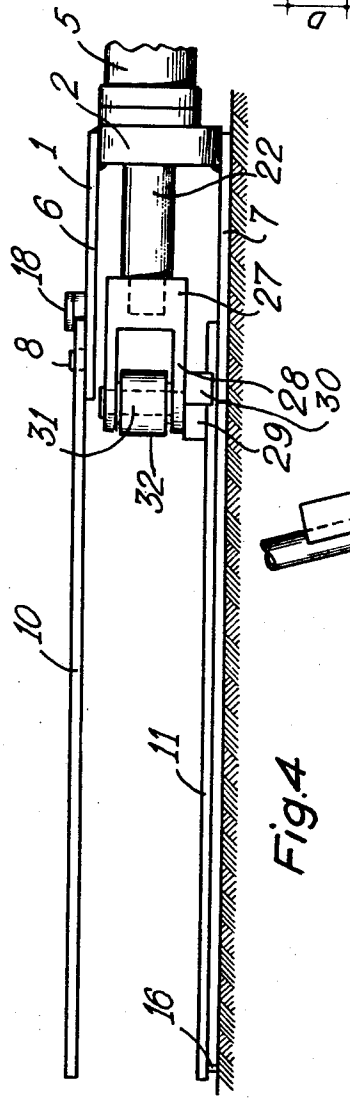


Fig. 4

Fig. 3

Fig. 8

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Fig.5

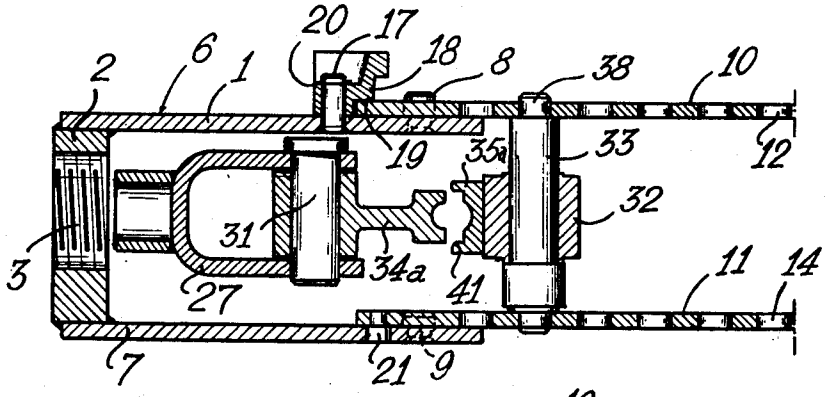
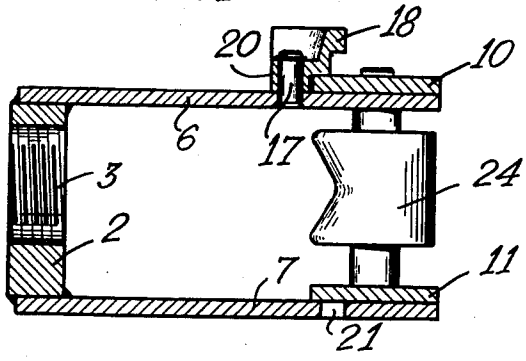


Fig.6.



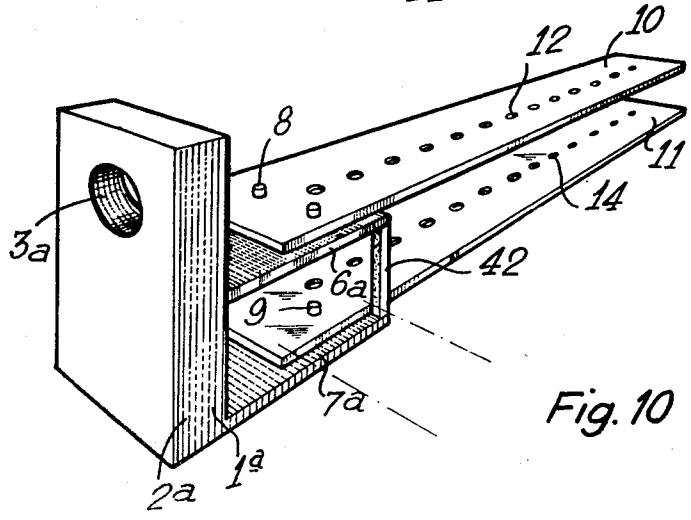


Fig. 10

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3,112,787

APPARATUS FOR BENDING TUBES, BARS AND METAL SECTIONS

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17 Claims. (Cl. 153—38)

This invention relates to apparatus for bending tubes, bars and metal sections.

It is an object of the invention to provide apparatus which is adapted for selectively bending a workpiece by pressure bending and by bending by wrapping on a former.

According to the present invention apparatus of the above described kind comprises a one-piece connecting member in the shape of a stirrup having a base adapted for connection to load applying means such as a ram. The stirrup includes arms extending from the base and means on the arms for supporting a pair of cross-pieces through apertures which are identically formed in the crosspieces. The means on the arms is adapted for supporting the crosspieces in first and second positions corresponding respectively to a pressure bending position and a bending by wrapping position.

The shaping tools adapted for being employed in the above apparatus for pressure bending include pressing cones fittable on the end of the ram and double cone members supported in the crosspiece apertures with the crosspieces in the first position in which they extend transversely to the stirrup. The tools for bending by wrapping include a yoke having guiding lugs, a roller and a set of wrapping formers which are placed on the stirrup with the crosspieces in the second position in which they extend in alignment with the stirrup, the roller and formers being fittable in the yoke and between the crosspieces. There is further provided a block associated with the former.

The apparatus comprises only four main elements, viz, the one-piece connecting member, the two cross-pieces and the yoke with its roller. The apparatus therefore is very simple in construction and its cost is low, while it provides a wider scope of operation than heretofore known devices.

Two embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of bending apparatus set up for pressure bending,

FIG. 2 is a side elevation of the apparatus shown in FIG. 1,

FIG. 3 is a plan view of the bending apparatus set up for bending by wrapping on a former,

FIG. 4 is a side elevation of the apparatus shown in FIG. 3,

FIG. 5 is a sectional view, to a slightly enlarged scale, of an alternative set-up of the apparatus for bending by wrapping,

FIG. 6 is a sectional view showing in detail the crosspieces disposed on a one-piece connecting member for pressure bending,

FIG. 7 is a partly sectioned view showing a tube grip fitted to the end of a former,

FIG. 8 is a plan view of a portion of FIG. 7,

FIG. 9 diagrammatically illustrates a chock positioned on a toroidal roller, and

FIG. 10 is a diagrammatic perspective view of an alternative construction of a one-piece connecting member.

Referring to FIG. 1, therein is shown a connecting member 1 in the general shape of a stirrup. The member 1 has a base 2 formed with a threaded opening 3 adapted to receive a screwthreaded flange extending from an end flange 4 of a ram 5, so that the latter can be

rotated relative to the member 1. The ram 5 is adapted for exerting a thrust force along an axis which lies substantially along the longitudinal axis of the member 1. A pair of studs 8 are disposed on the top surface of one arm 6 of the member 1, and a pair of corresponding studs 9 are disposed on the top surface of the other arm 7 of the member 1 in alignment with the studs 8. A pair of cross-pieces 10 and 11 which have a generally rectangular and elongated shape are adapted to be connected to the member 1. Each cross-piece is provided with a row of apertures 12 along the central line thereof and parallel with the long side. The apertures 12 are evenly spaced apart by an amount corresponding to the spacing between the studs 8 and the studs 9. One end of the top cross-piece 10 is formed with a pair of apertures 13 disposed along a line parallel to the short side, the spacing between the apertures 13 being equal to the spacing between two consecutive apertures 12. The bottom cross-piece 11 is formed with apertures 14 and 15 identical with the apertures 12 and 13, but the undersurface of the cross-piece 11 preferably has, near its ends, feet 16 and 16*a* of a height equal to the thickness of the arm 7 of the member 1. Welded to the top surface of the arm 6 is a spindle 17 receiving a lock in the form of a locking tongue 18 (FIGS. 1 and 5) which is retained by a circlip and which is formed with a shoulder 19 and with a flat portion 20. The bottom arm 7 of the member 1 is formed with an aperture 21 in which the foot 16*a* can be engaged.

As can be seen in FIGS. 1, 2 and 6, the crosspieces 10 and 11 can be supported respectively on the arms 6, 7 with the studs 8 and 9 accommodated in the appropriate apertures 12 and 14 of the crosspieces. The bottom crosspiece is stably supported since it rests on the arm 7 and also on the feet 16 and 16*a*. The top cross-piece 10 is positioned with the flat 20 of the locking tongue 18 placed opposite the studs 8, whereafter the cross-piece 10 is locked by turning the tongue 18, locking being effected by the shoulder 19 against crosspiece 10. The crosspieces 10 and 11 can be positioned symmetrically with respect to the axis of the stirrup or alternatively, either the top crosspiece 10 along or both crosspieces can be offset to either side of the axis of the stirrup 1 to provide lateral clearances for counterbends.

For press-bending, the ram thrust rod 22 supports a pressing former 23 and double-cone members 24 constituting reaction means are placed on spindles 25 which are engaged in appropriate apertures 12 and 14 in the cross-pieces 10 and 11. Preferably, the spindles 25 act as end pivots for the double-cone members which help to stabilise the cross-pieces. The double-cone members are provided with different surfaces and grooves in known manner so that they can be used for press-bending or for restraightening excessively bent parts.

The apparatus can be assembled as shown in FIGS. 3 and 4 for bending by wrapping on a former. The top arm 6 of the member 1 supports the top cross-piece 10 with the studs 8 engaged in the apertures 13. The end 26 of the crosspiece 10 adjacent apertures 13 is located, relative to the apertures 13, at the same distance as the apertures 12 from the long sides of the cross-piece, so that the end 26 can be locked by means of the shoulder 19 on the tongue 18 in the same manner as heretofore shown for the long sides of the crosspieces for pressure bending. The bottom crosspiece 11 is supported with the foot 16*a* placed in the aperture 21 in arm 7 and the foot 16 at the other end of crosspiece 11 resting on the ground.

For bending by wrapping on a former the ram thrust rod 22 is fitted with a yoke 27, the bottom arm 28 of which is provided at one end with a shoe 29 which slides on the top surface of the cross-piece 11 and having lugs 30 which engage the two long sides of the cross-piece 11

to guide the yoke 27 in alignment with the thrust axis of the ram.

As can be seen in FIGS. 3 and 4, the yoke 27 supports a spindle 31 carrying a roller 32. A spindle 33 is disposed in one of the apertures 12 in the top cross-piece 10 and in the matching aperture 14 in the cross-piece 11 and is fitted with a bending former 34. A block 35 is placed between the roller 32 and the former 34. When urged by the rod 22 the roller 32 acts on the block 35 which rolls on the former 34 to rotate the same. The workpiece 36 is maintained between the former 34 and the block 35, which are each formed with an appropriate groove, and the workpiece is bent by wrapping, the end of the workpiece 36 being supported by the former 34 by a tube grip 37.

Alternatively, and as shown in FIG. 5, a bending former 34*a* can be fitted to the yoke 27 by means of the spindle 31, while the spindle 33, which is of the same diameter as the spindle 31, supports the roller 32 and terminates at each end in studs 38 accommodated in opposite apertures 12 and 14 in the two cross-pieces 10 and 11. A block 35*a* is engaged with the roller 32 and is interposed between the latter and roller 32. Thus there is shown in FIG. 5 an arrangement wherein the roller 32 and block 35 has been replaced in yoke 27 with former 34*a*, while former 34 is replaced with roller 32 and block 35*a*.

Bending by wrapping can therefore be performed either by applying a force to the block, in which case the reaction means is constituted by the former, or by applying the force to the former, in which case the block is the reaction means. In the case in which the force is applied to the block, as shown in FIG. 3, the spindle 33 supporting the former, remains supported in a fixed location, whereas in the case in which the force is applied to the former, as shown in FIG. 5, the spindle 33 supporting the roller 32 and block 35*a* remains supported in a fixed location. In either case, the arrangement of the tool-bearing spindles along the geometric axis of symmetry of the apparatus, permits the formers to be inverted and rotated in either direction, so that operation is very flexible.

Advantageously, the tube grip 37 is fitted to the former 34 not by drifting but by a hook connection. To this end, flanges on the tube grip 37 are provided with internal claws 39 (FIGS. 7 and 8) which are engageable in grooves 40 in the rim of the former 34. The space E between the claws 39 is greater than the diameter D of the workpiece. The tube grip 37 can then be placed onto a tube in the former and need not be threaded onto the tube from one end thereof. The tube grip 37 can be introduced through the grooves 40 into the former 34.

The former and block preferably interengage. Accordingly, one of the two members, for instance, the block 35*a* has flanges 41 (FIG. 5) for centering it on the side walls of the rim of the former. Centering is provided, for instance, by conical parts. To improve centering, and as shown in FIG. 9, the roller 32 can have a hollow toroidal periphery 32*a*, the back part of the block 35*a* being cylindrical. The block is therefore moved automatically into the line of thrust.

In an alternative construction for overhang bending—i.e., operations in which total access is provided for the tools and workpieces—the connecting member 1*a* shown in FIG. 10 comprises a stirrup with a top arm 6*a* and a bottom arm 7*a*, but the base 2*a* extends considerably above the top arm 6*a* in order that the aperture 3*a* which is adapted to receive the screw-threaded flange of the jack may be disposed above the arm 6*a*. The same cross-pieces 10 and 11 can be used with the connecting arrangement provided by the studs 8 and 9. Pillars 42 are secured between the front parts of the flanges, and an opening is provided in the pillars to permit entry of crosspiece 11. FIG. 10 shows in solid lines the position of the cross-pieces for bending by wrapping, while the chain-dotted lines denote the position of the bottom cross-piece for press-bending.

In the construction shown above the bending tools, formers and double-cone members or formers, straight-edges and rollers are disposed on long spindles which engage in the corresponding apertures 12 and 14 of the two-cross-pieces but which extend beyond the cross-piece 10 to receive the corresponding bearing tools, such spindles cross bracing the two cross-pieces and thus helping to strengthen the reaction beam thus formed.

Of course, the embodiments hereinbefore described can be varied without departing from the scope of the invention. For instance, the tapped aperture 3 could receive, instead of the screw threaded flange of a hydraulic ram, the connecting member of a screw ram or other thrust element or of a motor-operated ram of any kind. Whatever system is used, the advantage is retained of the relative narrowness of the arms 6 and 7 of the member 1, such narrowness insuring that very little angular space is required to perform any bending operations on workpieces, the counterbends of which can therefore come very close to the thrust axis. The contours of the formers both for press-bending and for bending by wrapping can be in the form of circular arcs or of any other shape; the formers for bending by wrapping can comprise a number of articulating bearing surfaces forming consecutive bending centers for corresponding sectioned parts.

Such a device can co-operate with shaping mandrels or with tube-filling tools known as "caterpillars" which are secured to the unbent end of the tube.

What I claim is:

1. Apparatus for bending material comprising means for exerting a thrust along an axis, a pair of rigid cross-pieces, a tool adapted for being coupled to said means for exerting a force on said material, reaction means coupled to said cross-pieces for engaging said material simultaneous with said tool to bend said material under the action of said force, a one-piece connecting member of stirrup shape and including a base and arms extending therefrom, means for connecting the first said means to said base while allowing said first means to exert said thrust, means on said arms for supporting said cross-pieces therefrom in first and second positions, the cross-pieces in the first position being adjustably positioned in a direction extending perpendicular to the thrust axis and in the second position being supported by the means on the arms to extend in the direction of said thrust axis, said reaction means cooperating with the first said means to cause pressure bending of the material with the cross-pieces in the first position, and to cause bending by wrapping with the cross-pieces in the second position.

2. Apparatus as claimed in claim 1 wherein each of said cross-pieces is identically provided with a plurality of spaced apertures extending along a line, the apparatus comprising means for coupling said reaction means to said cross-pieces by engagement in said apertures.

3. Apparatus as claimed in claim 2 wherein the means on the arms for supporting the cross-pieces therefrom comprises a pair of studs spaced apart by a distance corresponding to the spacing of said apertures in the cross-pieces, said apertures being adapted for accommodating said studs.

4. Apparatus as claimed in claim 2 comprising locking means on said one piece member and engageable with one of said cross-pieces for locking the latter and said one piece member together.

5. Apparatus as claimed in claim 2 wherein the means for coupling said reaction means to said cross-pieces comprises spindles coupled to said reaction means and engageable in corresponding of said apertures in each of the cross-pieces.

6. Apparatus as claimed in claim 5 wherein the means on the arms for supporting the cross-piece therefrom comprises a pair of studs spaced apart by a distance corresponding to the spacing of said apertures in the cross-piece, said apertures being adapted for accommodating said studs, said spindles and studs being of the same diameter,

which diameter corresponds to the diameter of the aperture whereby said studs and spindles can be interchangeably supported in the apertures.

7. Apparatus as claimed in claim 3 wherein each of said cross-pieces has opposite ends and a pair of apertures at one of said ends, the latter said apertures being spaced apart a distance equal to the spacing of the first said apertures and aligned in a direction extending perpendicularly to the line of the first apertures.

8. Apparatus as claimed 7 wherein said studs are engaged in said latter apertures with said cross-piece in said second position.

9. Apparatus as claimed in claim 7 wherein the latter said apertures are equally spaced on opposite sides of said line.

10. Apparatus as claimed in claim 9 comprising means on one of said cross-pieces for supporting the same in addition to the support furnished by said one-piece member.

11. Apparatus as claimed in claim 10 wherein said cross-pieces rest on said arms, said one cross-piece being the lower cross-piece, said means on said cross-piece for additionally supporting the same including a pair of feet at the opposite ends of said cross-piece, said feet extending a distance from the cross-piece equal to the thickness of the arms whereby with the lower cross-piece resting on the corresponding arm a planar support constituted by the one-piece member and said feet is provided.

12. Apparatus as claimed in claim 11 wherein the arm supporting said lower cross-piece is provided with a groove for accommodating one of said feet with the cross-pieces in the second position.

13. Apparatus as claimed in claim 9 wherein said tool comprises a yoke, a roller, a wrapping former, a corresponding block for said wrapping former, pivots respectively on said roller and on said wrapping former, said pivots being respectively operatively connected to said yoke and engaged in the apertures in said cross-pieces, said pivots having all a uniform diameter.

14. Apparatus as claimed in claim 13 wherein said roller has a concave periphery and is adapted for cooperating with the block, the back side of said block being curved to the same curvature as that of said concave periphery.

15. Apparatus as claimed in claim 13 wherein said wrapping former has in leading ends groove-like apertures adapted for receiving corresponding claws of grips, the space between the claws being greater than the thickness of the material to be bent and retained on said former by said grips.

16. Apparatus as claimed in claim 13 wherein said yoke has a slide shoe operatively adapted to slide on the lower cross-piece, and guiding lugs adapted to move along the sides of said lower cross-piece.

17. Apparatus as claimed in claim 1 wherein said tool is adapted for being selected from a multiplicity of press formers, said reaction means including cone members, respectively operatively connected to said first means and to said cross-pieces.

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