Dec. 5, 1967 C. E. GILLET 3,355,923

ROLLING MILL OF THE REDUCING TYPE

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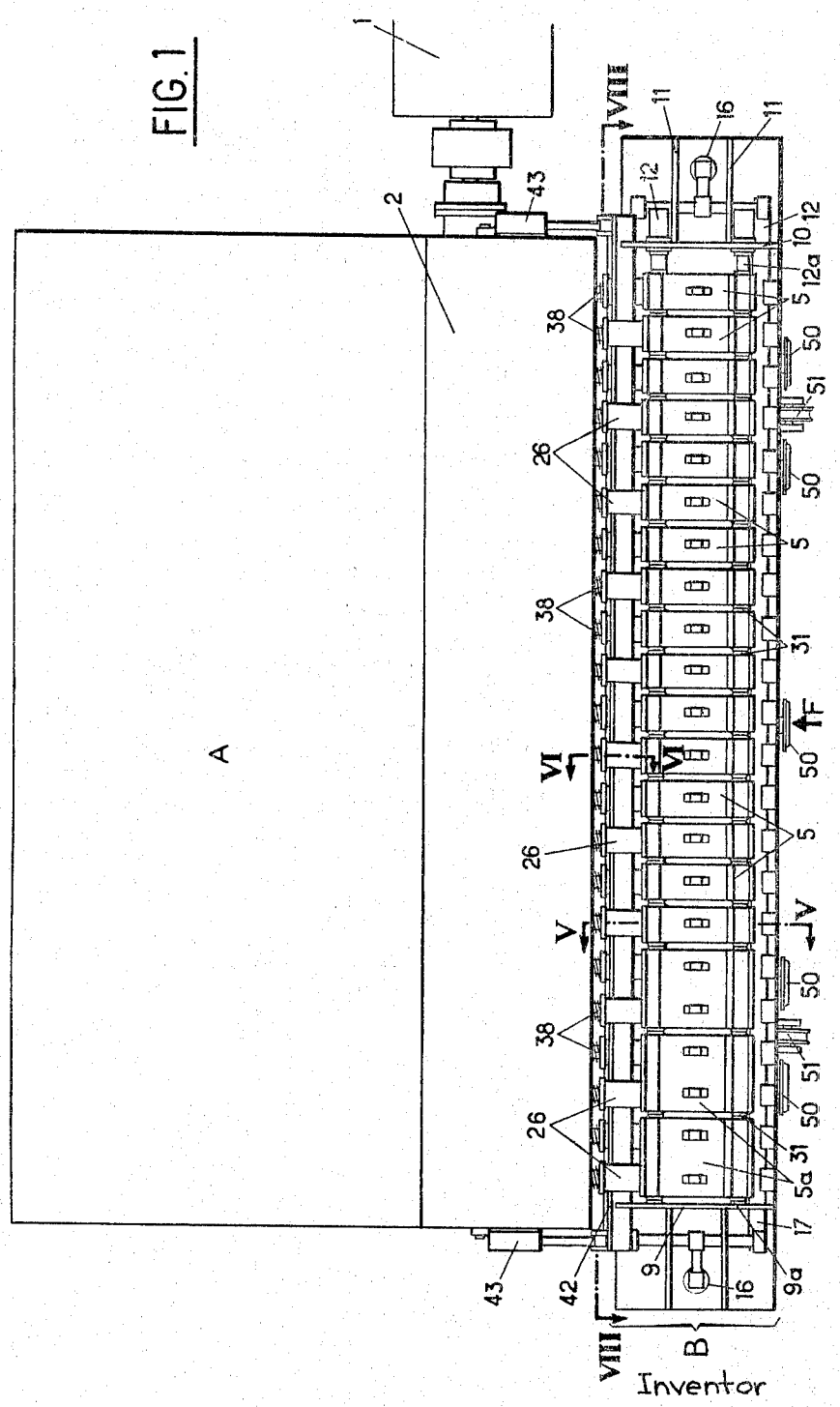
FIG. 1

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ROLLING MILL OF THE REDUCING TYPE

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FIG. 2

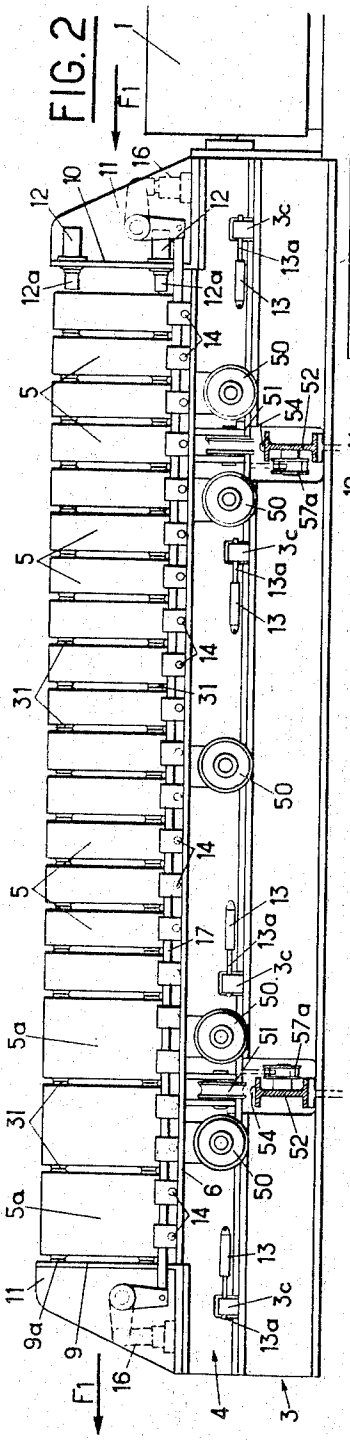
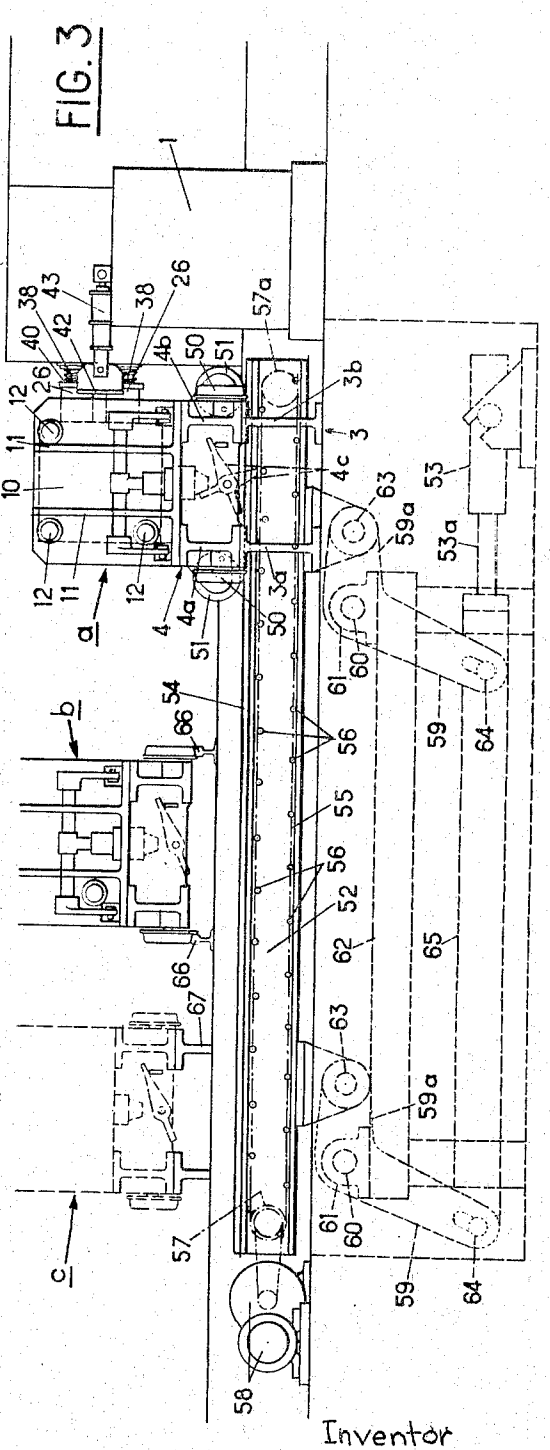


FIG. 3



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ROLLING MILL OF THE REDUCING TYPE

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FIG. 4

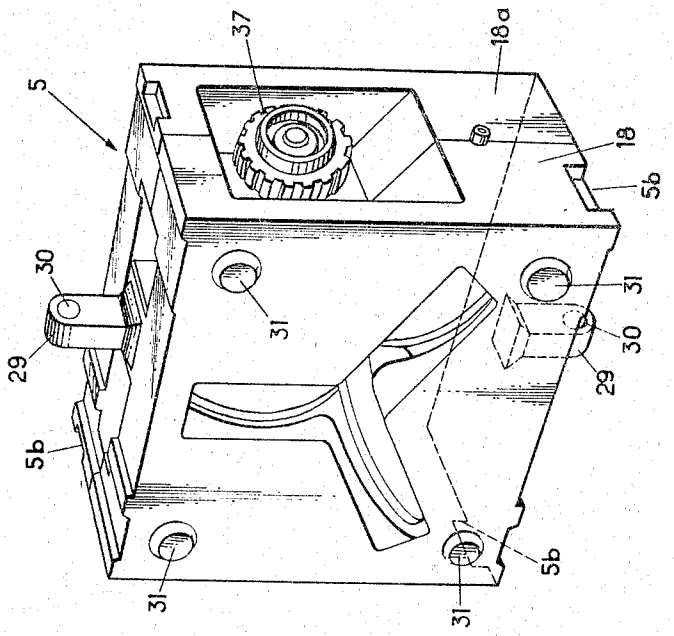


FIG. 5

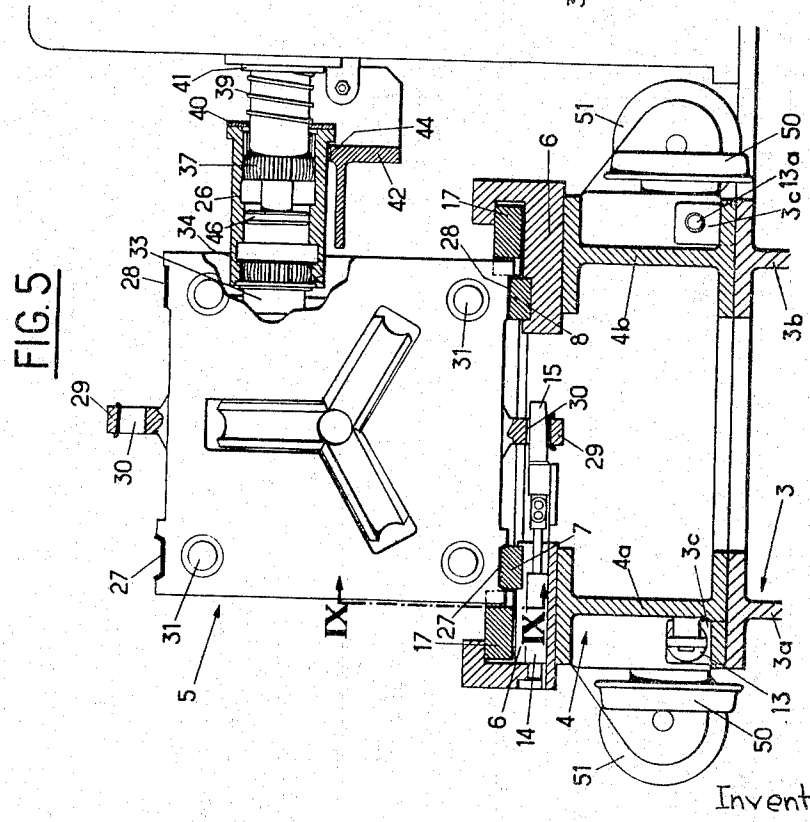


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FIG. 6

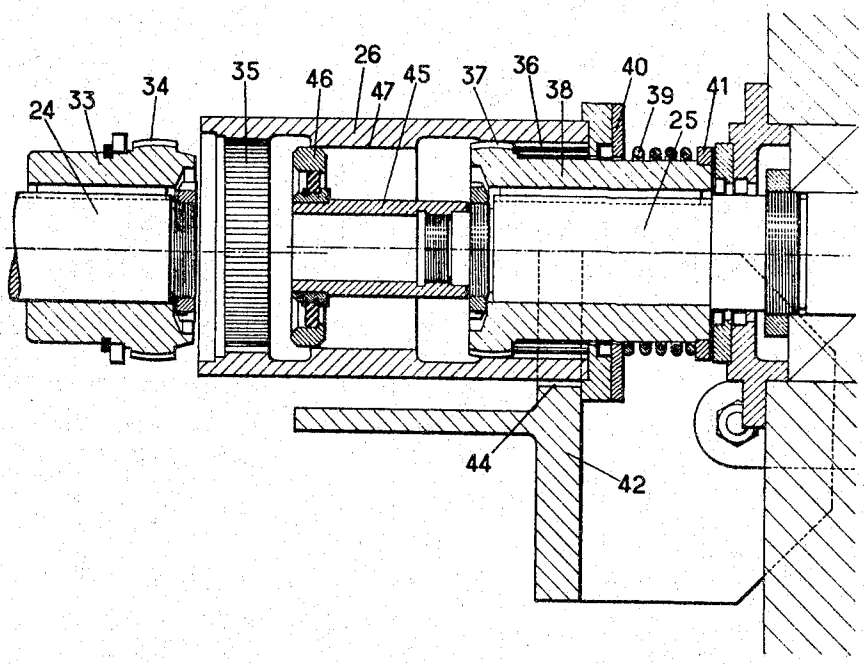
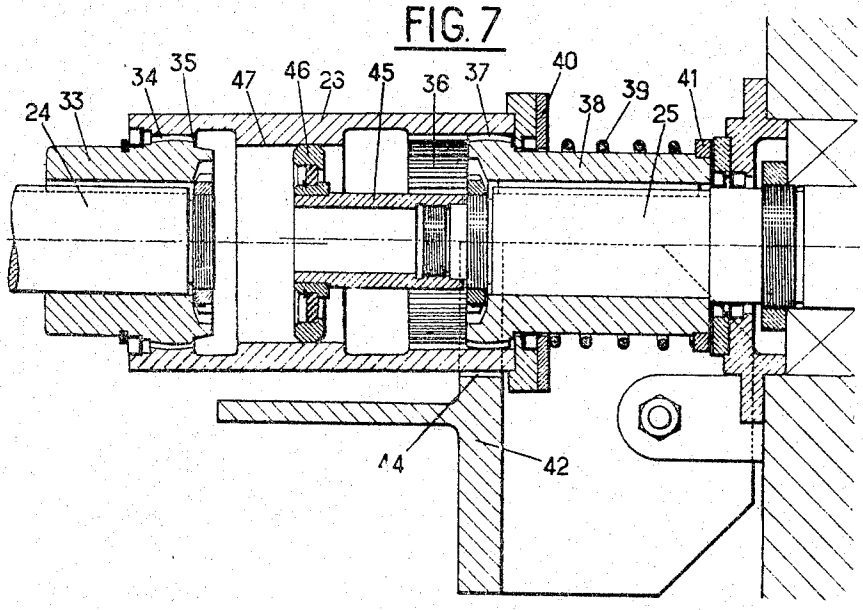



FIG. 7

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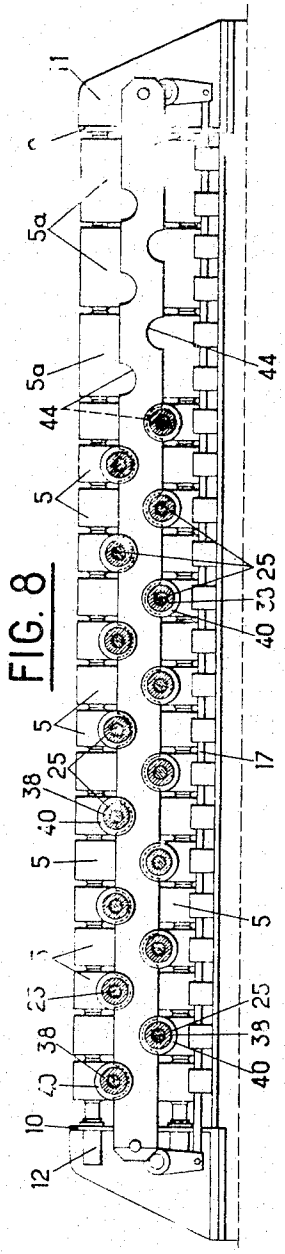


FIG. 8

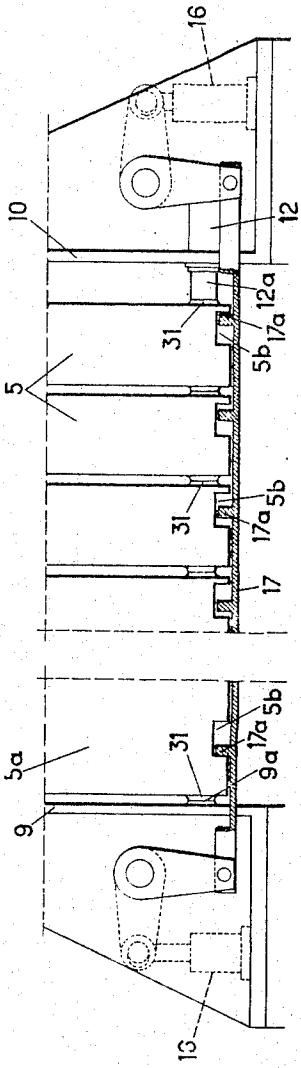


FIG. 9

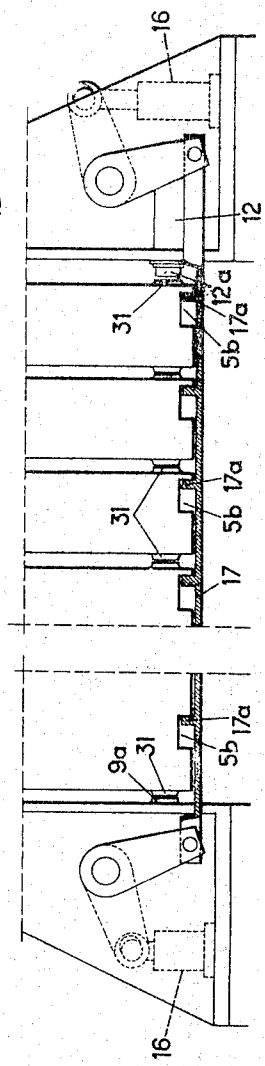


FIG. 10

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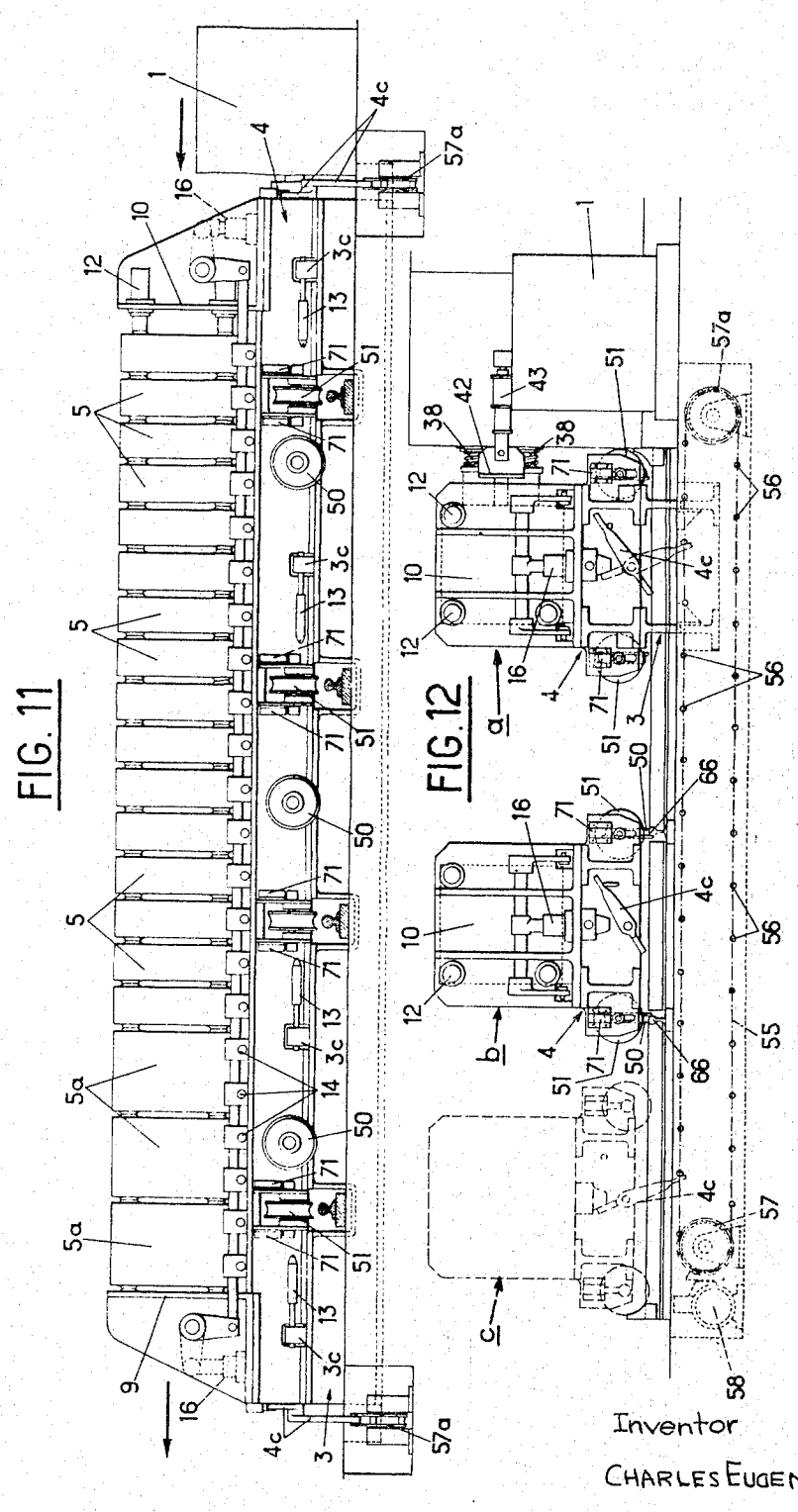

FIG. 11

FIG. 12

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ROLLING MILL OF THE REDUCING TYPE

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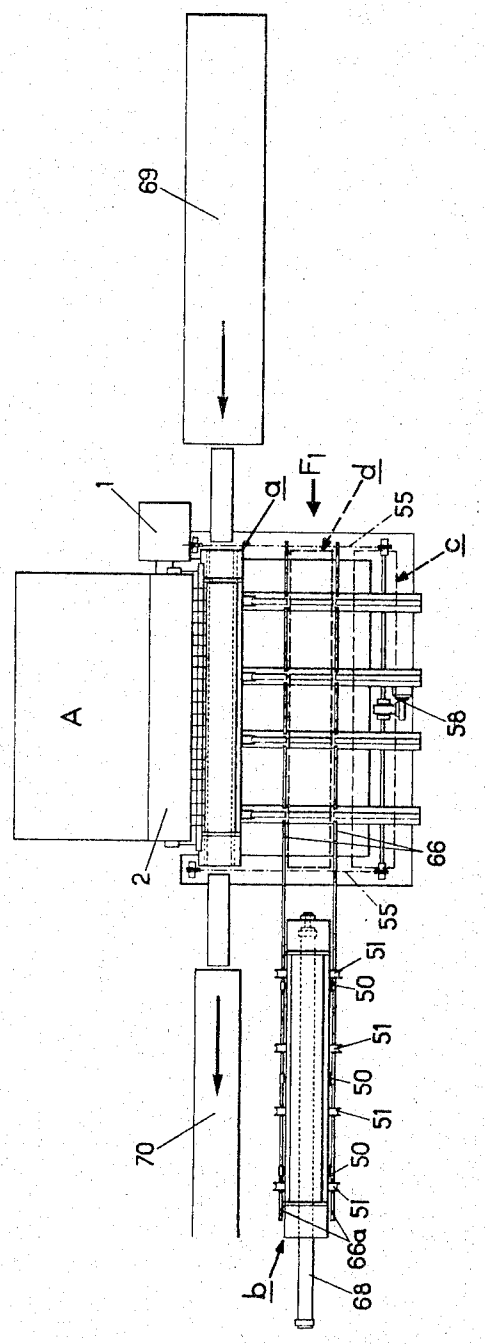
FIG. 13

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United States Patent Office 3,355,923 Patented Dec. 5, 1967



3,355,923

# ROLLING MILL OF THE REDUCING TYPE

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Claims priority, application France, July 25, 1963, 942,706, Patent 1,490,464
7 Claims. (Cl. 72—224)

## ABSTRACT OF THE DISCLOSURE

A rolling mill comprising in combination with a suitable control unit, a plurality of interchangeable and individually removable roll housings, apparatus for clamping said roll housings individually to a common frame, apparatus for clamping said roll housings together as a group unitary with said frame so that the resulting housing assembly is formed into a rigid block which acts as a unit to resist those shocks resulting from sudden changes in the rolling force, and a piston-operated toothed rack for separating said roll housings from each other longitudinally of the frame when said clamping means is released.

The present reducing rolling mills for tubes or equivalent products usually include removable and independent roll housings or stands.

The fastening of said housings at their working position is oftentimes a complex problem, as it must be extremely precise, substantially rigid and quickly done, so as to reduce to a minimum the idle times resulting from a change of housings.

Said requirements, which are difficult to reconcile, do not appear as having been properly met up to now. Either cylindrical or other shaped housings, individually fixed on the rolling mill frame, are utilized.

It happens that, in conventional installations, after a relatively short time of operation, the abovementioned requirements are no longer met because of the play resulting from the machining tolerances and the damage to the positioning surfaces which results from the repeated and severe shocks imparted to the housings or stands when the products being rolled are engaged.

The present invention has for its object a novel reducing roll mill arranged so as to obivate the abovementioned defects, said reducing roll mill being of the common type or of the calibrating type or of the so-called traction type.

Such a roll mill is essentially characterized by the fact that, in combination with an appropriate control arrangement, it includes a rolling assembly comprising a series of interchangeable housings or stands, which may be dismounted either as a whole or separately, said housings not only being independently fastened to a frame, but being also clamped firmly together against a frame stop member so that the housing assembly prestressed in this manner forms a very rigid block, which is unaffected by the shocks and damage usually occuring as a consequence of sudden variations in the rolling forces.

As said force has to be maintained as long as the rolling assembly is at its working position, it is advantageous that the device applying said force should be either of the irreversible type, or of the locked type. For example, said device may be:

mechanical (screws, wedges, cams etc.)

or

hydraulic (hydraulically or mechanically locked rolls)

On the other hand, during the operation of a reducing roll mill, it may well happen that all of the housings



have to be changed; this change becomes necessary, in particular:

- when the degree of wear of the finishing housings—which happens at a faster rate than that of the other housings—is so great that the size of the final product is no longer correct
- when it is desired to change the size of the final product.

Now, when the clamping force on the housings is released, said housings may nevertheless remain stuck together, so that it may be difficult to remove from the assembly of housings those housings which it is desired to replace.

This is why, in accordance with the present invention, the clamping arrangement for said housings is associated with a separating device which acts to maintain a gap between the housings such that the housing or housings which are to be changed may be taken out easily, without any risk of damaging their contacting surfaces, by means of a suitable handling device.

Said separating device may consist, for example, of longitudinal racks activated by a jack whose teeth mesh with notches in the housings, the pitch of said racks being greater than the distance between the axes of the housings by that distance by which it is required to separate them during removal. Through the action of the jack, the rack teeth come, successively, into contact with a corresponding boss supported by the housings, so that said housings are successively separated one from the other.

It should be noted that the inventive arrangement of the housings or stands is independent of the connection between, the frame supporting the housings, and the part of the reducing roll mill comprising the control device.

In fact, the frame may be permanently mounted on a base which is common to the whole roll mill assembly. In that case, each time a housing is changed, the abovementioned rolling assembly is assembled at the work station, the housings being removed and replaced by any suitable handling device.

The frame which receives the housings together with their clamping, blocking and spacing arrangements could also be of a removable type and held in working position by locking it by means of any suitable arrangement to the rolling mill base.

Such an arrangement makes it possible, by utilizing two identical housing-supporting frames, to have a standby rolling unit readied without stopping the operation of the roll-mill. Said standby rolling unit may be substituted, through appropriate handling means, for a unit removed from the housing assembly, in a minimum time.

The abovementioned arrangements relative to the clamping of the housings and their change-over are utilized in combination with coupling sleeves which transmit the driving action to the housings and, if necessary, with rolling unit exchange arrangements which leave free the space adjacent to the furnace which supplies the reducing assembly, and requiring for handling a space only twice the length of the rolling assembly.

In order to provide a better understanding of the present invention, there will now be given, in a purely illustrative manner, a description of two embodiments thereof in reference with the annexed drawings, in which:

FIG. 1 is a schematic top plan view of one of said embodiments with the rolling unit coupled to the control unit;

FIG. 2 is an elevation of FIG. 1 taken in the direction of arrow F;

FIG. 3 is an end view of said embodiment taken in the direction of the arrow $F^1$ in FIG. 2;

FIG. 4 is a perspective view of one of the rolling housings;

FIG. 5 is an enlarged view taken along the line V—V of FIG. 1 showing the coupling of the rollers and the general arrangement of a housing;

FIG. 6 is a detailed sectional view taken along the line VI—VI of FIG. 1 showing the coupling device of FIG. 5 disconnected from the roller driving shaft;

FIG. 7 is a view corresponding to FIG. 6, with the coupling device at its connected position;

FIG. 8 is a sectional view taken along the line VIII—VIII of FIG. 1;

FIG. 9 is a reduced scale schematic sectional view taken along the line IX—IX of FIG. 5, showing the roller housings with their separating device in inoperative position;

FIG. 10 is a view corresponding to FIG. 9 showing the housings in their drawn-apart position;

FIG. 11 is a view similar to FIG. 2 showing an alternate embodiment of the rolling block translation device;

FIG. 12 is an elevational view of said second embodiment taken in the direction of arrow $F^2$ of FIG. 11; and

FIG. 13 is a schematic top plan view showing the general arrangement of the rolling unit and of its rolling housing transfer devices.

Referring now more particularly to FIGS. 1 and 2, the location of the inventive control unit (not shown) has been designated A and that of the rolling unit has been designated B.

The kinematic assembly of the control unit driven by motor 1 includes two lines of staggered shafts 25 (FIG. 6). Said shafts extend from casing 2 affixed to a base whereupon also bears fixed frame 3 including two beams 3*a*, 3*b* supporting frame 4 upon which the interchangeable rolling unit housings 5–5*a* are mounted.

It should be noted also that housings or stands 5 are roll housings while housings 5*a* are intended to convey the products being reduced towards the roll mill exit end when the abovementioned roll housings are not all operated simultaneously. Housings or stands 5*a* have a thickness double of that of roll housings 5.

Frame 4 comprises two metal beams 4*a*, 4*b* (FIGS. 3 and 5) at the top part of which is affixed plate 6 (FIG. 5) comprising two longitudinal guiding rails 7 and 8 which effect the positioning of housings 5–5*a*.

At one of its ends, frame 4 includes an abutment plate 9 comprising bosses 9*a*, and, at its opposite end, a bearing plate 10. Said plate comprises suitable reinforcements 11 (FIG. 8). Plate 10 supports a hydraulic device comprising jacks 12 having shafts 12*a* (FIGS. 8, 9 and 10).

Jacks 13, mounted on frame 4 lock or clamp said frame on framework 3 (FIG. 11) through their shafts 13*a* extending through lugs 3*c* supported by beams 3*a*, 3*b* of framework 3 (FIG. 5).

Frame 4 also carries a series of hydraulic jacks 14, each of said jacks actuating a key 15 (FIG. 5) which locks a housing on said frame. It also carries hydraulic jacks 16 which control the longitudinal movement of two racks 17 whose teeth 17*a* mesh in recesses 5*b* in the bottom of the housings (FIGS. 9 and 10).

Frame 4 also supports the manifolds for the lubricant tubes, for the cooling water of the rollers and for the various hydraulics circuits (not shown).

As best seen in FIG. 5, the upper and lower face of the roller housings or stands each include a trapezoidal groove 27 and a smooth bearing surface 28, grooves 27 receiving the abovementioned rail 7, while the bearing surfaces 28 engage rail 8.

Said upper and lower faces carry two bosses 29 having an opening 30 which receives the corresponding key 15 which locks the housing on the frame.

The housing or stands also carry bosses 31 at their opposed vertical faces.

There will now be described in detail, with reference to FIGS. 5, 6 and 7, the arrangement which couples shaft



24 of each of the reducing rolls to the corresponding driving shaft 25 of the control unit.

On each shaft 24, a sleeve 33 is keyed, and said sleeve carries adjacent one end an outer spherical gear 34 cooperating with an internal spur gear 35 at the end of a coupling sleeve 26. Sleeve 26 also includes longitudinal inner serrations 36 cooperating with an external spherical gear 37 on the end of sleeve 38 which is keyed to the end of driving shaft 25. A spring member 39 is inserted between a bearing collar 40 fixed to sleeve 26 and a washer 41 fixed to the end of sleeve 38. Said spring member 39 is compressed, when the coupling arrangement is disconnected, by a disconnecting cross beam 42 actuated by the hydraulic jacks 43 mounted on the opposite sides of housing 2 (FIG. 1).

Cross-beam 42 comprises, at the opposed longitudinal edges thereof, staggered semi-circular recesses 44, as clearly seen on FIG. 8, said recesses receiving the abovementioned sleeves 26.

It should be noted that each coupling arrangement includes a semi-elastic mounting which, in working conditions, makes it possible to accomodate a slight misalignment of shaft 25 and shaft 24 of the corresponding roller housing.

Said semi-elastic mounting is constructed as follows:

An end part 45, which carries a resilient ring 46, the periphery of which cooperates with bore 47 of sleeve 26, is fastened to the end of shaft 25.

The mounting of the roller housings or stands is effected as follows:

After having clamped frames 4 and 3 to each other by means of rods 13*a* of jacks 13, jacks 12 being held inoperative, the housings are then placed upon rails 7 and 8 of framework 4, the even numbered housings being inverted in relation with the odd numbered ones in a manner such that the reducing rolls are offset by 60° from one housing to the next one. The housings are automatically positioned by longitudinal rails 7 and 8, trapezoidal grooves 27 and bearings 28. Keys 15 are then put into position and the housings are clamped against stop plate 9 by jacks 12. The presence of the bosses 31, however, ensures that a sufficient space remains between the housings to introduce a torch or blowpipe therebetween. As hereinabove indicated, during said operation, racks 17 are at their retracted position relative to the housings, that is with their teeth at their inoperative position.

The unit assembled in this manner may now be brought into engagement with control unit A, said displacement being effected by an overhead crane or by mounting framework 4, comprising wheels, on a movable frame associated with a suitable translation mechanism.

Whichever mode of translation is utilized, when shafts 25 are aligned with shaft 24 of the roller housings 5–5*a*, the disconnecting cross-beam 42 is released by actuation of jacks 43. At this time, springs 39 are again operative and automatically effect the connection of the gears of the coupling devices.

The disconnection of said coupling devices is effected by the reverse operation through jacks 43.

The rolling assembly may then be removed and replaced by another standby assembly.

If only a few housings (finishing housings for example) are to be changed, it is sufficient to compress springs 39, by means of cross-beam 42 actuated by jacks 43, thus disconnecting the coupling members. It is then possible to unclamp and separate the housings or stands by means of racks 17 actuated by jacks 16 and to exchange only the required housings, the lifting of said housings being effected by hooking a hauling apparatus onto the bosses, and then finally to reclamp and tighten the assembly.

It has been noted above that the roll assembly could be provided with wheels and associated with a translation arrangement.

FIGS. 1, 2 and 12 show an illustrative embodiment of such an arrangement.

Framework **4** is provided with a first series of wheels **50**, parallel to the axis of the rolling operations and with a second series of wheels **51**, normal to said first series of wheels.

The translation arrangement is provided with two horizontal maneuvering beams **52** (FIG. 2), normal to the axis of rolling, which can be lifted or lowered by hydraulic jacks **53** (FIG. 3). At one end, beams **52** are fitted into the frame **3**, under the housing carrier or truck at its working position.

Beams **52** have, at their upper part, a race **54** supporting wheels **51** of the housing carrier.

All along its length, each beam **52** supports an endless chain **55** provided with dogs **56** cooperating with arms **4***c* pivotally mounted on frame **4**, said arms driving the housing carriers, as will be explained further on. Chains **55** are mounted between a driving wheel **57** and an idler wheel **57***a*, provided with a tensioning device. The driving wheels of each chain are driven by a stationary power device **58** comprising speed reducing means.

The control mechanism includes two groups of angle levers **59**–**59***a* located under each beam, said levers being mounted on axes **60** pivotally mounted in bearings **61**, supported by frame **62**. All the levers of a group are pivotally connected on the one hand, to one of the manoeuvering beams **52** and, on the other hand, at **64** to a link **65** connected to rod **53***a* of the corresponding jack **53** (FIG. 3).

At **66** is a trackway perpendicular to the manoeuvering beams **52**. The rails of said trackway carry wheels **50** of the housing carrier or truck. Said rails are extended to the point **66***a* (FIG. 13), for purposes which will be described later on, at such a level, that said manoeuvering beams may pick up or release a housing carrier thereon.

A standby frame is located at **67** perpendicular to beams **52**, at the opposite side of the rolling mill and spaced from the trackway **66**, said standby frame being made, for example, of welded channel irons, and being at such a level that beams **52**, actuated in the abovementioned manner, may pick up from or release on said standby frame a housing carrier (position *c* in dotted lines of FIG. 13). However, the housing carrier occupies, when on said standby frame, a level substantially higher than that of the housing carrier at its work position, so that a carrier in its work position may be cleared off by dogs **56** without coming into contact with the arm **4***c* of a carrier located on frame **67**.

A pneumatic jack **68**, whose axis is parallel to the axis of the trackway **66**–**66***a* translates said housing carrier along said way.

In order to explain the operation of said arrangement, it will be assumed that one housing carrier is at its rolling position *a*, between a conventional tunnel type furnace **69** and a pipe cutting station **70**, as shown in FIG. 13, while a second standby housing or stand carrier is at *b* on the trackway **66***a*.

After having unlocked the housing plate holder at working station *a*, beams **52** are sufficiently lifted by jack **53** and levers **59**–**59***a* so that rails **54**, which they support, come to bear under wheels **51** and lift the carrier relatively to frame **3** for making possible the transfer thereof into position *c* on the standby frame **67** by means of the shifting chains **55** and arms **4***c* at their active position.

At this time, by means of jack **68**, the carrier at standby position *b* is brought at position *d* on trackway **66**. Now by again actuating jack **53** and crank levers **59**–**59***a*, beams **52** are lifted to clear out said carrier so that it may be displaced by chains **55** to position *a* (FIG. 13). By lowering beams **52**, the carrier is lowered on frame **3**, then is locked on frame **4**, connected by cross beam **42**; then the rolling operation may be immediately started.

It is obvious that instead of effecting the abovementioned operations through the sequence *a*, *c*, *b*, *a*, it can be effected through the sequence *a*, *d*, *b*, *c*, *a*.

It should be understood that the abovementioned embodiments have been described in an illustrative rather than limitative manner and may receive any structural modifications without departing from the scope of the present invention.

For example, the arrangement of the abovedescribed housings or stands remains applicable whatever may be the shape and the structure of said housings, especially with respect to the number of reducing rolls and the kinematic chain transmitting the rolling speeds and torques to each roller.

For example, said kinematic chain associated with a rolling housing or stand may comprise:

(a) a single input shaft supporting one of the reducing rollers and driving, through gears, the other rollers in turn mounted on secondary shafts.

(b) one input shaft for every reducing roll, said roll being either driven directly by said shaft or, if it is supported by a secondary shaft, being driven through gears.

It should be noted also that instead of utilizing manoeuvering beams **52** actuated by jack **53**, for lifting and displacing the carrier, it is possible, as shown on FIGS. 11 and 12, to vertically displace wheels **51** by jacks **71** mounted on each side of the axis of wheels **51**.

In that case, the rails provided for the displacement of the carrier are all situated in the same plane.

Finally, especially for low capacity rolling mills, the coupling arrangement such as described in connection with FIG. 6 may be simplified by translating the casing **2** as a unit.

What is claimed is:

**1**. In a rolling mill comprising a plurality of roll housings, an elongated common frame for supporting said roll housings, an abutment on said frame, releasable means for clamping said roll housings as a group to said abutment, and a control unit for driving the rolls in said housings when said housings are clamped to said abutment, the improvement which comprises means for forcibly separating said roll housings from each other longitudinally of said frame when said clamping means is released.

**2**. A rolling mill as claimed in claim **1** in which said roll housings are provided with abutment surfaces which extend transversely of said common frame when said roll housings are mounted thereon, and said separating means comprises a rack equipped with teeth and power means for moving said rack from a first position in which said teeth permit said roll housing to be clamped together to a second position in which said teeth bear on said abutment surfaces and thereby hold said roll housings apart.

**3**. A rolling mill as claimed in claim **1** in which said roll housings comprise surfaces which extend transversely with respect to said supporting frame, and projections which extend from said surfaces longitudinally of said frame and thereby prevent the surfaces of adjacent roll housings from coming into contact with each other when said roll housings are clamped to said abutment.

**4**. A rolling mill as claimed in claim **1** in which said control unit comprises a separate transmission shaft for the rolls of each roll housing and each roll housing carriers an individual drive shaft which is aligned with a transmission shaft when said roll housings are clamped to said abutment, a coupling sleeve slidably carried on each transmission shaft, means biassing each coupling sleeve toward the drive aligned therewith, a projection extending from each transmission shaft into each sleeve, and resilient means carried by said projection which engages and guides the inner wall of said sleeve.

**5**. A rolling mill as claimed in claim **1** comprising a first set of wheels mounted on said supporting frame to

support said frame during longitudinal movement, and a second set of wheels mounted on said frame to support said frame during transverse movement.

6. A rolling mill as claimed in claim 5 comprising a set of rails for supporting each set of wheels and means for raising and lowering one set of rails to bring said one set of rails into and out of a position engaging a set of wheels.

7. A rolling mill as claimed in claim 6 comprising a plurality of parallel sets of rails for supporting said frame during longitudinal movement, and in which the set of rails which may be raised and lowered supports said frame for transverse movement, said rolling mill further comprising means for moving said frame along said last mentioned set of rails, when that set is in its raised position, from a position above one set of longitudinal rails to a position over another set of longitudinal rails.



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