Feb. 23, 1971 R. HERBURG 3,564,889

PYRAMID ROLL BENDING MACHINE FOR FORMING SHEET METAL

Filed Aug. 30, 1968 3 Sheets-Sheet 1

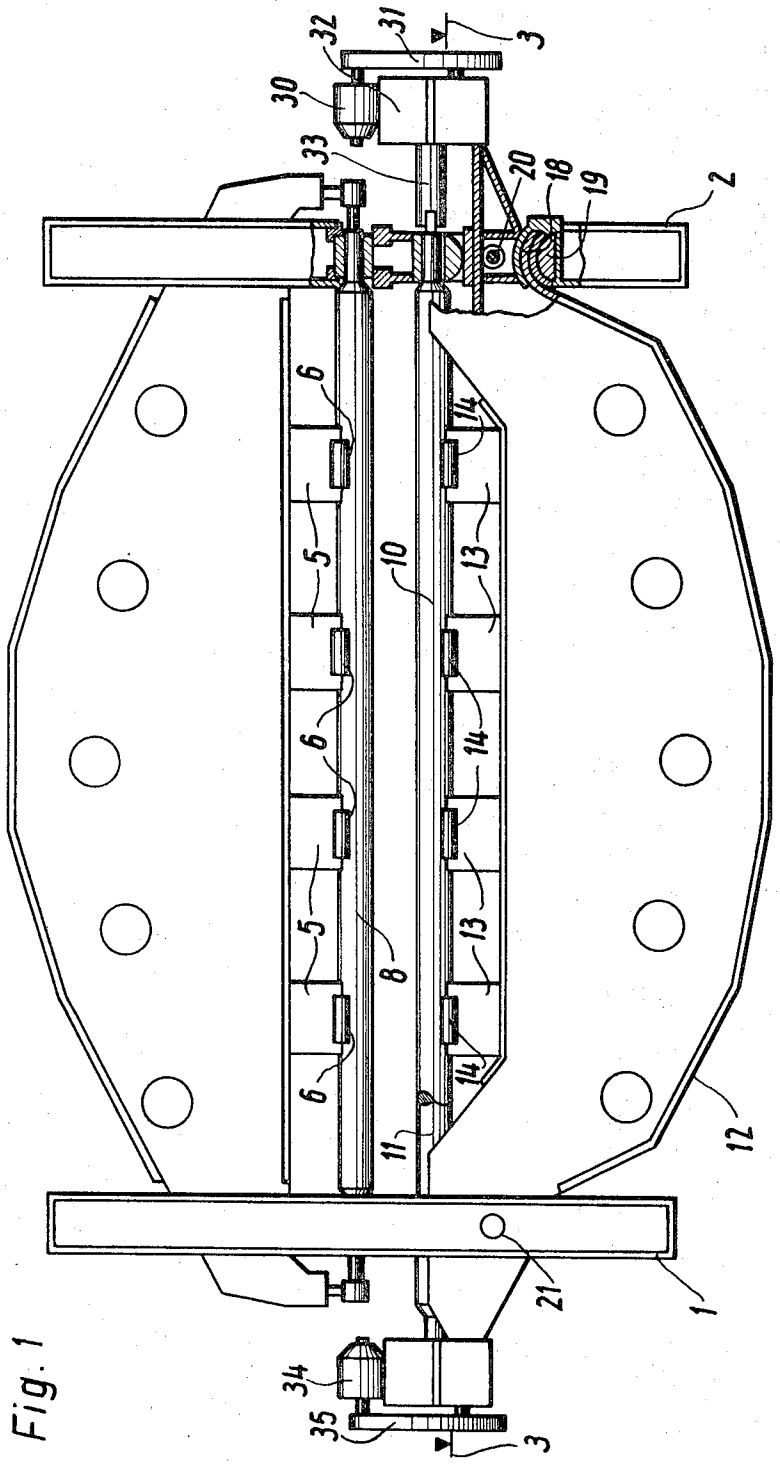


Fig. 1

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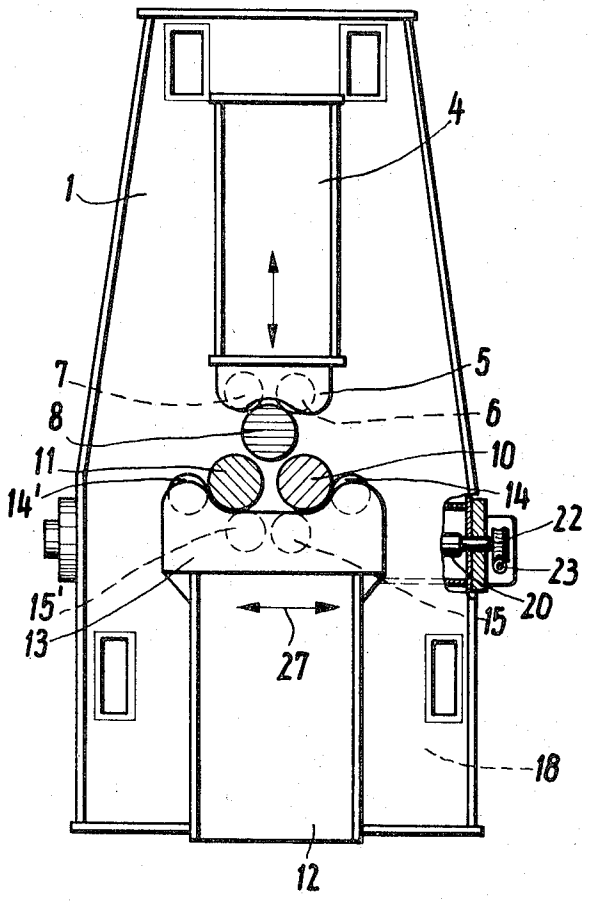
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Filed Aug. 30, 1968 3 Sheets-Sheet 2

Fig. 2



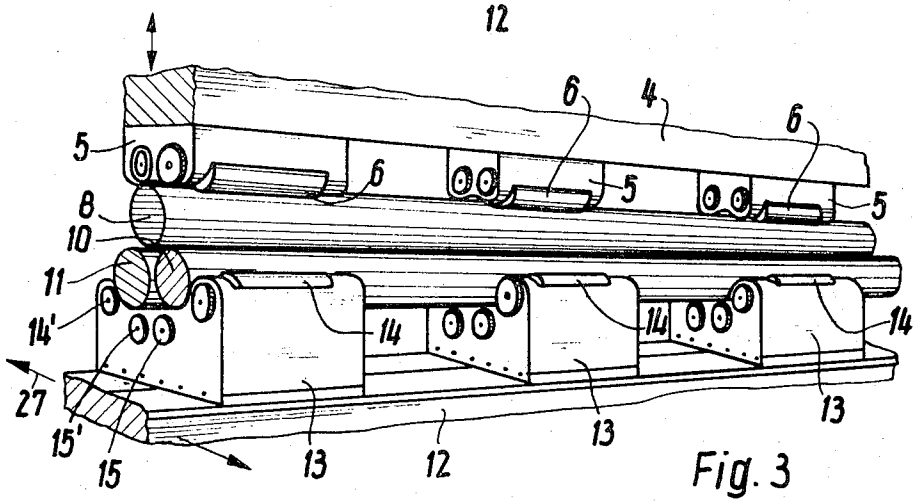


Fig. 3

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Feb. 23, 1971 R. HERBURG 3,564,889

PYRAMID ROLL BENDING MACHINE FOR FORMING SHEET METAL

Filed Aug. 30, 1968 3 Sheets-Sheet 3

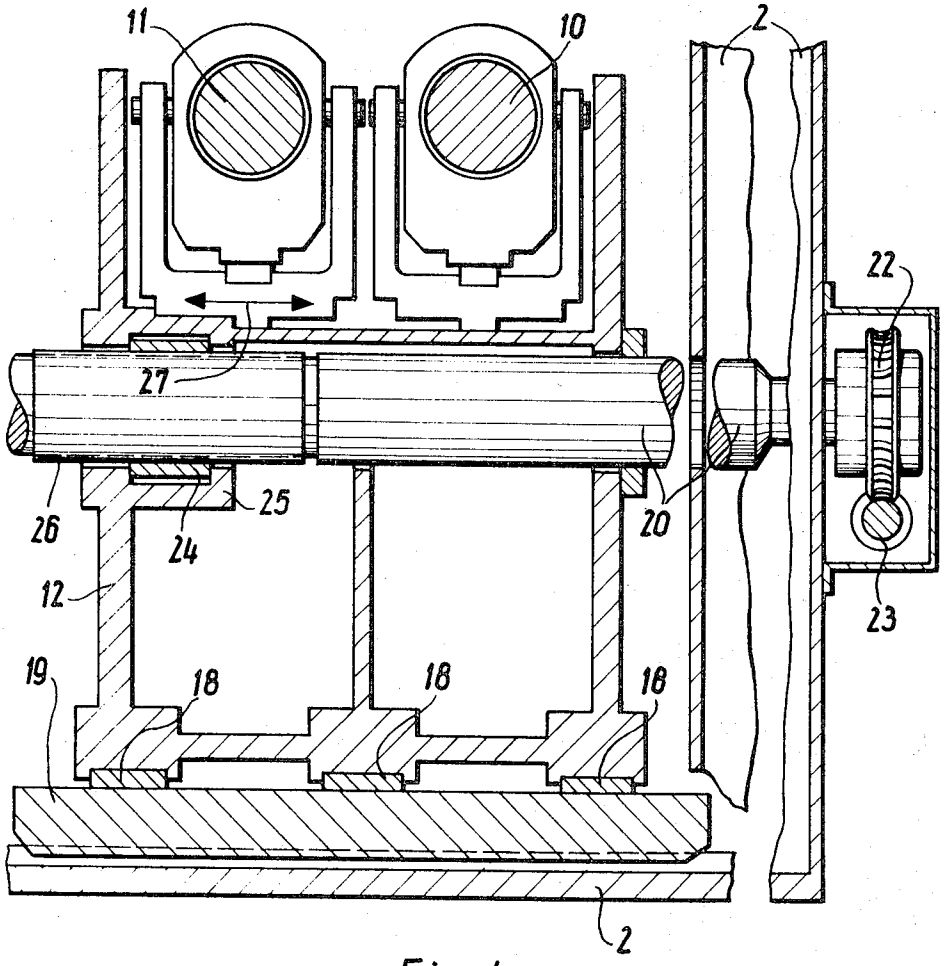


Fig. 4

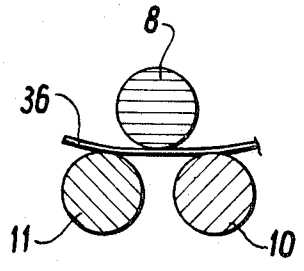


Fig. 5

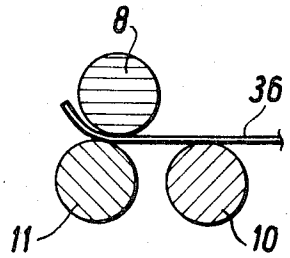


Fig. 6

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PYRAMID ROLL BENDING MACHINE FOR FORMING SHEET METAL

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Int. Cl. B21d 5/14
U.S. Cl. 72—174 8 Claims

ABSTRACT OF THE DISCLOSURE

The combination comprising a bottom yoke that is movably mounted for crosswise movement with respect to the longitudinal axis of upper bending rolls in a pyramid roll bending machine is provided. Two bottom rolls and support means for the bottom rolls are mounted on the movable bottom yoke. The bottom yoke includes bearing means slidably resting on a cooperating bearing located in a frame means at each end of the bottom yoke. A screw shaft is located in the frame means for moving the bottom yoke thereby carrying any structure mounted thereon to any desired position. In more specific embodiments, drive means is mounted on the movable bottom yoke for driving the bottom rolls.

BACKGROUND OF THE INVENTION

In pyramid roll bending machines comprising one upper roll and two bottom rolls, the problem arises of also bending the leading and trailing edges of a sheet or plate as it passes through the machine, since these edge portions are not supported by the bottom rolls when they are under the upper bending roll of the pyramid unless the bottom rolls are moved into an asymmetrical position under the upper roll. In order to reduce the width of these edge portions which cannot be satisfactorily bent, it has already been proposed to mount the bottom rolls in a pyramid roll bending machine so that they can be adjustably moved crosswise of the upper roll axis.

In a prior art roll bending machine of this type the two bottom rolls are independently traversed for lateral adjustment in relation to the upper roll. This facility permits the spacing of the bottom rolls to be reduced for the purpose of rounding narrow sheet metal strips. Lateral adjustment of the bottom rolls in this machine is effected by jointly displacing the pillow blocks of the backing rolls as well as the bearings of one of the bottom rolls. If each bottom roll has two end bearings and four backing roll pillow blocks, each pillow block carrying two backing rolls, a total of 12 traversing gear assemblies and associated slideways are needed for adjusting both bottom rolls. This greatly complicates the production of such machines and the traversing gears call for continuous maintenance since they are liable to experience considerable wear.

Another shortcoming of this prior art arrangement is that the two bottom rolls must have separate drive means. This is due to the fact that the drive wheels of the bottom rolls are mounted directly on the movable roll necks, whereas the interposed reduction gears are mounted on the stationary bed. Since the drive wheels move with the bottom rolls when these are traversed, whereas the cooperating pinions remain stationary, any displacement of the bottom rolls changes the conditions of mesh and the backlash between meshing teeth. This is not usually desirable. Furthermore, if crowned bottom rolls are used and the backing roll pillow blocks are unevenly spaced for spherical bending, the roll necks and the drive wheels

assume positions of obliquity. This obliquity causes considerable additional edge pressure between tooth flanks and leads to greater wear.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a pyramid roll bending machine for forming sheet metal, particularly for bending plates for ships' hulls, which is of simple construction and free from the above-mentioned defects.

To attain this object the present invention provides a pyramid roll bending machine for forming sheet metal, which comprises two end frames, an upper bending roll, upper backing rolls for supporting the upper bending roll from above, an upper yoke rotatably mounting said upper bending roll and said upper backing rolls and arranged to be elevationally adjustable between said two end frames, two bottom rolls, bottom backing rolls for supporting said bottom rolls from below, pillow blocks carrying said bottom backing rolls, and a bottom yoke also extending between the two end frames and mounting said bottom rolls, said pillow blocks and said bottom backing rolls and being jointly with them traversible crosswise of the longitudinal axis of said upper roll.

Moreover, in a preferred embodiment of the present invention it is proposed that a drive motor as well as a reduction gear are associated with each of the bottom rolls and are operatively connected to the bottom yoke and hence traversed together therewith. For traversing and adjusting the bottom rolls, their associated backing rolls and the pillow blocks in which the latter are mounted as well as the drive means comprising the motors and reduction gears, the provision of a single traversing gear in each end frame is therefore sufficient. In a convenient arrangement such a traversing gear may preferably consist of a screw shaft driven by a wormwheel and a worm, since it is simpler to produce and maintain such a mechanism than say a hydraulic traversing gear although this would nevertheless be applicable to the contemplated purpose.

In such a machine in which the two bottom rolls can be adjustably traversed into an asymmetrical position on either side of the upper roll for the purpose of bending the leading and trailing edges of sheet metal plates that are passed through the machine, extreme eccentricities can be obtained in which the horizontal center spacing between the upper bending roll and one of the bottom rolls is so small that fully satisfactory edge bending effects can be achieved. The proposed form of construction requires only a moderate expenditure in mechanical adjusting and guide means and thus generally constitutes a robust design which requires little maintenance. Particularly useful are screw shafts for cross traversing the bottom yoke and hence the two bottom rolls since they are self-locking devices which do not call for the provision of special arresting means, and they can transmit lateral forces directly to the end frames in any position of the bottom rolls. Another advantage in this context resides in the fact that in the proposed machine only the difference of the horizontal forces acting on the bottom rolls is actually transmitted to the traversing gear and the screw shafts. If in the prior art machines one of the bottom rolls is transversely adjusted independently of the other, the pillow blocks of the backing rolls and the backing rolls associated with said bottom roll must be separately traversed on the stationary bottom yoke. The horizontal component of the forces which acts on this bottom roll during the bending operation is thus transmitted in its entirety to the traversing gear. The same applies to the other bottom roll of the prior art machines.

On the other hand, if the pillow blocks for the bottom backing rolls of both bottom rolls are attached to a

traversible bottom yoke, as is the case in the present invention, then the traversing gear of the bottom yoke is merely loaded by the difference between the two horizontal components of the force acting on the two bottom rolls, since these two components are arranged relative to each other and act in contrary directions. Hence, if the force acting on one roll in horizontal direction exceeds that acting on the other roll in the opposite direction, then the traversing gear which is common to both bottom rolls and their respective backing rolls will be loaded only by the difference between these two components of force. The traversing gear in a machine according to the invention is therefore called upon to withstand much smaller operational loads than the individual traversing gears in a conventional machine.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings in which:

FIG. 1 is a front elevation, partly in section, of a pyramid roll bending machine according to the invention;

FIG. 2 is a cross section of the machine;

FIG. 3 is a perspective view, on a slightly larger scale, of part of the machine;

FIG. 4 is a cross section, on an enlarged scale, of the traversing gear;

FIG. 5 is a vertical section through the three pyramid rolls symmetrically disposed, and

FIG. 6 is a vertical section through the three rolls after the bottom rolls and the bottom yoke have been traversed into a position of asymmetry in relation to the upper roll.

DESCRIPTION OF SPECIFIC EMBODIMENTS

FIG. 1 shows a pyramid roll bending machine according to the invention which comprises two fixed end frames **1** and **2** which extend downwards to below the floor level **3**. An upper yoke **4** which is elevationally adjustable as indicated by the two-headed arrows in FIGS. 2 and 3 extends between the two end frames **1** and **2**. The upper yoke **4** carries four upper pillow blocks **5**, each rotatably mounting two upper backing rolls **6** and **7** as shown in FIG. 2. Between opposite inwardly inclined planes the upper rolls **6** and **7** provide backing support for an upper bending roll **8** which is rotatably mounted in the upper yoke **4** and thus elevationally adjustable together with the upper yoke **4**, the pillow blocks **5** and the associated upper backing rolls **6** and **7**.

Below the upper bending roll **8** are two bottom rolls **10** and **11** rotatably mounted in a bottom yoke **12**. The top of the bottom yoke **12** carries four pillow blocks **13** each mounting four bottom backing rolls **14**, **14'** and **15**, **15'**, the two backing rolls **14** and **14'** being disposed on the outside and the two other backing rolls **15** and **15'** on the inside (cf. FIGS. 2 and 3).

The ends of the bottom yoke **12** are each provided with bearing means in the form of a semicylindrical bearing shell **18** which slidably rests on a bearing in the form of a convex slide bar **19** on the respective end frame **1** or **2**, and the bottom yoke **12** is thus traversible between these end frames **1** and **2** crosswise of its longitudinal axis. The bottom pillow blocks **13** and the bottom backing rolls **14**, **14'** and **15**, **15'** as well as the bottom bending rolls **10** and **11** can thus be moved to and fro together with this yoke. For adjusting these components two screw shafts **20** and **21** of a traversing gear are rotatably mounted in the two end frames **1** and **2** as shown in FIG. 1.

From FIG. 4 which illustrates the traversing gear in simplified form it will be understood that the screw shaft **20** is rotatably mounted in the end frame **2** and that one of its ends carries a wormwheel **22** which is in mesh with a worm **23**. The other end of the screw shaft **20** works in a captive nut **24** kept in a casing **25**, the captive

nut meshing with a thread **26** on the shaft **20**. The casing **25** is rigidly attached to the bottom yoke **12** which by means of the semicylindrical bearing shell **18** slidably rests on the convex slide bar **19** on the end frame **2**, and which at its top carries the two bottom rolls **10** and **11**. In view of this arrangement rotation of the worm **23** will rotate the screw shaft **20** and, according to its hand of rotation, the nut **24** will shift on the screw shaft **20** in one of the directions indicated by the two-headed arrow **27** in FIGS. 2 and 4. The bottom yoke **12** and the bottom rolls **10** and **11** will thus be traversed crosswise of their longitudinal axes.

For driving the bottom roll **10** there is provided a first motor **30** (FIG. 1) which delivers torque to a first reduction gear **32** through a belt transmission **31**. This motor **30** as well as the reduction gear **32** are mounted on a bracket of the bottom yoke **12** and therefore participate in the traverse of said bottom yoke. The bottom roll **10** is coupled to the reduction gear **32** by a shaft **33** which may incorporate universal joints to allow for bending of the bottom roll **10** when this is under load. A second motor **34** is provided for driving the other bottom roll **11** and is mounted together with a second reduction gear **35** on the other end of the bottom yoke **12** and thus likewise moves together with the two bottom rolls **10** and **11** and the bottom yoke **12**.

When the bottom yoke **12** is in its central position the three rolls **8**, **10** and **11** are symmetrically placed, as illustrated in FIG. 5, and they permit a sheet metal **36** with the exception of its marginal portions to be bent to a desired curvature after appropriate elevational adjustment of the upper bending roll **8**. In order to bend, for example, the edge portion of the sheet metal **36** on the left hand side in FIGS. 5 and 6 the bottom yoke **12** is shifted by operation of the two screw shafts **20** and **21** until the bottom rolls **10** and **11** which retain their relative spacing occupy the position relative to the upper bending roll **8** which is illustrated in FIG. 6.

While the pyramid roll bending machine for forming sheet metal has been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

What is claimed is:

1. In a pyramid roll bending machine having an upper bending roll rotatably mounted on an upper yoke, means for supporting the upper bending roll from above, said support means being mounted on the upper yoke, and said upper yoke including means for elevational adjustment between two end frames, the combination comprising:

(a) a bottom yoke movably mounted for crosswise movement with respect to the longitudinal axis of the upper bending roll,

(b) said bottom yoke including bearing means slidably resting on a cooperating bearing located in a frame means at each end of the bottom yoke,

(c) two bottom rolls and means for supporting said bottom rolls from below,

(d) said rolls and support means being mounted on said movable bottom yoke, and

(e) a screw shaft located in said frame means for moving said bottom yoke.

2. A combination as defined in claim **1** including:

drive means mounted on said movable bottom yoke for driving the bottom rolls.

3. The combination as defined in claim **2** wherein:

said bottom roll drive means includes a motor mounted at each end of the bottom yoke,

one of said motors driving one of the bottom rolls and the other said motor driving the other of said bottom rolls.

4. The combination as defined in claim **2** wherein:

said bottom roll drive means includes a reduction gear means mounted on said movable bottom yoke for delivering torque to the bottom rolls.

5. The combination as defined in claim 2 wherein:

said bottom roll drive means includes a motor mounted at each end of the bottom yoke and a reduction gear means connected to each said motor for delivering torque to the bottom rolls,

one of said motors driving one of the bottom rolls and the other said motor driving the other of said bottom rolls.

6. The combination as defined in claim 1 wherein:

said frame means for carrying the bottom yoke includes the two end frames which carry the upper yoke.

7. The combination as defined in claim 1 wherein:

said support means for the bottom rolls includes backing rolls and pillow blocks which are mounted on said movable bottom yoke.

8. The combination as defined in claim 1 wherein:

said bottom yoke bearing means includes a semi-cylindrical bearing shell structure and

the bearing in the frame means includes a convex slide bar,

said shell structure slidably resting on said convex slide bar.

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U.S. Cl. X.R.

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