Aug. 8, 1961 C. HÄUSLER 2,995,171

MACHINE FOR BENDING METAL PLATES

Filed Dec. 3, 1957 4 Sheets-Sheet 1

Fig. 1

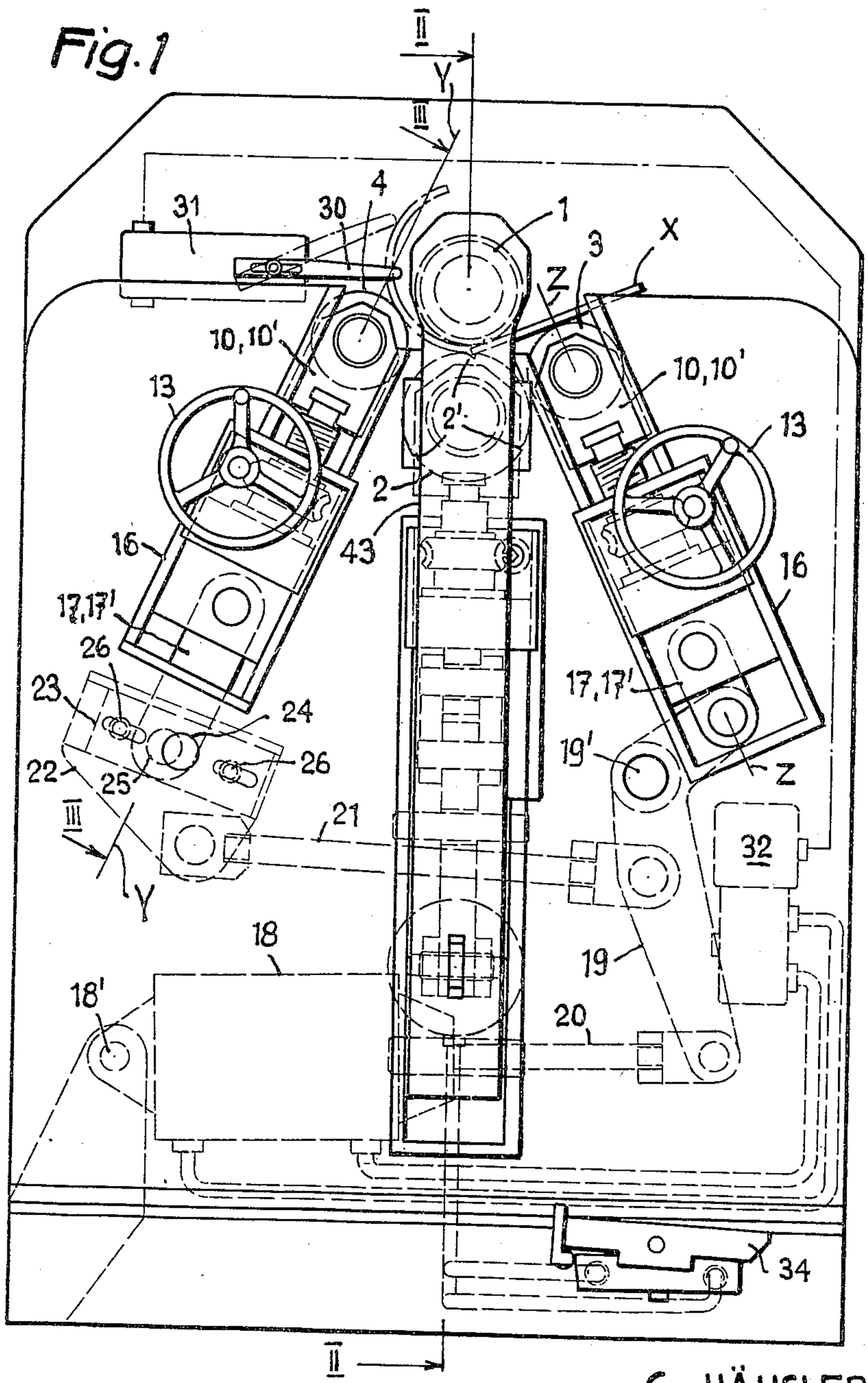

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Fig. 2

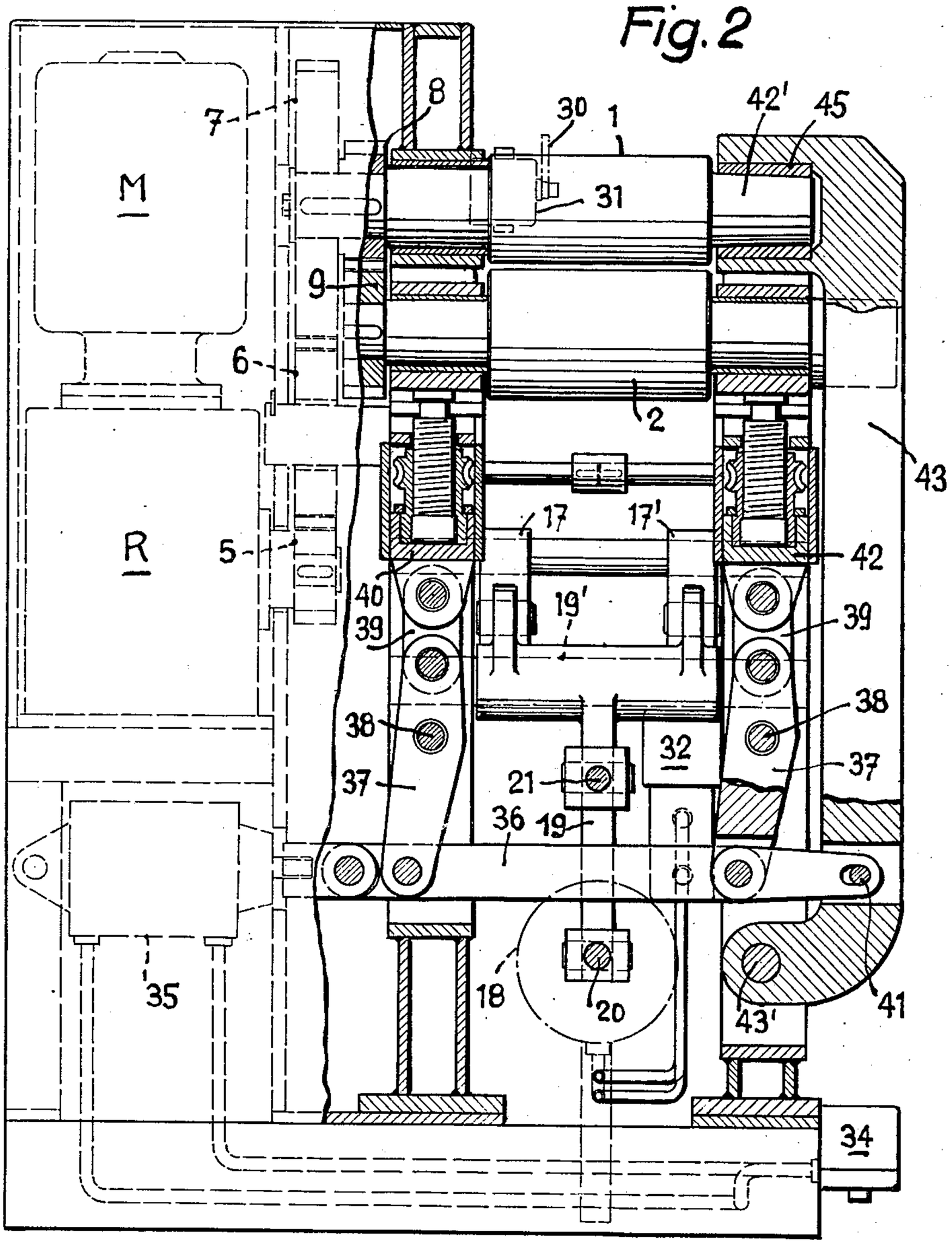

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Fig. 3

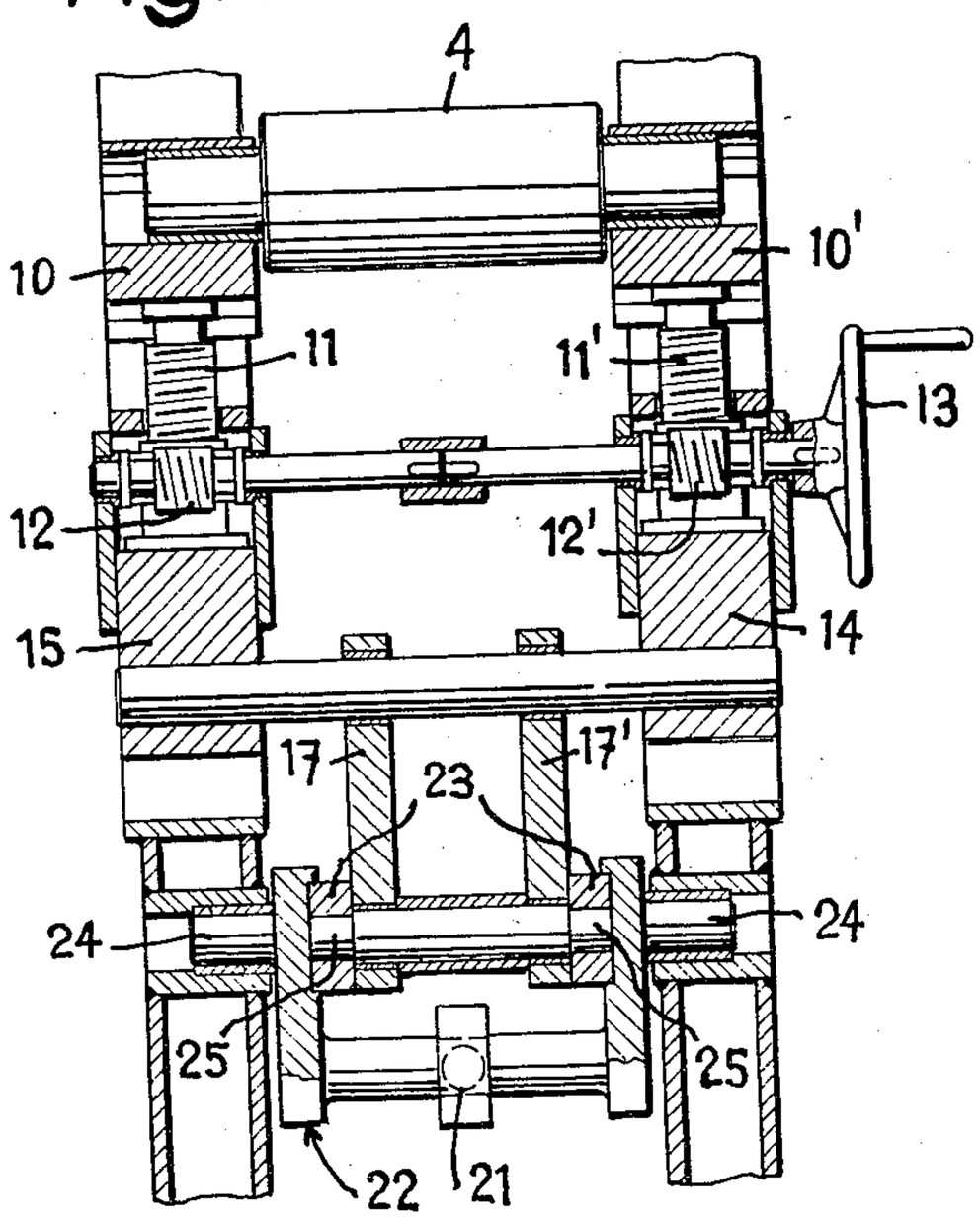

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Fig. 4

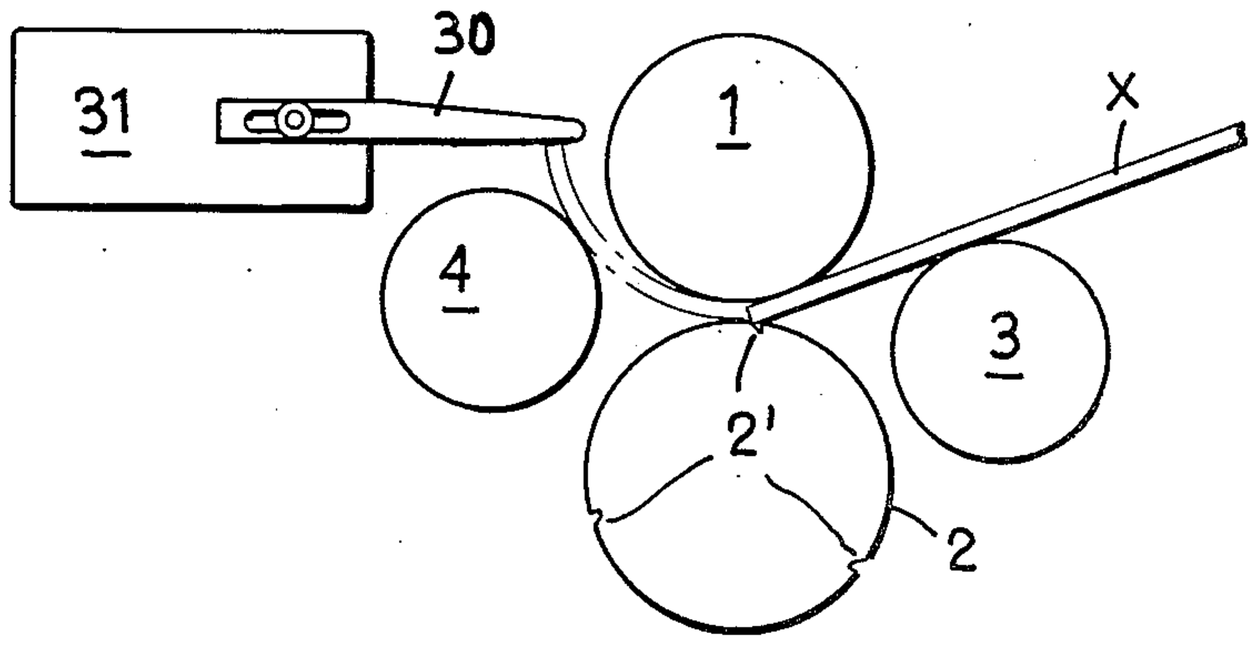
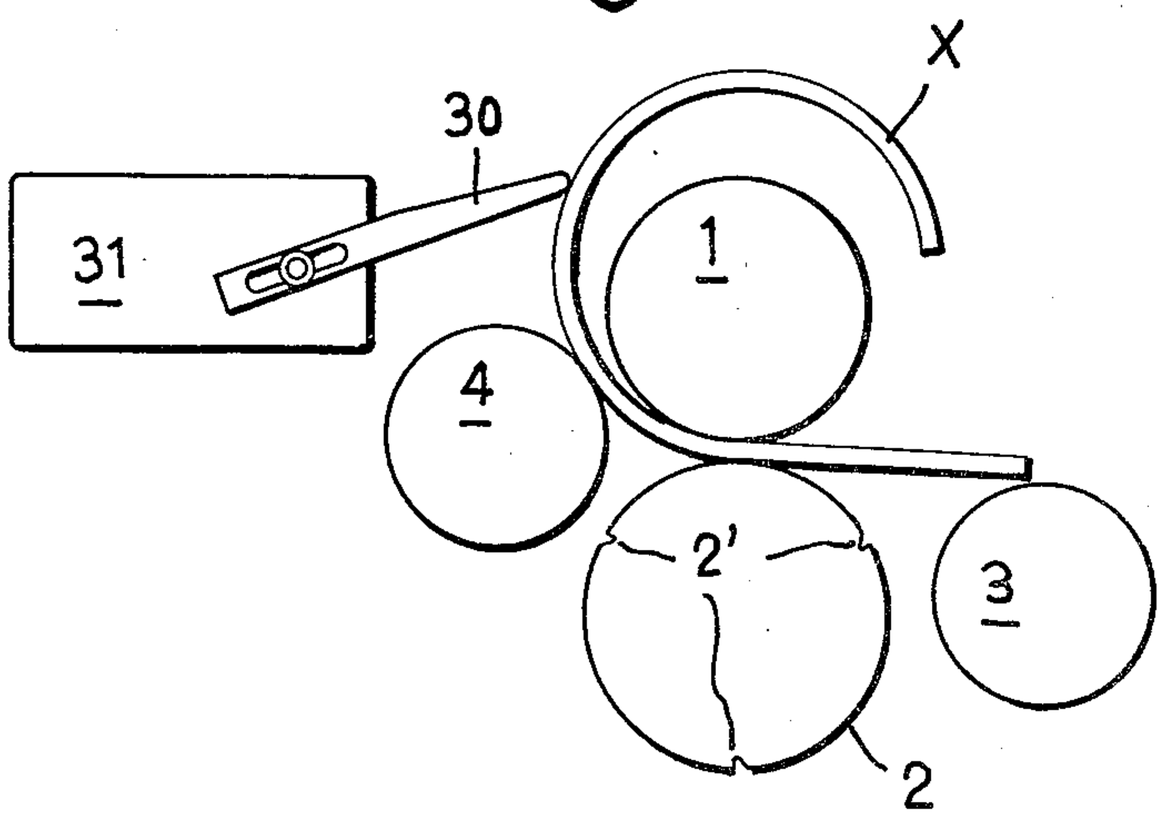


Fig. 5



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MACHINE FOR BENDING METAL PLATES

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4 Claims. (Cl. 153—54)

The present application is a continuation in part of my prior specification Serial No. 617,027 filed on October 19, 1956, now abandoned, and has for its object improvements in machines for bending metal sheets.

Machines are already known for bending metal sheets or plates into cylindrical or annular shapes; such machines executing a plurality of operations on each metal sheet can be controlled only by skilled workers with a considerable expenditure of time. It is therefore impossible to obtain a mass production of cylindrical or annular parts of a given diameter with such previously known machines.

It is an object of my invention to provide a bending machine adapted to automatically produce cylindrical and annular shapes with a large throughput without any skilled labor being required.

According to a primary feature of my invention, said machine includes a driven main roll carried in stationary bearings, and round which the sheet or plate to be bent is rolled, an adjustable pressure roll adapted to cooperate with said main roll and driven in synchronism with the latter and finally two rotary bending rolls located to either side of the first pair constituted by the main and pressure rolls, said bending rolls being carried in journal bearings slidingly carried by guiding members directed obliquely towards the first pair of cooperating rolls and controlled simultaneously by a pivotal link arrangement actuated automatically for each bending operation.

Said pivotal link system is advantageously controlled by a preferably hydraulic power unit, the operation of which is controlled by a sensing lever engaged by the forward edge of the sheet or plate which is being bent at the beginning of the bending operation. The sensing lever is returned into its starting position at the end of each bending operation by the leading edge of said sheet or plate, so as to make the pivotal link system return the bending rolls into their starting position. Thus, as soon as said bending operation has been initiated to a slight extent, the bending roll on the feed side is shifted towards the main roll and, simultaneously, the bending roll on the output side of the two first-mentioned rolls is shifted forwardly, so as to exercise the desired bending pressure on the piece of work to be bent.

I have illustrated diagrammatically in the accompanying drawings a preferred embodiment of my invention, which embodiment should, of course, not be construed in a limiting sense. In said drawings:

FIG. 1 is a side elevational view of my improved machine.

FIG. 2 is a cross-sectional view through line II—II of FIG. 1 showing the means for adjusting the vertical location of the pressure roll.

FIG. 3 is a cross-sectional view through line III—III of FIG. 1 showing the detail of the means adjusting the location of the bending roll.

FIGS. 4 and 5 are two diagrammatic showings of two stages of the operation.

Turning to FIG. 1, it is apparent that the sheet to be bent X is fed between the two rolls **1** and **2**. The main roll **1** is carried in stationary bearings so as to revolve round a stationary axis. The roll **2** extending underneath the roll **1** forms a pressure roll provided with a number of longitudinal notches **2'** and its periphery and

fitted at an adjustable vertical location with reference to the upper roll **1**, as will be disclosed hereinafter with reference to FIG. 2.

The sheet-clamping rolls **1** and **2** are associated with two bending rolls **3** and **4** located to either side of the gap between the two superposed rolls **1** and **2**. Said bending rolls are advantageously driven in synchronism with the rolls **1** and **2** by a prime mover M and speed reducer R. Said speed reducer controls the gear **5** controlling in its turn two gears **6** of which only one is shown in FIG. 2 and which drive the corresponding bending rolls **3** and **4** at least when in their operative position for which the bending roll and gear **6** coaxially rigid therewith are urged towards the main roll **1**.

Lastly, the operative gear **6** engages the gear **7** driving the upper main roll **1** which in its turn drives, through the interengaging gears **8** and **9**, the vertically shiftable lower roll **2**, the slight vertical shifting of which cuts out the interengagement between the teeth of said gears **8** and **9**.

The bending rolls are shiftable along lines shown at YY and ZZ respectively in FIG. 1 together with the corresponding gears **6**, so as to be selectively brought into their operative position.

I will now describe the means for adjusting the position of the roll **4** along said line YY, the corresponding means for the roll **3** being obviously identical.

As shown in FIG. 3, the journal bearings **10** and **10'** in which are revolubly fitted the terminal stub shafts of the roll **4** (FIG. 3) are subjected to the longitudinal movement of the threaded spindles **11** and **11'** which latter are controlled by corresponding worm gears of which the worms **12** and **12'** are rigid with a common shaft controlled by the handwheel **13**. The rotation of said handwheel and of its shaft revolubly carried in the slider **14, 15** provides for the simultaneous longitudinal adjustment of the journal bearing **10** and **10'** in the said slider **14, 15**. This slider **14, 15** may be shifted inside a stationary casing **16** (FIG. 1) by links such as **17** and **17'** controlled simultaneously by a pivotal link system controlled in its turn by the hydraulic power unit **18**, the cylinder of which is pivotally secured to the frame at **18'**. Said pivotal link system which is common to both rolls **3** and **4** includes a bell crank **19** rocking round a stationary pivot **19'** and pivotally connecting the rod **20** of the hydraulic piston of the hydraulic power unit with the links **17** and **17'** corresponding to the bending rolls **3** the larger arm of said bell crank controlling furthermore through the link **21** the links **17** and **17'** shifting the bending roll **4**. To this end, the link **21** is pivotally connected with a two part shoe **22** rocking round a stationary pivot **24** and a slider **23** is adjustably fitted between the two parts of the shoe in a direction defined by the line showing the upper surface of the shoe in FIG. 1; said slider pivoting with the shoe under the action of the system **20, 19, 21** controls directly the corresponding pivotal links **17** and **17'** which are attached thereto through the pivot **25** rigid with the slider **23**, on a line passing through the stationary pivot **24** and parallel with the direction of adjustment of the slider; thus, the lever system constituted by the part of the slider extending between the pivots **24, 25** and by the links **17, 17'** may be adjusted through a shifting of the pivot **25** on the slider **23** over the shoe **22**. The slider may be secured in its adjusted position over the shoe by screwing down nuts over the bolts **26** engaging, through longitudinal slots in the slider **23**, tapped openings in the shoe.

Now, if the hydraulic power unit **18** is operated, this will shift the two links **17, 17'** corresponding to either bending rolls in opposite directions by relative amounts depending on the lever ratio, as adjusted by the location of the pivot **25**. The bending operation provided by such

a shifting of the bending rolls will be disclosed hereinafter.

The hydraulic power unit **18** is controlled by an electromagnetically controlled valve **32** having a winding which is energized by an electric circuit passing through a switch **31**. The switch **31** is controlled by a sensing lever **30**, so that the closing of said switch connects the winding of the valve **32** to the electric circuit, thus controlling the hydraulic power unit. The feeler **30** is controlled, as a matter of fact, by the leading edge of the sheet or plate which is being bent at the moment at which it extends beyond the gap between the rolls **1** and **2**, so as to engage at the beginning of the bending operation said feeler **30**. The latter is thus shifted upwardly, so as to energize the valve **32**. The piston of the hydraulic power unit is then shifted towards the left-hand side of FIG. 1, so that the bending rolls are shifted through the agency of the pivotal link system which has just been described in a manner such that the roll **3** is lowered and the roll **4** is raised; when the bending operation is at an end, the hydraulic circuit is closed mechanically through depression of the foot-operated valve **34**, and the hydraulic piston returns into its right-hand position illustrated in FIG. 1 and corresponding to the starting position of the rolls **3** and **4**. This alternation of the operation of the rollers **3** and **4** is important, since the roller **3** serves only for the actual engagement of the leading edge of the metal sheet and there is a change over to engagement by the bending roller **4** without any stopping in the rotation of the machine or any transient stoppage in the application of the pressure for the following purpose: for a good operation, either of the three roller-groups **1, 2, 3** or **1, 2, 4** should be used at a time. The actual bending is performed by the roller **4** when the sheet-introducing roller **3** has just been retracted so as not to interfere in said bending operation.

When the bending operation is at an end, the second hydraulic power unit **35** (FIG. 2) should also be actuated, so that the piston in the latter may be shifted towards the right hand side of FIG. 2 and shift, along with it, the bar **36** to which are pivotally connected two levers **37** pivoting round the pivotal axes **38**, so as to control through the links **39** the vertically sliding support **40** for the lower or pressure roll **2**. When the bar **36** is thus shifted towards the right-hand side the control levers **37** are constrained to rock round their axes, whereby the lower pressure roll **2** is slightly shifted downwardly by a few millimeters away from the main roll **1**.

Thus, the plate or sheet to be bent over the periphery of the main roll **1** is released and may be removed from said roll **1**. To allow a longitudinal removal of the bent part of the main roll **2**, the latter is fitted in a normally stationary support **43** adapted to rock transiently round a pivot **43'**, so as to release the upper roll **1**; the normally stationary rockable support **43** is fitted through a stud and slot connection **41** on the horizontal bar **36**, so as to allow a lost motion of the latter. Thus, the bar **36** may execute an idle progression during the lowering of the pressure roll **2** and thenafter provide for a rocking of the arm **43** towards the right-hand side, so that the bent part may be now removed readily off the roll **1**. This is made easier through the frusto-conical stub axle **42'** terminating the roll **1** for engagement inside the bronze ring **45** fitted in the arm **43**.

It should be remarked that the lower roll **2** is vertically slidable inside the support **43** and that its normal location is adjustable by means of screws in a manner entirely similar to the arrangement disclosed for the adjustment of the rolls **3** and **4**.

Operation of the arrangement will be readily understood through inspection of FIGS. 4 and 5.

In the position of the part to be bent X prior to operation which position is drawn in solid lines, the front bending roll **3** is in its forward position nearest the main rolls **1** and **2**, while the bending roll **4** is slightly retracted.

The leading edge of the plate or sheet X to be bent is fed into the gap between the main roll **1** and the pressure roll **2** and engages one of the longitudinal notches **2'** of the pressure roll **2**, while it is urged against the upper main roll **1** by the roll **3**. Immediately thereupon and after a short angular shifting of the rolls, the part X is subjected to a bending pressure by the bending roll **3** and is drawn along by the rolls **1** and **2** so that its leading edge progresses beyond the roll **1**, as shown in dot-and-dash lines in FIG. 4. This leading edge will then switch the sensing lever **30** into its switch-closing position so that the control valve **32** will open. The hydraulic power unit **18** provides then for a retraction of the piston rod **20** and for a pivotal movement of the bell crank **19** in a clockwise direction round its pivot **19'**. Thus, the two journal bearings **10, 10'** corresponding to the bending roll **3** are urged slightly away from the rolls **1** and **2** (FIG. 5), while those corresponding to the bending roll **4** are urged towards said rolls **1** and **2**. Thus, the roll **3** is urged towards its tangential feeding position with reference to the rolls **1** and **2**. The roll **4** is caused to progress by an amount less than the retraction of the roll **3** by an amount which may vary within predetermined limits through adjustment of the position of the slider **23** on the shoe **22**. Comparison between FIGS. 4 and 5 will thus show that the bending pressure is exerted on the part X by the roll **3** at the beginning of the bending operation and thenafter, as soon as the initial bend has been given to the front section of said part X, by the roll **4**, the leading edge of the part X having acted then on the sensing lever located beyond said roll **4**. When the part X has been bent so as to engage the complete periphery of the main roll **1**, the drive of the roll is stopped by hand or automatically in the case where suitable control means are provided. At this moment, the pressure roll is slightly shifted downwardly, as disclosed, so as to allow the part X bent into cylindrical shape to be removed from the roll **1** after a pivotal movement of the bearing member **43**.

A spring acting on the sensing lever **30** returns then the latter into its starting position and the hydraulic power unit **18** is actuated in the reverse direction and causes the pivotal link system to return from the position illustrated in FIGS. 1 and 4 to that corresponding to FIG. 5.

What I claim is:

1. In a machine for bending metal sheets into cylindrical and annular shapes, the combination of a main cylinder, a pressure cylinder defining a narrow operative gap with the main cylinder, an auxiliary roll located on the input side of the gap, a bending roll on the output side of said gap, journal bearings for each of said rolls, means guiding the journal bearings radially of the corresponding rolls along corresponding lines slightly sloping with reference to the plane passing through the axes of the first-mentioned cylinders, means simultaneously rotating the cylinders and the rolls, a power unit, a pivotal link system operatively connecting said power unit with the journal bearings to shift the latter along their inclined guiding means to move the rolls selectively to an operative position with reference to the gap and a slightly retracted position with reference thereto, each roll being in its operative position when the other is in its slightly retracted position, the introduction of the metal sheet over the input roll when it is in the operative position and between the two cylinders producing a preliminary bending of the front section of said sheet, and means engaged by the front edge of said sheet upon said preliminary bending and connected to said power unit for starting operation of the power unit to move the output roll to its operative position and urge the sheet to be bent, as it progresses beyond said gap, towards the periphery of the main cylinder and to simultaneously retract the input roll to the retracted position to release the sheet which is then being bent by the output roll.

2. In a machine for bending metal sheets into cylindrical and annular shapes, the combination of a main cylinder, a pressure cylinder defining a narrow operative gap with the main cylinder, an auxiliary roll located on the input side of the gap, a bending roll on the output side of said gap, journal bearings for each of said rolls, means guiding the journal bearings radially of the corresponding rolls along corresponding lines slightly sloping with reference to the plane passing through the axes of the first-mentioned cylinders, means simultaneously driving the cylinders and the rolls, a hydraulic power unit, a pivotal link system operatively connecting said power unit with the journal bearings to shift the latter along their inclined guiding means to move the rolls selectively to an operative position with reference to the gap and a slightly retracted position with reference thereto, each roll being in its operative position when the other is in its slightly retracted position, the introduction of the metal sheet over the input roll when it is in the operative position and between the two cylinders producing a preliminary bending of the front section of said sheet, a sensing lever located beyond the output roll in the path of the sheet and connected to said power unit and adapted to be engaged by the front edge of said sheet upon said preliminary bending for starting operation of the power unit to move the output roll to its operative position and urge the sheet to be bent, as it progresses beyond said gap, towards the periphery of the main cylinder, and to simultaneously retract the input roll to the retracted position to release the sheet which is then being bent by the output roll, an electromagnetic valve controlling the operation of the power unit, a circuit energizing the valve, a switch in said circuit controlled by said sensing lever and a spring urging the sensing lever back into its starting position when no longer engaged by the sheet to be bent.

3. In a machine for bending metal sheets into cylindrical and annular shapes, the combination of a main cylinder, a pressure cylinder defining a narrow operative gap with the main cylinder, an auxiliary roll located on the input side of the gap, a bending roll on the output side of said gap, journal bearings for each of said rolls, means guiding the journal bearings radially of the corresponding roll along corresponding lines slightly sloping with reference to the plane passing through the axes of the first-mentioned cylinders, means simultaneously driving the cylinders and the rolls, a bell crank pivoting around a stationary point, two pairs of links connected to and pivotally controlling the position of the journal bearings, the links corresponding to the journal bearings for the input roll being pivotally secured to the shorter arm of the bell crank, a further link pivoted to a point along the length of the longer arm of the bell crank, a shoe pivoting around a stationary axis to which shoe said further link is pivoted, a transverse spindle connecting the outer ends of the second pair of links, a slider longitudinally adjustable along the transverse surface of the shoe and forming a bearing for said spindle, a power unit connected to the outer end of the longer arm of the bell crank to shift the journal bearings along their inclined guiding means to move the rolls selectively to an operative position with reference to the gap and a slightly retracted position with reference thereto, each roll being in its operative position when the other is in its slightly retracted position, the introduction of the metal sheet over the input roll when it is in the operative position and between the two cylinders producing a preliminary bending of the front section of said sheet, and means engaged by the front edge of said sheet upon said preliminary bending connected to said power unit for starting operation of the power unit to move the output roll to its operative position and urge the sheet to be bent, as it progresses beyond said gap, towards the periphery of the main cylinder, and to simultaneously retract the input roll to the retracted position to release the sheet which is then being bent by the output roll.

4. In a machine for bending metal sheets into cylindrical and annular shapes, the combination of a main cylinder, a pressure cylinder defining a narrow operative gap with the main cylinder, means for shifting the pressure cylinder away from the main cylinder and including a pressure cylinder shifting power unit and an adjustable lever system operatively connecting said pressure cylinder shifting power unit with the two ends of the pressure cylinder, an auxiliary roll located on the input side of the gap, a bending roll on the output side of said gap, journal bearings for each of said rolls, means guiding the journal bearings radially of the corresponding rolls along corresponding lines slightly sloping with reference to the plane passing through the axes of the first-mentioned cylinders, means simultaneously rotating the cylinders and the rolls, a roll shifting power unit, a pivotal link system operatively connecting said roll shifting power unit with the journal bearings to shift the latter along their inclined guiding means to move the rolls selectively to an operative position with reference to the gap and a slightly retracted position with reference thereto, each roll being in its operative position when the other is in its slightly retracted position, the introduction of the metal sheet over the input roll when it is in the operative position and between the two cylinders producing preliminary bending of the front section of said sheet, and means engaged by the front edge of said sheet upon said preliminary bending and connected to said power unit for starting operation of the roll shifting power unit to move the output roll to its operative position and urge the sheet to be bent, as it progresses beyond said gap, towards the periphery of the main cylinder, and to simultaneously retract the input roll to the retracted position to release the sheet which is then being bent by the output roll.

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