July 17, 1956 L. F. GAUTIER 2,754,879

BENDING MACHINE CHIEFLY FOR BENDING TUBES AND BARS

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Fig. 1

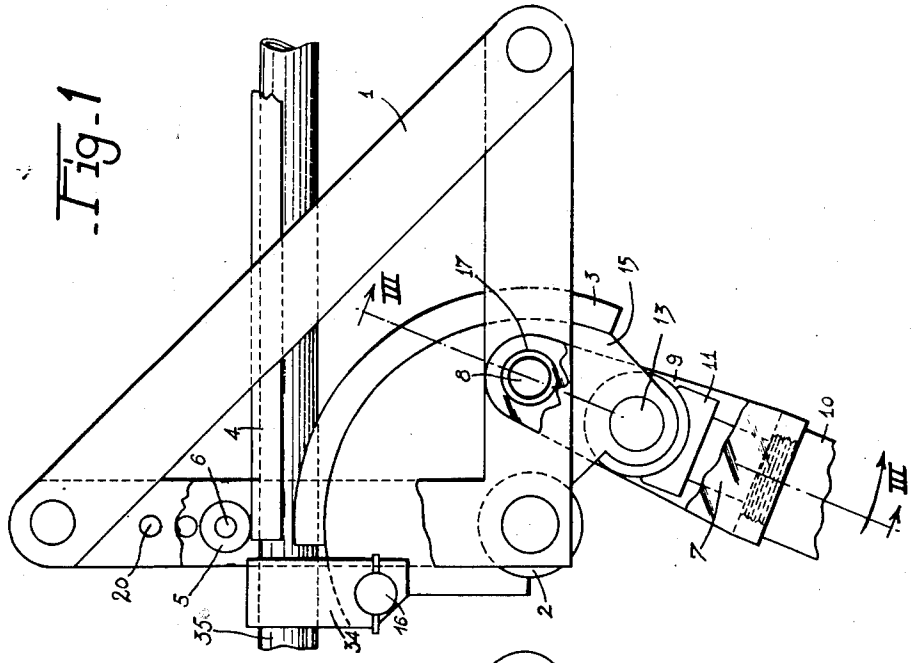
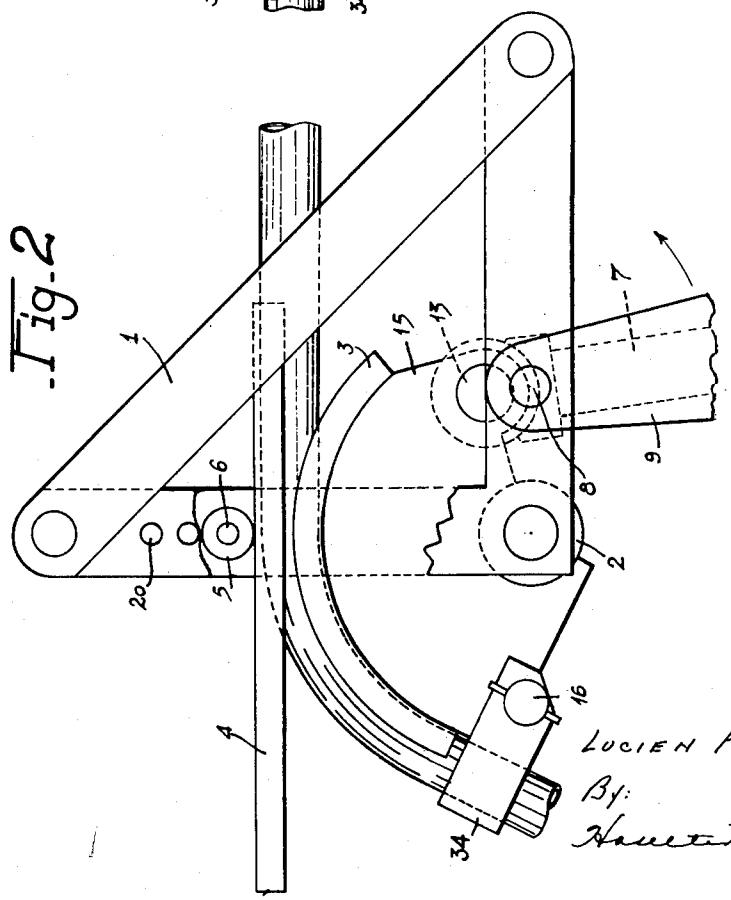


Fig. 2



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Fig. 3.

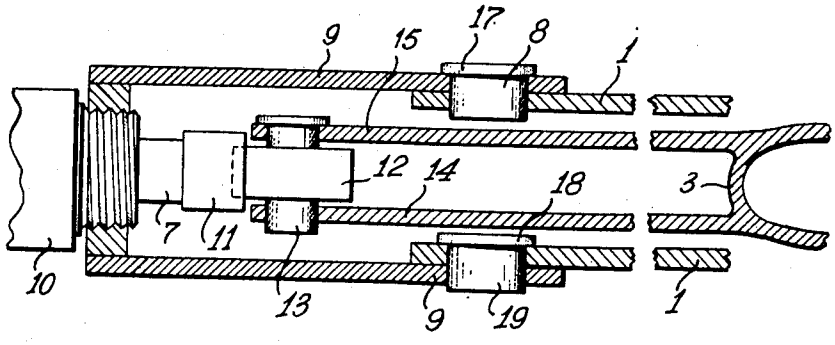


Fig. 11.

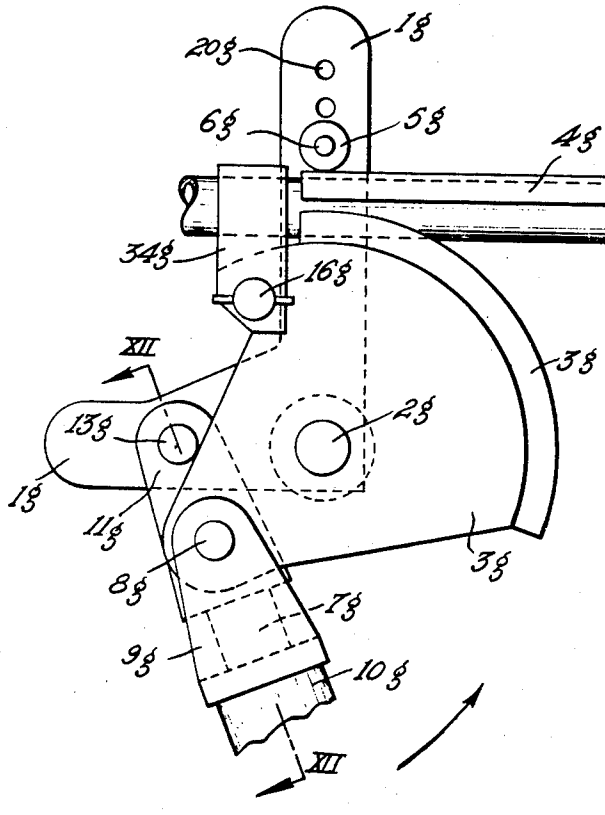
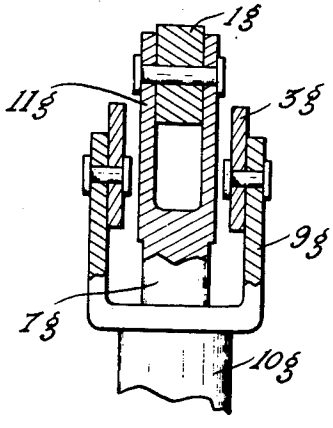


Fig. 12.

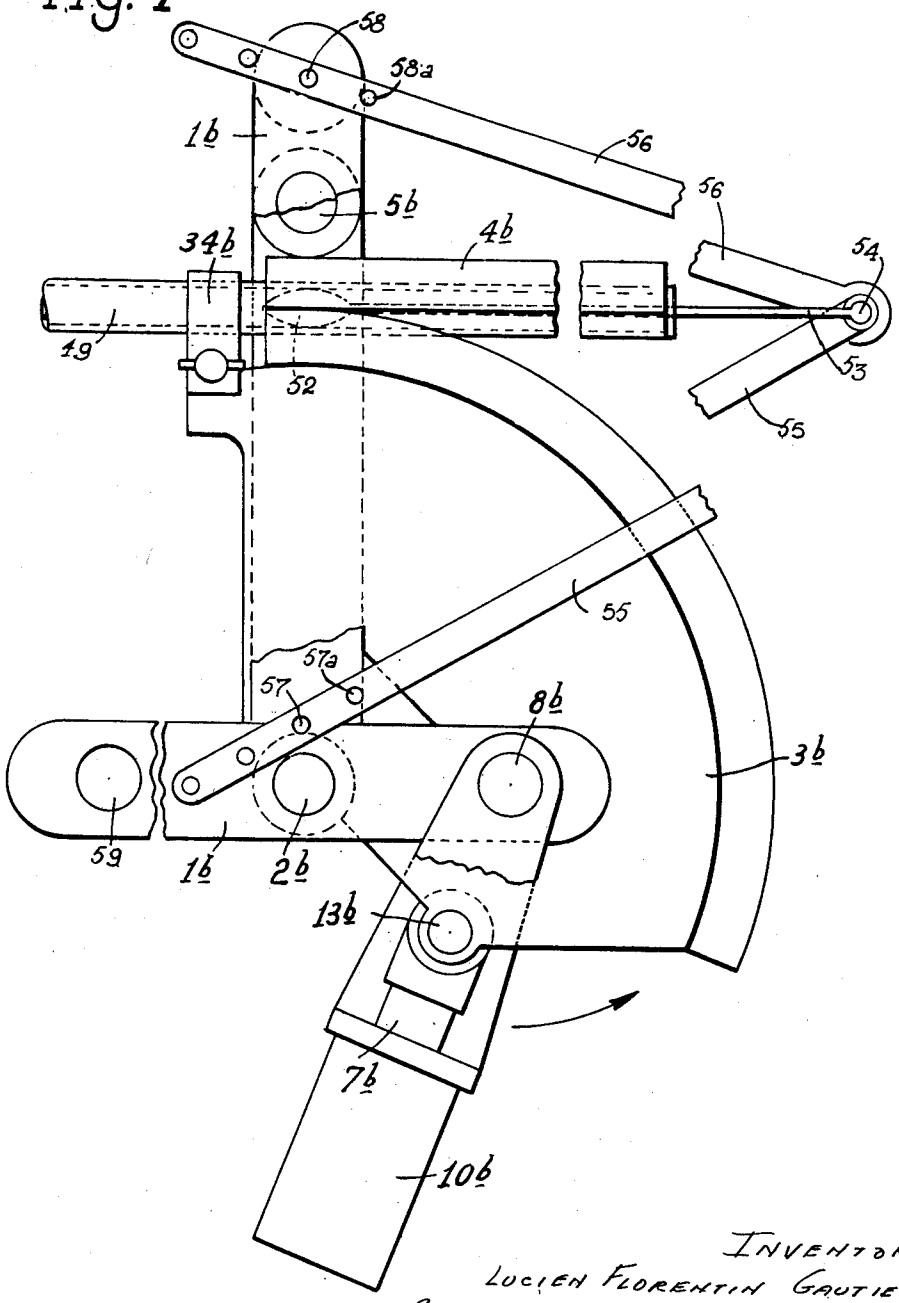


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BENDING MACHINE CHIEFLY FOR BENDING TUBES AND BARS

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Fig. 4



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BENDING MACHINE CHIEFLY FOR BENDING TUBES AND BARS

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Fig. 5

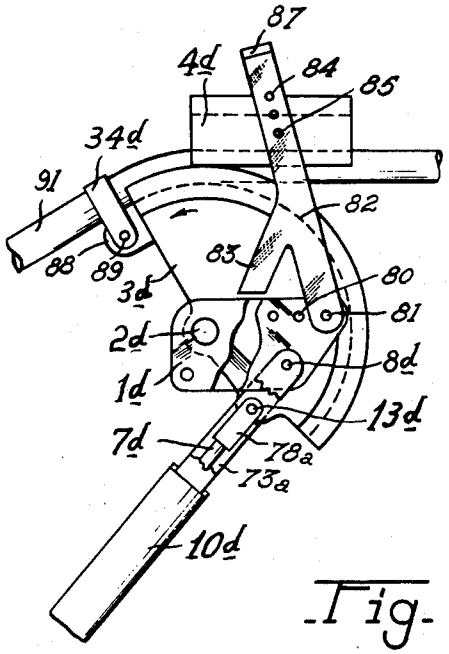


Fig. 6

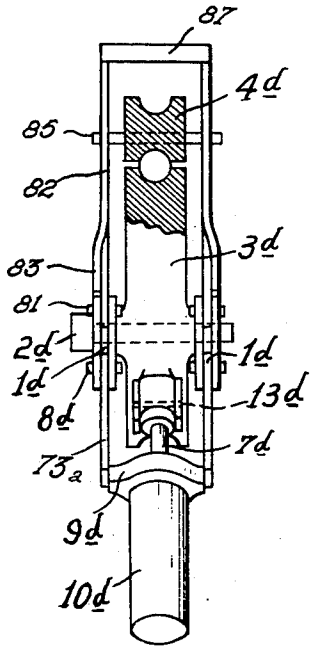


Fig. 7

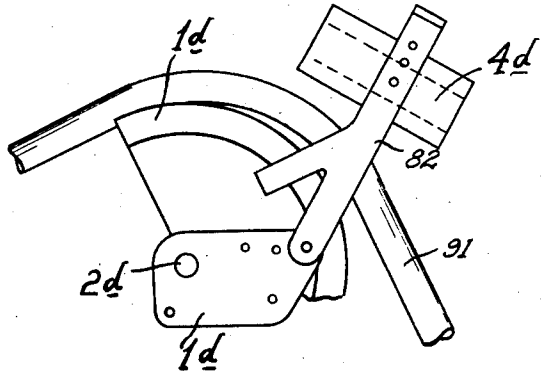


Fig. 8

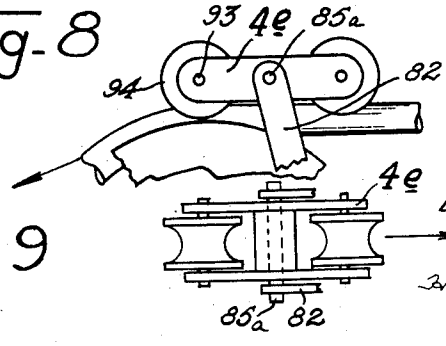


Fig. 9

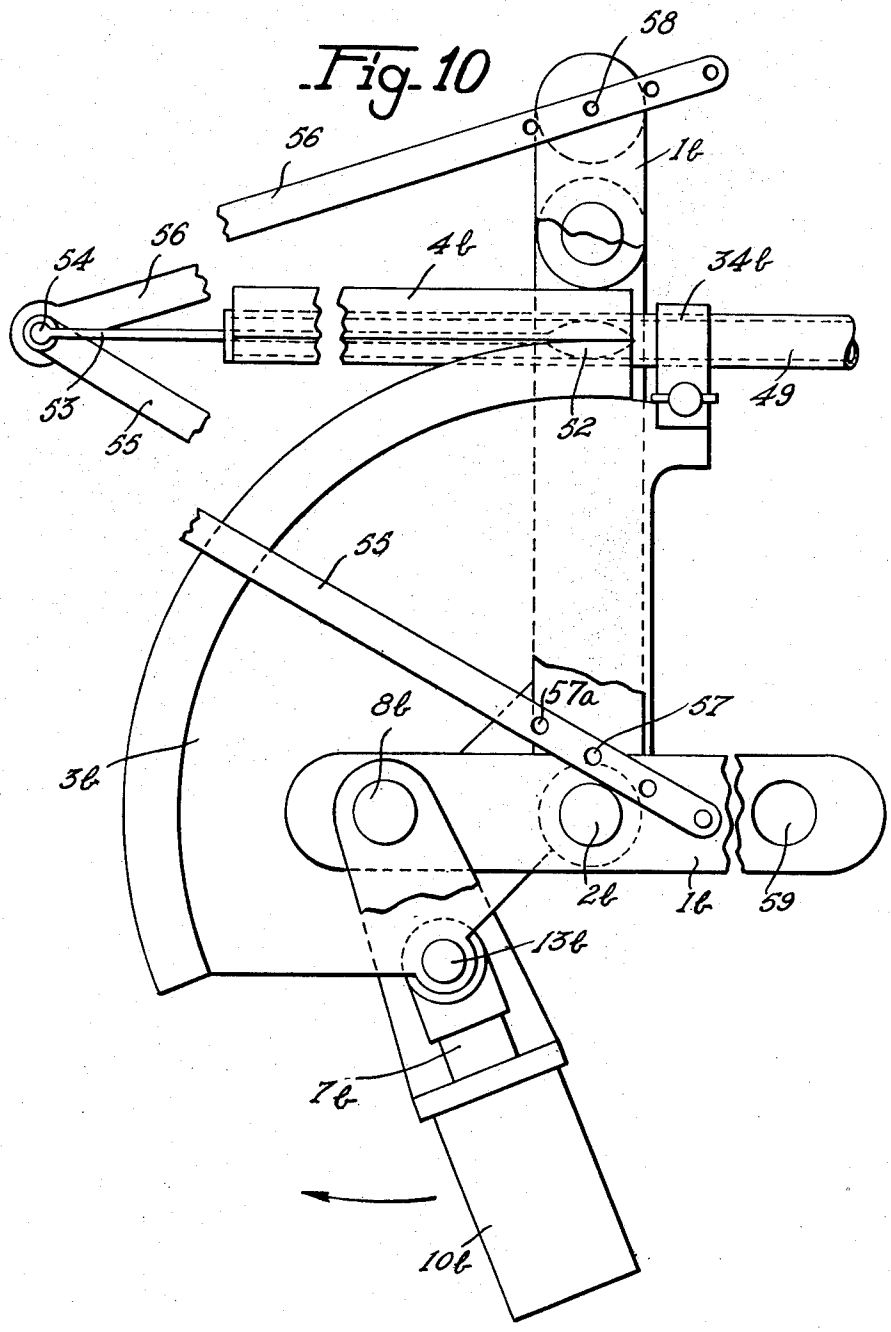
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Fig. 10



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BENDING MACHINE CHIEFLY FOR BENDING TUBES AND BARS

Lucien Florentin Gautier, Paris, France

Application January 4, 1951, Serial No. 204,413

Claims priority, application France January 10, 1950

9 Claims. (Cl. 153—40)

My invention has for its object improvements in bending machines chiefly in machines for bending tubes and bars of the type including a bending member or forming block controlled by a mechanical, hydraulic or the like jack.

My invention has for its object the provision of a bending machine of the type described, wherein the body or the shank of the shaft is pivotally coupled with the forming block which is in turn pivotally mounted on the frame of the bending machine, while the shank or the body of said jack is pivotally coupled with said frame, which allows said jack to assume freely any desired angular direction with reference to said frame and said forming block.

Such a pivotal connection shows the advantage of cutting out any transverse reaction arising in the operative member of the jack during the bending operation performed with bending machines incorporating a forming block pivotally secured to the frame of the machine and over which the bar or tube is wound through a tractional action exerted, during the movement of said forming block, on the end of the part to be bent.

The transverse reaction on the operative member of the jack, the carrier member of which is rigidly connected with the frame of a bending machine of the type defined hereinabove, has a detrimental effect by reason of the consequent wear appearing inside the jack, which wear produces a warping of the jack worm and dulls the threads in the case of a mechanical jack or again the cylinders of a pneumatic hydraulic jack are ovalized through this transverse straining and/or the packings or stuffing boxes thereof may be damaged. Furthermore, this transverse reaction transmitted to the carrier member of the jack assumes such an intensity that there frequently appear breaks in said member.

Lastly, the efficiency of such bending machines is poor.

If the bending machine is of the type wherein the forming block is carried by the free end of the operative member of the jacks, the part to be bent being held fast by two supports located to either side of the point of contact between the forming-block and said part to be bent, the transverse reaction is practically zero. However the connection between the frame of such a bending machine and the member through which the jack bears on said frame will allow a large range of bending operations for various directions of the jack with reference to the frame, the jack turning automatically under the effect of the thrust exerted by the operative member of the jack on the part to be bent, whereby the transverse reaction arising in said opperative member is reduced to a minimum.

It is also of advantage to provide a bending machine frame assuming the shape of a T in order to allow bending operations either in a predetermined direction or in the opposite direction, the ends of the transverse arms of the T including pivotal connections with the jack that may be thus connected selectively with either end.

Lastly, in order to make the operation of such bending machines easier, the frame of the bending machine with reference to which the forming block pivots and that is pivotally connected on one hand with a yoke rigid with the body of the jack, the shank of which includes a yoke pivotally connected with the forming block is, on the other hand, connected also pivotally with the levers holding the guiding device or forming counterblock. Said counterblock is in its turn pivotally secured to the levers holding it.

The frame carries a series of perforations adapted to engage at different points, according to the radius of the forming block, the pivotal axes of said levers. The levers carry in their turn a series of perforations that allow adjusting the position of the counterblock.

The levers include stop members or parts that limit their pivotal movements connecting them with the frame, said stop members or parts bearing through adjustment against the actual frame.

The following description and accompanying drawings given by way of example and by no means in a limiting sense will allow a ready understanding of the manner of executing my invention. In said drawings:

Fig. 1 is a plan view of a bending machine in which the frame is partly torn off, said machine being shown in the starting position before bending a tube.

Fig. 2 is a plan view of the same machine during the bending of the same part.

Fig. 3 is a cross-section through the line III—III of Fig. 1 of a portion of the jack and of the members pivotally connecting the jack with the frame.

Fig. 4 is a plan view of a bending machine, part of which is torn off, said bending machine being provided with an arrangement including a mandrel to be inserted inside the tube.

Fig. 5 is a plan view, partly torn off, of a further bending machine according to the invention.

Fig. 6 is a side view of said bending machine, also partly torn off.

Fig. 7 is a partial plan view of the same machine during the release of the counterblock.

Fig. 8 shows a detail of a modified counterblock arrangement seen sideways.

Fig. 9 is a plan view of the same detail.

Fig. 10 is a modification of the embodiment shown in Fig. 4.

Fig. 11 is a plan view of another embodiment of a bending machine according to the invention.

Fig. 12 is a section of Fig. 11 along the line XII—XII.

Figs. 1 to 3 show a frame of a bending machine formed by two parallel elements 1 defining a space between them and provided with a pivot 2 over which is revolubly carried between said elements a forming block 3 having two flanges 14 and 15 and formed with a peripheral arcuate portion.

The frame elements 1 carry a gutter-shaped guiding device 4 adapted to run transversely by engagement with a roller 5, the spindle 6 of said roller being fitted in corresponding perforations provided in the frame elements 1. The frame elements 1 also carry aligned trunnions 8 and 19 round which may pivot a yoke 9 secured to the body 10 of a jack for pivotally and directly coupling said jack body with the frame. The yoke 9 is mounted on the outside of the frame elements in order to leave as much room as possible free inside the frame body. Bearing collars 17 and 18 provided on the trunnions 8 and 19 serve for holding the trunnions in place through gravity during the movements of said yoke 9. The shank 7 of the jack which moves between the arms of yoke 9, carries at its free end a shaped support 11 operatively engaging and holding a roller 12 that is loosely mounted on a spindle 13 mounted between said two flanges 14 and 15 near two adjacent edges thereof. To the flanges 14 and 15 of the

forming block 3 near the other adjacent edges is rigidly secured through the agency of a screw 16 a clamping collar 34 through which is removably secured the end of an elongated member or of a tube such as 35 to be bent in tangential relationship with the peripheral arcuate portion of the forming block.

The operation is ensured through the thrust exerted by the shank 7 of the jack 10 that transmits said thrust to the flanges 14 and 15 through contact between the shaped support 11 and the roller 12, while the jack 10 rocks in the direction of the arrows in Figs. 1 and 2. The tube 35 to be bent, that is drawn along by the rotation of the clamping collar 34 and of the arcuate forming block assumes the desired shape while the gutter-shaped guiding device 4 the inner wall of which is slidingly engaged by a portion of the lateral surface of said tube 35 is allowed to move along its axis in the direction of progression of the tube 35, said sliding movement of the guiding device 4 being made easier by the roller 5 that exerts a pressure on said gutter-shaped memebr 4, which prevents it from being shifted laterally. It is possible to bend members of various sections along varying radii of curvature through an adjustment of the roller 6 as obtained through a shifting of its carrier spindle selectively into one of the perforations 20 of the frame while resorting to forming blocks 3 having different suitable radii of curvature.

In the case illustrated in Fig. 4, the frame 1*b* of the bending machine is provided with a pivot 2*b* round which pivots a forming block 3*b*. A jack 10*b* is connected through a spindle 8*b* with the frame 1*b*. The shank 7*b* of the jack is connected with the forming block 3*b* through the trunnion 13*b*. A clamping collar 34*b* rigid with the forming block 3*b* encloses a tube 49 guided along the gutter-shaped guide member 4*b* which bears on the roller 5*b* revolubly carried by a pivot adjustably mounted on the frame 1*b*.

A mandrel 52 assuming for instance the shape of an olive is rigid with a rod 53 connected with a pivot 54 to which are pivotally secured furthermore two rigid bars 55 and 56. Said bars are connected with the frame 1*b* respectively through pivots 57 and 58 secured on frame 1*b*. Openings such as 57*a* and 58*a* are provided in the rigid bars 55 and 56 for cooperation with the pivots 57 and 58 with a view to adjust said bars relatively to said pivots and also to frame 1*b*. It is apparent that this arrangement is capable of use with tubes of variable diameters and lengths.

The frame 1*b* of the bending machine illustrated in Fig. 4 assumes the shape of a T, the cross-bar of which is provided with a central bearing carrying the pivot 2*b* of the forming block 3*b* and with two perforations 59 for securing selectively to either side of said central bearing the spindle carrying the free end or yoke of the jack 10*b*, whereby it is possible to proceed with the bending operations through a progression of the part to be bent on the forming block towards the left (Fig. 4) or towards the right (Fig. 10).

As apparent from inspection of Fig. 5, the bending machine includes a frame constituted by a double flange 1*d* carrying the removable pivot 2*d* of the forming block 3*d*. Between the elementary flanges 1*d* may move the arms 73*a* of the yoke 9*d* rigid with the cylinder body 10*d* of the jack. The arms 73*a* of the yoke are connected with the flanges 1*d* through trunnions 8*d* that are also removable. The operative shank 7*d* of the jack carries at its end a yoke 78*a* that is connected through a spindle 13*d* with the forming block 3*d*. Said forming block may, therefore, pivot round the pivot 2*d* with reference to the double flange frame 1*d*.

The flanges forming the frame of the machine include a series of perforations 80 in which may be selectively fitted spindles 81 to which are pivotally secured levers 82 forming stops. Said levers 82 include to this purpose lateral extension 83 that lie angularly with reference to said levers and are adapted to bear against the edge of the double flange frame 1*d*. The levers 82 are provided with series of perforations 84 wherein may be engaged selectively a spindle 85 passing through a bore in the guiding device or counterblock 4*d*. The levers 82 are preferably connected furthermore by a terminal plate 87 that may removably be secured thereto.

The forming block 3*d* is provided with an extension 88 through which passes a spindle 89 that serves for securing a clamping collar 34*d* engaging the part 91 that is being bent and holding it over the forming block.

The stop parts 83 rigid with the levers are located on the side of the levers 82 towards which the latter are urged when the forming block is set into rotation in the direction of the arrow illustrated in Fig. 5 under the action of the jack.

The control lever of the jack cylinder, that is preferably incorporated into the machine body is of a type that is irrelevant, as far as the invention is concerned and neither this lever nor the jack pump is illustrated.

The operation of the apparatus is as follows:

The part 91 to be bent is positioned while it is still rectilinear, over the forming block 3*d* and is held thereon by the collar 34*d*. The counterblock 4*d* is fitted in a suitable location on the other side of the part to be bent, and the jack 10*d* is started operating. The counterblock 4*d* is carried along by the progression of the part 91 and assumes a gradually increasing slope with said progression until the end of the counterblock reaches the bending point. At this moment, the part 91 slides inside the gutter-shaped portion of the counterblock while engaging the outline of the groove in the forming block. If the stresses required for bending the tube added to the frictional stresses due to the sliding in the counterblock rise beyond a predetermined limit, the counterblock may rock round the axis 85 and the levers 82 assume an angular movement that is limited to a maximum value through the engagement of the stop parts 83 against the flanges 1*d*.

The points of attachment between the levers 82 and the counterblock and the flanges are selected in accordance with the size of the bending members and of the parts to be bent and also with the distribution, on one hand, of the stresses exerted at the bending point for holding the counterblock in its cooperating position with reference to the forming block and, on the other hand, of the stresses exerted at a certain distance from said point to provide for the application of the torque required for the bending operation.

As apparent from inspection of Fig. 7, the release of the bent portion of part 91 is made easier through the possibility of rocking rearwardly the system including the levers and counterblock with reference to the flanges.

As apparent from Figs. 8 and 9, the bending counterblock may be constituted by a double yoke 4*e* rockably mounted with reference to the spindle 85*a* that is located in the middle of said double yoke. This double yoke 4*e* carries to either side of the spindle 85*a* pivots 93 revolubly carrying rollers 94, the rims of which assume shapes matching those of the parts to be bent.

Obviously, many modifications may be brought to the above disclosed embodiment without unduly widening thereby the scope of the invention as defined in accompanying claims. In particular, the embodiment of a bending machine according to the invention shown in Figs. 11 and 12 comprises a yoke 9*g* of the body 10*g* of the jack which is pivotally secured at 8*g* to the forming block 3*g*, the shank 7*g* of the jack being pivotally secured with the ends thereof to the frame 1*g* of the machine by means of a pivot 13*g*. The forming block 3*g* is pivotally connected by a trunnion 2*g* with the frame 1*g* so that two flanges of the forming block 3*g* are separated from one another by a gap in which moves the piece 11*g* rigidly connected with the shank 7*g* of the jack. A clamp 34*g* pivotally connected with the leading edge of the forming block 3*g* bends the pipe having a main portion held between the curved perimeter of

the forming block 3g and a counterblock 4g. The axle 6g of a counterroller 5g is inserted in holes such as 20g provided in the frame 1g so as to make the counterroller to slide on the counterblock 4g.

What I claim is:

1. In a bending machine for elongated parts of the type comprising guiding device connected to the frame of the machine and engaging the elongated part to be bent in cooperation with a forming block pivotally mounted on said frame, said block being formed with a peripheral arcuate part receiving portion and on which a portion of the elongated part is tangentially and removably secured, said elongated part being bent by rolling on said forming block under the action of a jack carried by the frame and coupled with said pivotable forming block; the improvement which comprises a stationary frame formed by two parallel elements defining a space between them, said forming block having two flanges which are pivotally mounted on the frame of the machine for pivoting between said elements, a spindle mounted between said two flanges near two adjacent edges thereof, the elongated member to be bent being secured on the forming block near the other adjacent edges of the two flanges, a jack comprising a body and an operative member, a yoke carried by the body of the jack and between the arms of which moves the operative member of said jack, trunnions pivotally and directly coupling said yoke with the two elements of the frame respectively, a roller pivotally mounted on said spindle, and a shaped support operatively engaging said roller and carried by the other part of the jack for actuating and controlling the pivoting movement of the forming block to constrain the same to rock round its pivoting axis to roll the elongated member thereon.

2. In a bending machine as claimed in claim 1, said frame being T-shaped, the crossbar of which is formed with a central and two terminal perforations, a first spindle mounted through said central perforation, said forming block being pivotally mounted on said first spindle, a second spindle mounted through one of said terminal perforations, and a jack comprising a body and an operative member forming its component parts one of which is pivotally and directly mounted on said second spindle while the other is pivotally coupled with the forming block for actuating and controlling the pivoting movement of the latter to roll the elongated member on said forming block when pivoted, whereby, by placing the second spindle through either one or the other of said terminal perforations, the part to be bent is submitted to a progression towards opposite directions.

3. In a bending machine for elongated parts of the type comprising guiding device connected to the frame of the machine and engaging the elongated part to be bent in cooperation with a forming block pivotally mounted on said frame, said block being formed with a peripheral arcuate part receiving portion and on which a portion of the elongated part is tangentially and removably secured, said elongated part being bent by rolling on said forming block under the action of a jack carried by the frame and coupled with said pivotable forming block; the improvement which comprises said forming block being pivotally mounted on the frame of the machine, and a jack comprising a body and an operative member forming its component parts one of which is pivotally and directly coupled with the frame while the other is pivotally coupled with the forming block for actuating and controlling the pivoting movement of the latter to roll the elongated member on said forming block when pivoted, the axes of the two pivotal couplings of said component parts on the frame and on the forming block, respectively, being located inside the circumference which extends the peripheral arcuate portion of the forming block.

4. A bending machine, according to claim 3, wherein said axes of the pivotal couplings of the component parts

of the jack on the frame and on the forming block, respectively, are located on a common circumference centered on the pivotal point of the forming block.

5. In a bending machine for elongated parts of the type comprising guiding device connected to the frame of the machine and engaging the elongated part to be bent in cooperation with a forming block pivotally mounted on said frame, said block being formed with a peripheral arcuate part receiving portion and on which a portion of the elongated part is tangentially and removably secured, said elongated part being bent by rolling on said forming block under the action of a jack carried by the frame and coupled with said pivotable forming block; the improvement which comprises a stationary frame formed by two parallel elements defining a space between them, said forming block having two flanges which are pivotally mounted on the frame of the machine for pivoting between said elements, a spindle mounted between said two flanges near two adjacent edges thereof, the elongated member to be bent being secured on the forming block near the other adjacent edges of the two flanges, a jack comprising a body and an operative member, a yoke carried by the body of the jack and between the arms of which moves the operative member of said jack, trunnions pivotally coupling said yoke with the two elements of the frame respectively, a roller pivotally and directly mounted on said spindle, and a shaped support operatively engaging said roller and carried by the other part of the jack for actuating and controlling the pivoting movement of the forming block to constrain the same to rock round its pivoting axis to roll the elongated member thereon, the axes of the two pivotal couplings of the yoke on the frame and of the roller on the forming block being located inside the circumference which extends the peripheral arcuate portion of the forming block.

6. In a bending machine as claimed in claim 3, said forming block being pivotally mounted on the frame of the machine, a jack comprising a body and an operative member forming its component parts one of which is pivotally and directly coupled with the frame while the other is pivotally coupled with the forming block for actuating and controlling the pivoting movement of the latter to roll the elongated member on said forming block when pivoted, a guiding device, and means for connecting the guiding device to the frame, said connecting means comprising at least one lever pivotally carrying said guiding device, each lever being pivotally mounted on the frame at a point located with respect to the pivotal axis of the forming block in a direction opposite to that of the bending stress, whereby on the one hand, said guiding device may rock round its pivotal axis on each lever and the latter round its pivotal axis on the frame when the bending stress rises beyond a predetermined limit and, on the other hand, the release of the part formed with a bent portion is made easier through a rocking movement of each lever in reverse direction.

7. A bending machine, according to claim 6, wherein the guiding device comprises a body formed with a yoke at least at one end thereof and a roller pivotally mounted in each yoke for engaging the elongated part to be bent.

8. In a bending machine as claimed in claim 3, said forming block being pivotally mounted on the frame of the machine, a jack comprising a body and an operative member forming its component parts one of which is pivotally and directly coupled with the frame while the other is pivotally coupled with the forming block for actuating and controlling the pivoting movement of the latter to roll the elongated member on said forming block when pivoted, a guiding device, and means for connecting the guiding device to the frame, said connecting means comprising at least one lever pivotally carrying said guiding device, each lever being pivotally mounted on the frame at a point located with respect to the pivotal axis of the forming block in a direction opposite to that of

the bending stress, whereby on the one hand, said guiding device may rock round its pivotal axis on each lever and the latter round its pivotal axis on the frame when the bending stress rises beyond a predetermined limit and, on the other hand, the release of the part formed with a bent portion is made easier through a rocking movement of each lever in reverse direction, the pivotal axes of said guiding device and of each lever being selectively determined on each lever and on the frame, respectively, according to the size of the forming block, the guiding device and the part to be bent.

9. In a bending machine as claimed in claim 3, said forming block being pivotally mounted on the frame of the machine, a jack comprising a body and an operative member forming its component parts one of which is pivotally and directly coupled with the frame while the other is pivotally coupled with the forming block for actuating and controlling the pivoting movement of the latter to roll the elongated member on said forming block when pivoted, a guiding device, and means for connecting the guiding device to the frame, said connecting means comprising at least one lever pivotally carrying said guiding device, each lever being pivotally mounted on the frame at a point located with respect to the pivotal axis of the forming block in a direction opposite to that of the bending stress, whereby on the one hand, said guiding device may rock round its pivotal axis on each lever and the latter round its pivotal axis on the frame when the bending stress rises beyond a predetermined limit and, on the other hand, the release of the part formed with a bent portion is made easier through a rocking movement of each lever in reverse direction, and a stop member rigid with each lever and located on the side of said lever towards which the latter is urged when the forming block is set into rotation for performing a bending operation, said stop being adapted to bear against the frame for limiting the rocking movement of said lever.

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