ROLLING MILL HAVING PLURALITY OF ROLL HEADS

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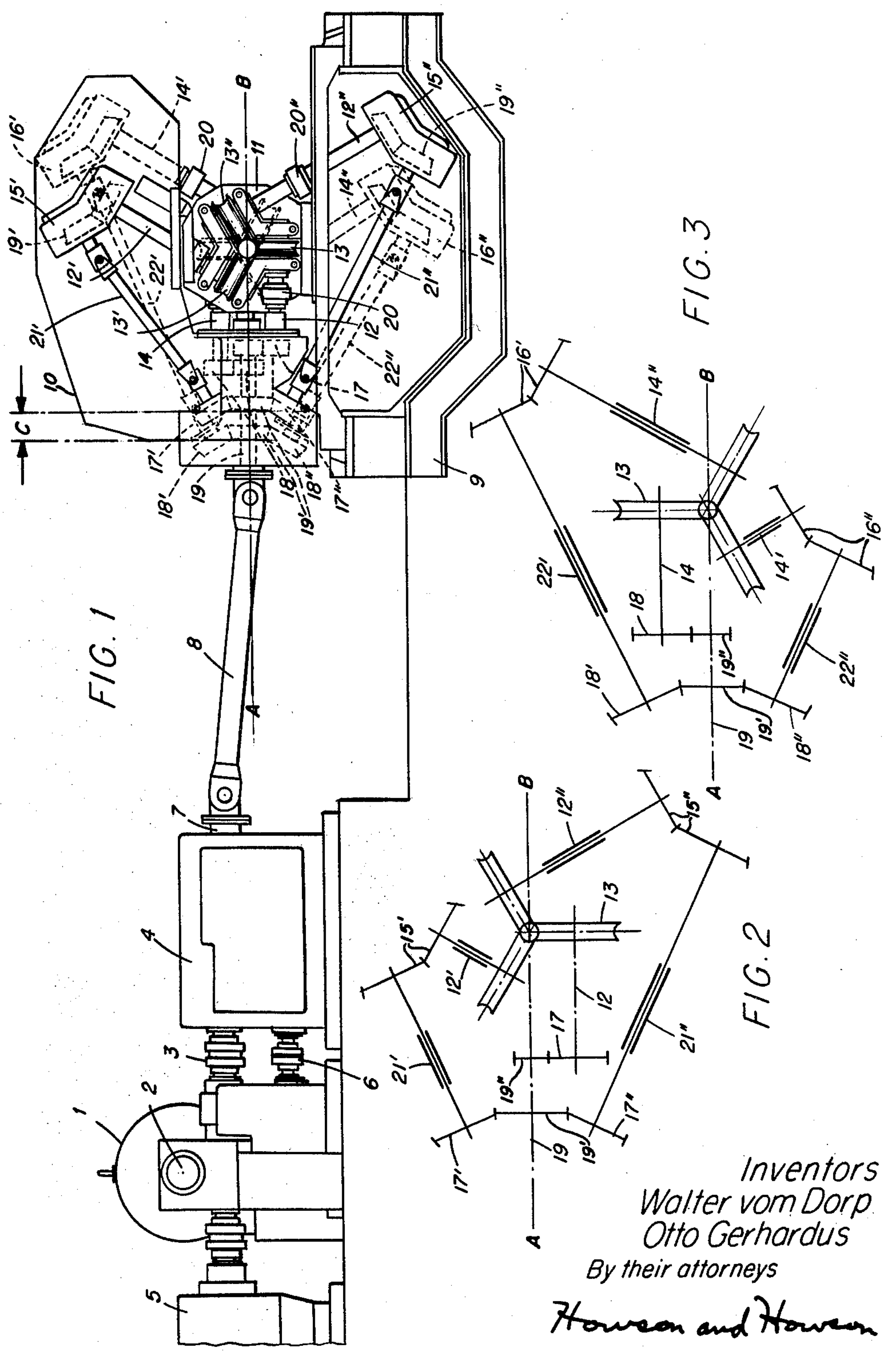

Inventors
Walter vom Dorp
Otto Gerhardus
By their attorneys
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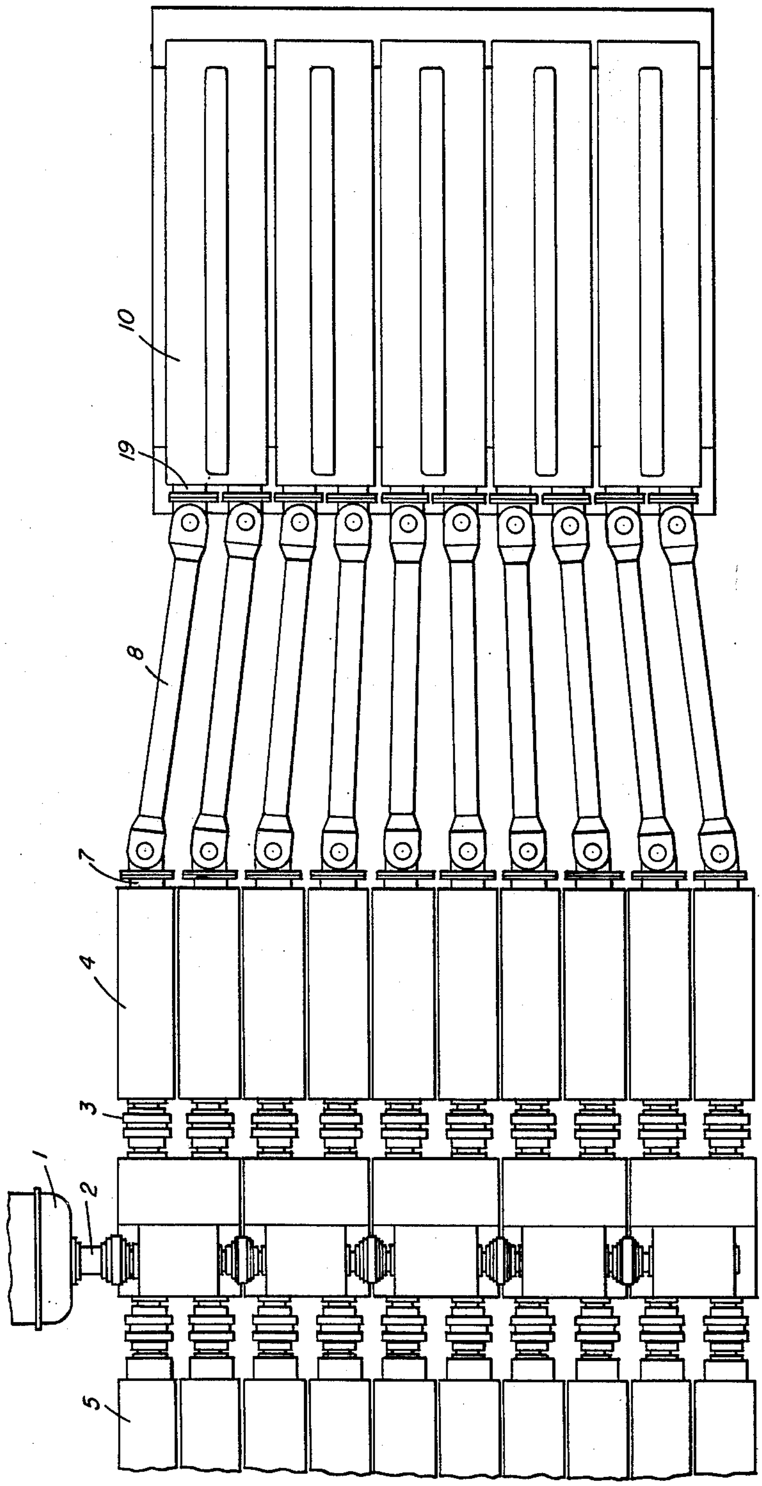

FIG. 4

Inventors
Walter vom Dorp
Otto Gerhardus
By their attorneys
Howson and Howson

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ROLLING MILL HAVING PLURALITY OF ROLL HEADS

Walter vom Dorp, Rheydt, and Otto Gerhardus, Dusseldorf, Germany, assignors to Mannesmann-Meer Aktiengesellschaft, Dusseldorf, Germany, a German company

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This invention relates to a rolling mill having a plurality of roll heads with three rolls in each head, and more particularly to such a mill having a large range of usefulness in processing extremely thick-walled material especially where the material has a high resistance to deformation. The invention will be described in connection with a tube reducing mill.

In the case of thick-walled or extremely thick-walled material such, for instance, as comes from an extrusion press only short ingots can be fed into a rolling mill. When an ingot is processed in a rolling mill the ends of the strip after processing are somewhat thicker than the rest of the strip. With thick-walled material the effect of the thickened ends is magnified which is economically undesirable. It is known that the length of the thickened ends can be kept at a minimum by having the distance between roll heads as small as possible. On the other hand, processing material which has a high resistance to distortion or deformation requires considerable roll pressure, torsional moment and driving power. It is therefore necessary to use bearings and drive elements of as robust a construction as possible. This requires a large spacing between rolls. In addition, provision must be made for accessibility, facility of inspection and the ability to change the roll heads with the least expenditure of time in order to obtain practical usefulness in a modern tube rolling mill. These are assured by the present invention.

The present invention eliminates the reciprocal disturbing effects referred to above in the most efficient manner, doing it with the least possible distance between the rolls independent of the necessary driving elements, the least possible investment and the greatest possible range of usefulness.

In accordance with the invention, there is provided, in a known tube reducing mill, a multiplicity of roll heads arranged one behind the other in stands which are open at one side forming a common U-shaped bed, each roll head having three rolls of the same caliber in one plane. There is also a roll head input shaft for driving the rolls in each roll head. The power for driving two of the rolls in each roll head comes from one gear on the input shaft to that head. The power for driving the third roll comes from another gear on the same input shaft. Power is transmitted to each roll via one or more intermediary shafts and roll drive shafts, together with associated spur and bevel gears.

In addition, the mill is characterized by the roll heads being arranged in pairs, the rolls of each head in a pair being arranged symmetrically relative to a horizontal plane containing the axis of the material being rolled so that every roll in one head is disposed in a mirror image position with respect to a similar roll in the adjacent head. The plane is denoted as A–B in FIG. 1 of the drawings.

The mill is further characterized by the geometrical configuration of the intermediary shafts and roll drive shafts associated with each pair of roll heads. The shafts in every roll head are disposed symmetrically relative to the above mentioned horizontal plane so that each shaft in one roll head is disposed in the mirror image position of a corresponding shaft in the other roll head. By mirror image position is meant that when the horizontal plane is taken as a mirror, and one looks into the mirror, the image one sees in the mirror of a shaft which is in front of it, will denote the exact position of a corresponding shaft in an adjacent roll head which shaft is in fact behind the mirror.

The outside diameter of the gears because of the way they are positioned may be greater than the spacing distance between the roll heads measured center on center. This is made possible by the fact that the shafts and gear trains in adjacent roll heads are disposed at different distances from their respective rolls thus permitting the gears to overlap lengthwise of the material being rolled.

The invention has great advantages in that separation of the rolling mill into separate stands makes possible continuous production while permitting arbitrary assembly of the desired number of units. Power is furnished to each of the input shafts independently, thereby giving economic production of products of equal dimensions. A primary advantage of the invention is that it enables the distance between roll heads to be kept to a minimum thereby keeping the length of the thickened ends of the material being rolled as short as possible. The apparatus has this advantage because of an offset or staggered arrangement of the shafts and gear trains driving the rolls of adjacent roll heads. This, in turn, permits the gears delivering the power to be larger than the size of the roll heads and therefore, to be sufficiently robust to do the job required of them.

The invention has the further advantage of enabling the simultaneous quick change of all roll heads ready for re-calibrating by disconnecting from or to the U-shaped opening of the roll bed. This is possible without the interference of the group of the power drive units used to drive the roll heads, which are disposed on the other side of the rolling mill. To make this possible the dimension of the roll drive units has been consoliadted as required by the correspondingly higher drive output in the rolling direction. In addition, the fact that the drive units disposed one after another in a row are necessarily longer than the row of roll head beds has been equalized by coupling from the output shafts of the drive units to the input shafts of the roll heads by means of a fan-shaped assembly of drive shafts. The construction also permits economic production of all parts in larger series and enables rolling mills to take many assignments not heretofore possible.

In the embodiment shown in the drawings:

FIG. 1 is a view in elevation of a rolling mill embodying our invention, the view being taken transversely to the direction of rolling.

FIG. 2 is a schematic showing through a roll head of the machine in FIG. 1, the view being taken transversely to the direction of rolling.

FIG. 3 is a schematic showing similar to FIG. 2 through the adjacent roll head again taken transversely to the direction of rolling.

FIG. 4 is a plan view of a rolling mill such as shown in FIG. 1.

Referring now to FIGS. 1 and 4 there is a drive motor 1 driving a longitudinal shaft 2 for the mill. The motor is preferably a constant speed motor. By means of bevel gears the input shaft 3 of the drive 4 for each roll head is driven from the shaft 2. As shown in German Patent 970,102 the basic rate of rotation for each head is obtained by the sum of an added drive and the synchronized bevel gear drive. The feeding of the relatively large non-controlled portion of the power is fed to the drive housings 4. The relatively small controlled portion of the roll output is introduced through an auxiliary drive 6 for each drive by means of a stepless regulable drive 5. Preferably, the drive 5 is an oil pressure drive the slip of which, dependent upon the relation of the non-controlled to the controlled roll output, can be reduced and practically eliminated. Each oil pressure drive **5** consists of an oil pressure pump **1** driven by the main shaft **2** and an oil motor (not shown) driven by this pump, which oil motor, through shaft **6**, drives the secondary side of the auxiliary drive. By known means this permits the control of several roll heads either in common or individually. The output shafts **7** are coupled with the input shafts **19** of the rolling mill heads through drive shafts **8**. A base **9** holds pair stands **10** in each of which two roll heads **11** are disposed one behind the other. The heads, held on three sides, can be clamped tightly by a clamp device as, for example, an hydraulic one (not shown). The mounting and dismounting of the roll heads is accomplished, to and from the right side, into and out of the U-shaped openings of the base.

Referring now to FIGS. 1, 2 and 3, the rolls **13**, **13′** and **13″** are built into a six-cornered roll head **11**. The roll heads are mounted successively one after another. Driving the rolls **13**, **13′** and **13″** in one roll head are roll drive shafts **12**, **12′** and **12″** respectively. In the adjacent head in a roll head pair the rolls are driven by roll drive shafts **14**, **14′** and **14″** respectively. All of these shafts are fixedly mounted on the stands **10** and are elastically coupled via couplings **20**, **20′** and **20″** with the shafts carrying the rolls **13**, **13′** and **13″** respectively. Intermediary shafts **21′** and **22′** transmit power to shafts **12′** and **14′** respectviely. Shafts **21′**, **22′** take power from input shafts **19** via bevel gears **19′**, **17′** and **19′**, **18′** respectively, there being one gear **19′** for each input shaft. They deliver power via bevel gear drives **15′** and **16′** respectively. Similarly, intermediary shafts **21″** and **22″** transmit power to shafts **12″** and **14″** via bevel gears **19′**, **17″** and **19′**, **18″** and via bevel gear drives **15″** and **16″**. Roll drive shafts **12** and **14** are also driven from shafts **19**, but via gears **19″**, **17** and **19″**, **18** respectively. As in the case of gear **19′** there is one gear **19″** for each input shaft.

As shown in FIG. 1 in one roll head the roll **13** lies vertically downward, the roll **13′** lying upward at an angle and the roll **13″** at the opposite upward angle. In the next roll head, the roll **13** lies vertically upward with the other rolls **13′** and **13″** placed symmetrically. Thus, as shown in the figure, for every roll in one roll head there is a corresponding roll in the adjacent roll head of the pair which is positioned on the diametrically opposite side of the material being rolled. In this way, space is gained in packing the rolls.

It can be seen from FIG. 1 that the rolls in adjacent roll heads which are diametrically opposite each other on different sides of the material being rolled are driven by shafts extending in the same direction. These shafts, numbered **12′**, **14′** and **12″**, **14″** and **12**, **14** in the drawing, are not only separated from each other lengthwise of the material being rolled, but are also on radially opposite sides of the material. This construction permits intermediary shafts **22′**, **21″** to be longer than intermediary shafts **22″**, **21′** and enables gear drives **15′**, **15″**, **16′** and **16″** to be staggered, with gear drives **15′**, **16″** closer to the material being worked than the others. Likewise gears **19′**, **17′** and **17″** are closer to the material being worked than gears **19′**, **18′** and **18″**. Gear **19′** on one roll head, for example, is offset a distance "C" from gear **19′** of the adjacent roll head. The result is that each of the gears in drives **15′**, **15″**, **16′**, **16″**, and each of the gears **17**, **18**, **19′** and **19″** can have an outside diameter which is greater than the distance between the roll heads (measured center to center) without interfering with the adjacent roll head.

What is claimed is:

1. A rolling mill for rolling tubes and the like which is especially useful in processing thick wall material having high resistance to deformation, said mill comprising;
   - a plurality of roll heads arranged one behind the other in the direction of rolling, each roll head containing three cooperating rolls of the same caliber whose axes lie in a plane at right angles to the direction of rolling,
   - a plurality of input shafts connected to said roll heads at one side common to all drives for said rolls, said roll heads being provided in pairs, with the rolls of one head of each pair being positioned opposite rolls in the other head of the pair, there being one input shaft for each roll head in a pair,
   - a plurality of stands in which said roll heads are mounted, said stands each being open at one side, said side being common to all said stands and opposite the common side of the roll heads to which the input shafts are connected, in combination with shaft and gear means connected to said rolls for driving said rolls, said means comprising shafts disposed symmetrically about a horizontal plane containing the axis of the material being rolled, so that said shafts each have the same position as the mirror image of a corresponding shaft in an adjacent roll head, when said plane is considered a mirror.
2. A rolling mill according to claim 1, wherein two of the rolls in each roll head are driven by one gear mounted on the input shaft, and the third roll is driven by another gear on said shaft.
3. A rolling mill according to claim 2, wherein one of said gears mounted on said input shaft is a bevel gear.
4. A rolling mill according to claim 1 wherein two of the rolls in each roll head are driven by a bevel gear mounted on the input shaft for that head, and the shafts driving the rolls in adjacent roll heads are of different lengths such that the gears connecting the shafts in one roll head are staggered and disposed at different distances from the material being rolled than adjacent gears in an adjacent roll head.
5. A rolling mill according to claim 4, wherein some of the gears connecting said shafts have a diameter which is greater than the distance between roll heads measured center to center.
6. A rolling mill for rolling tubes and the like according to claim 4, wherein the roll heads are mounted in the stands in pairs, two roll heads to a stand.
7. A rolling mill according to claim 5, wherein each roll in one roll head is diametrically opposite a corresponding roll in an adjacent roll head, and is on an opposite side of the material being rolled, there being in addition elastic couplings connecting the rolls in each roll head with the shafts which drive them.

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WILLIAM J. STEPHENSON, *Primary Examiner.*

LEON PEAR, *Examiner.*