June 7, 1955 F. PLATZER 2,709,934

ROLLING MILL

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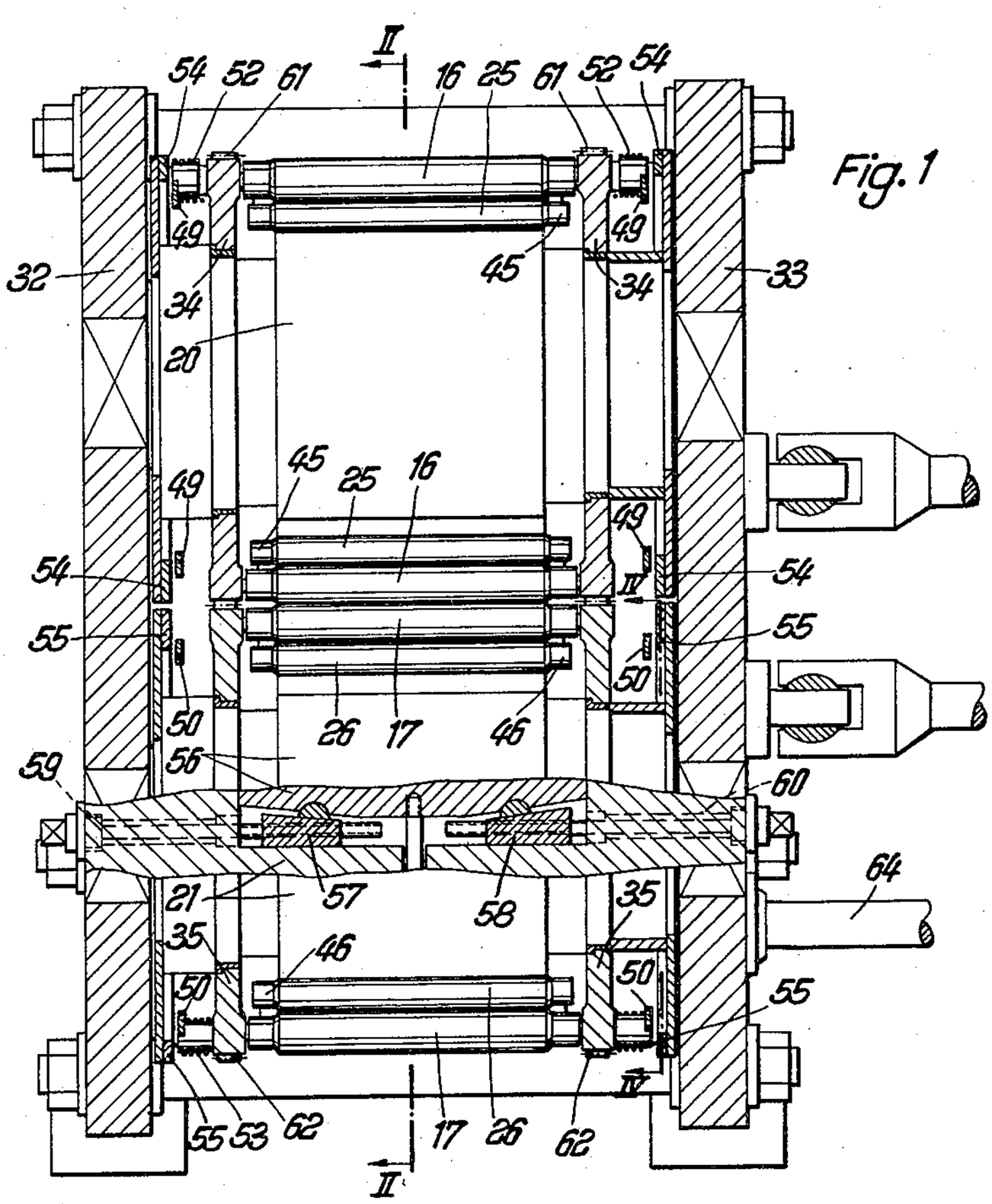

Fig. 1

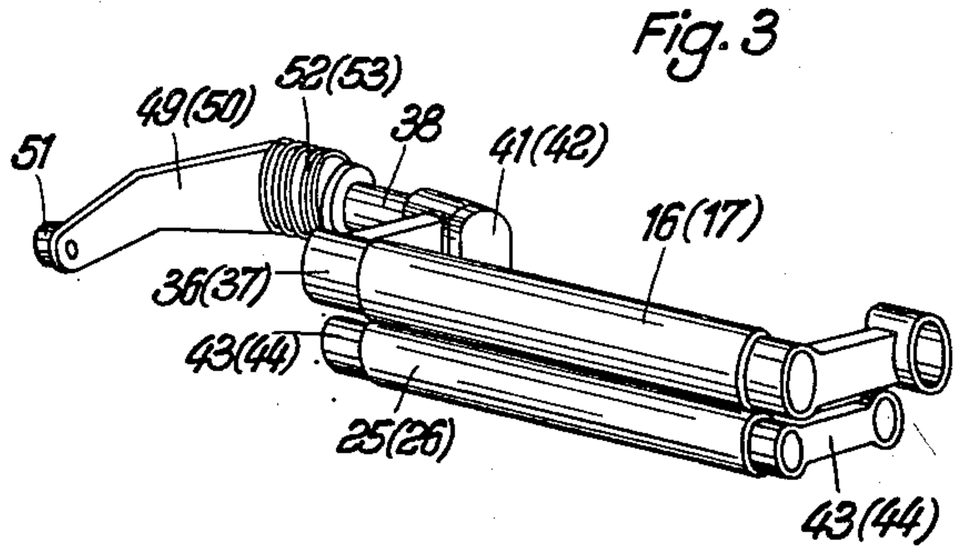

Fig. 3

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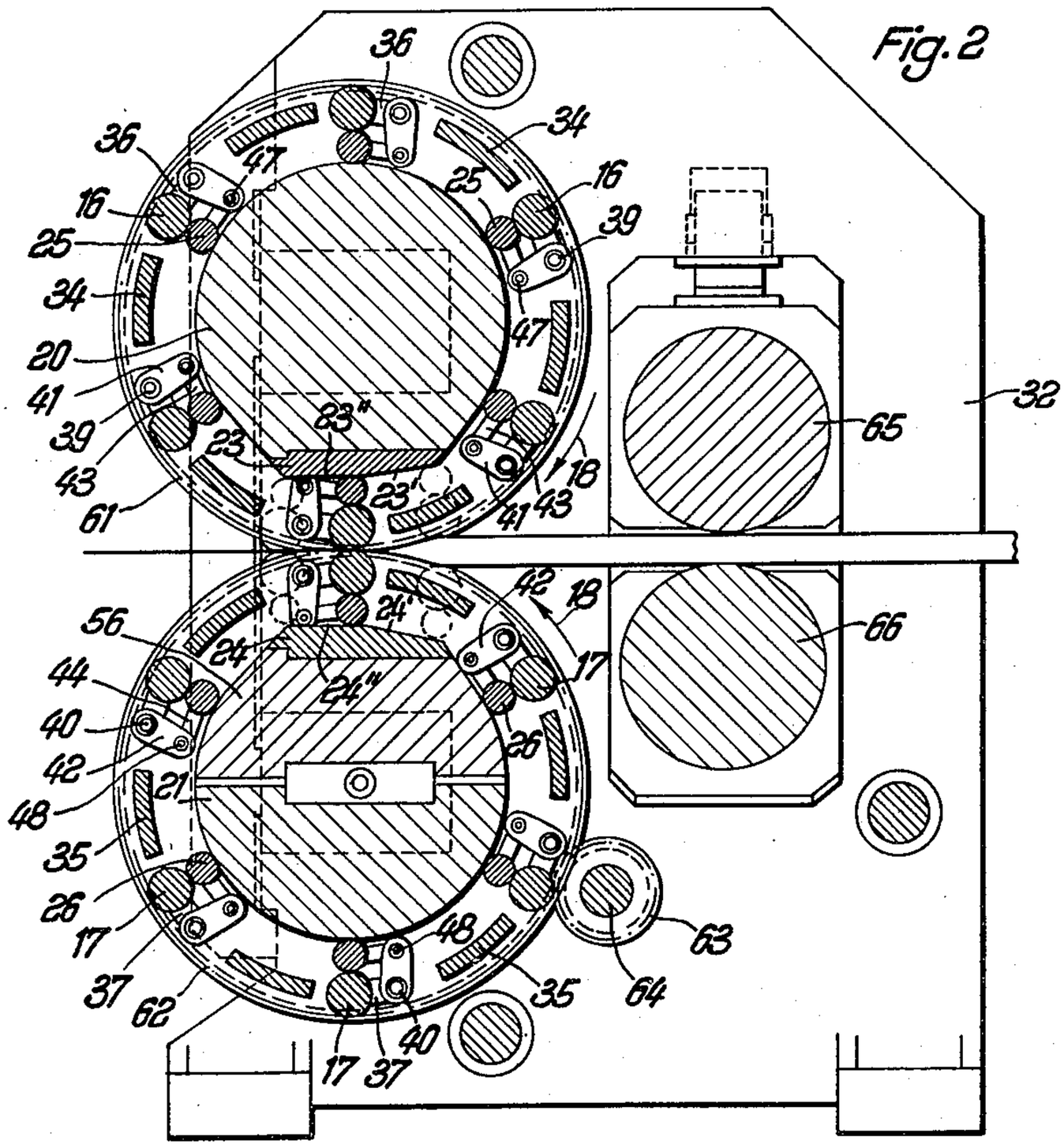
Fig. 2



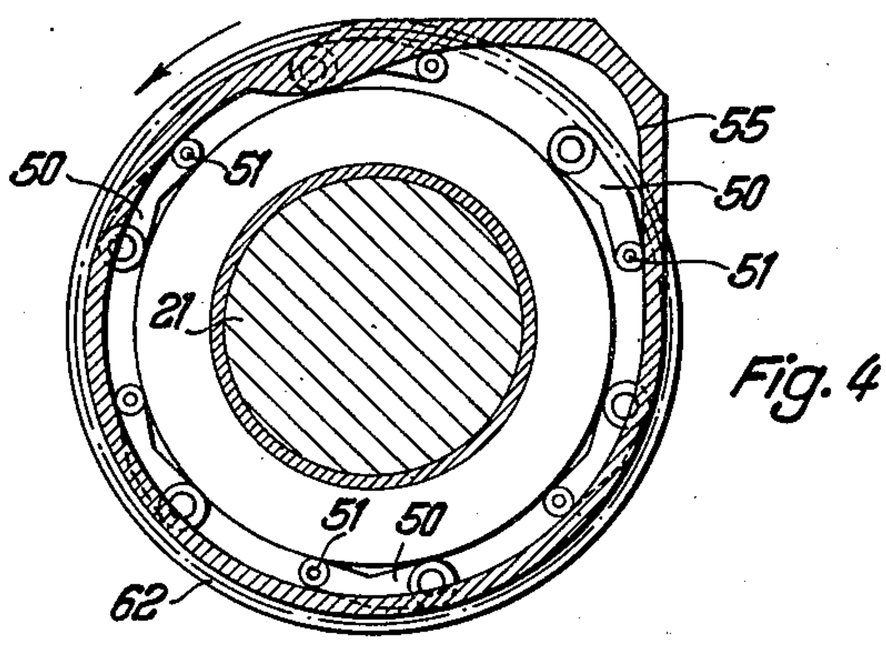


Fig. 4

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Fig. 5

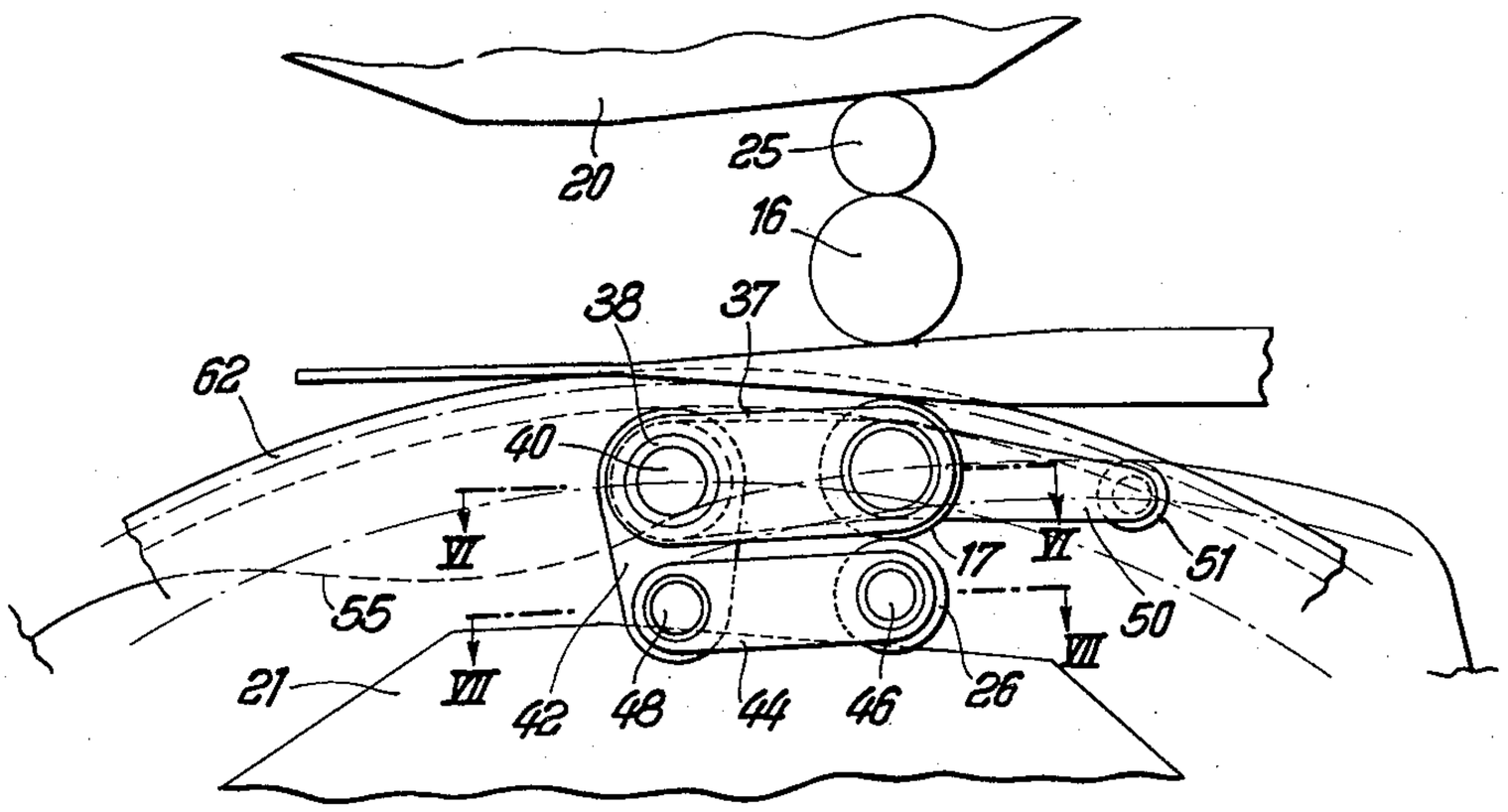


Fig. 6

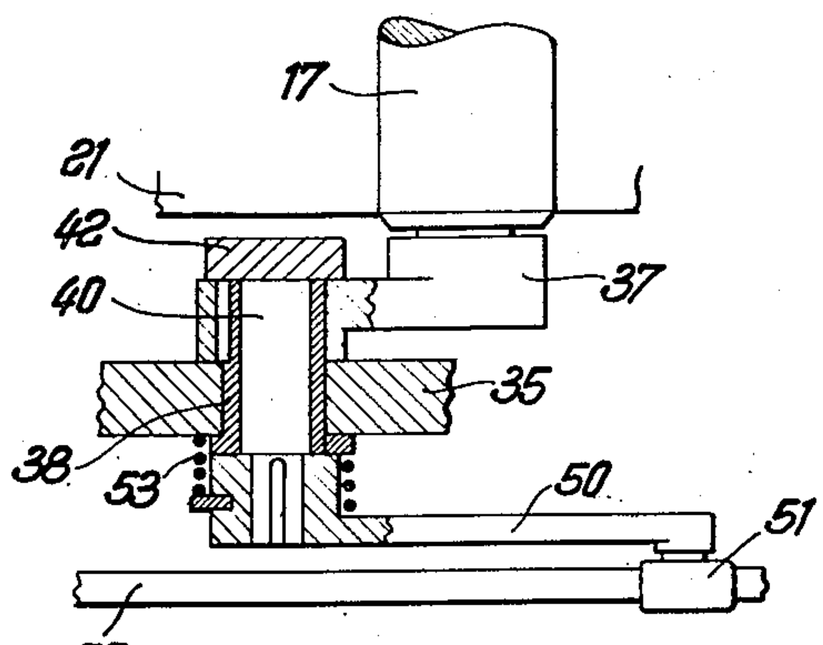
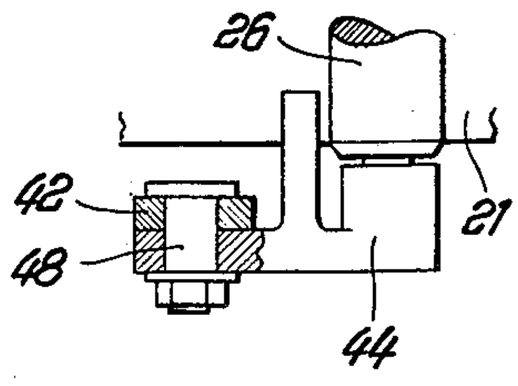


Fig. 7



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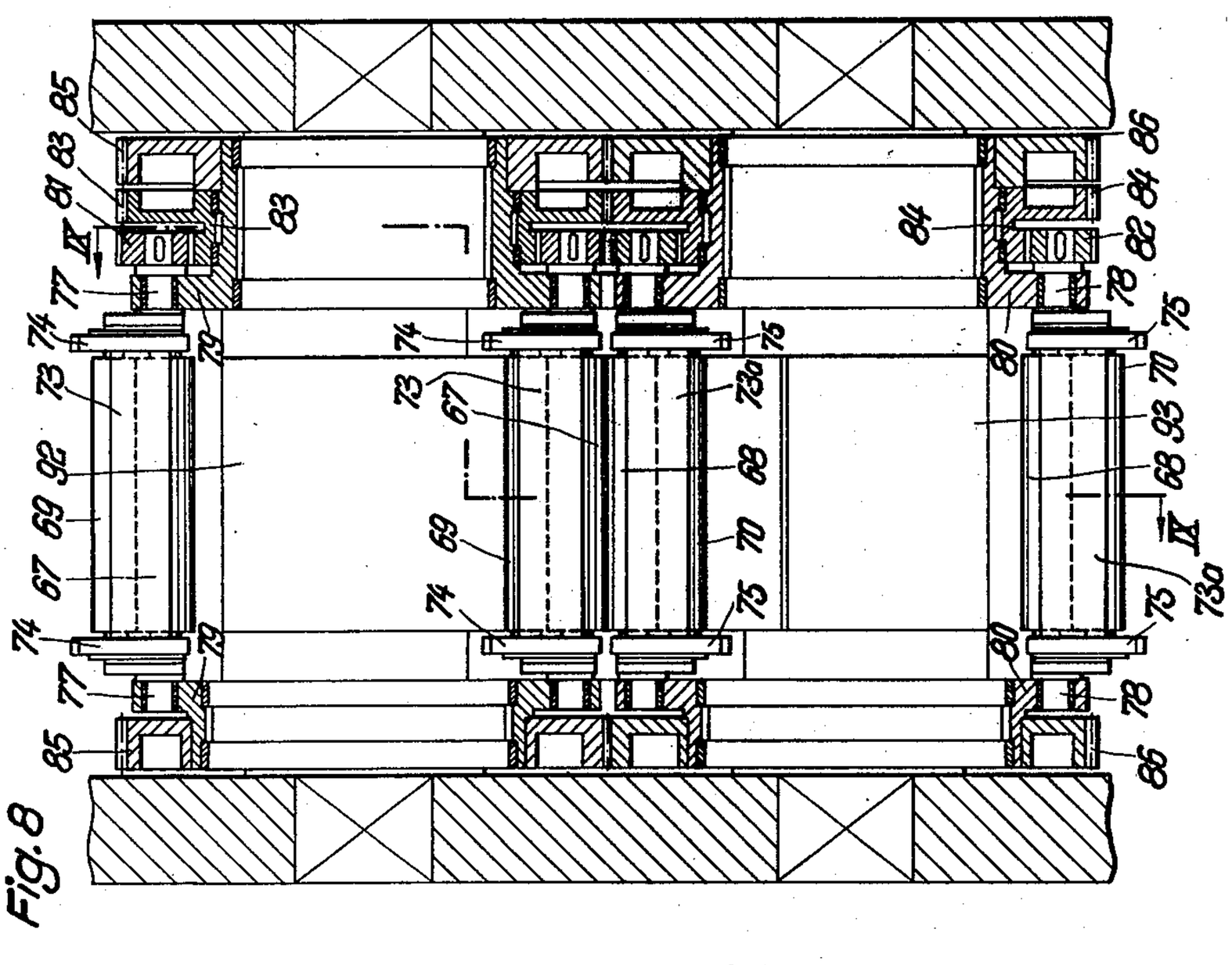

Fig. 8

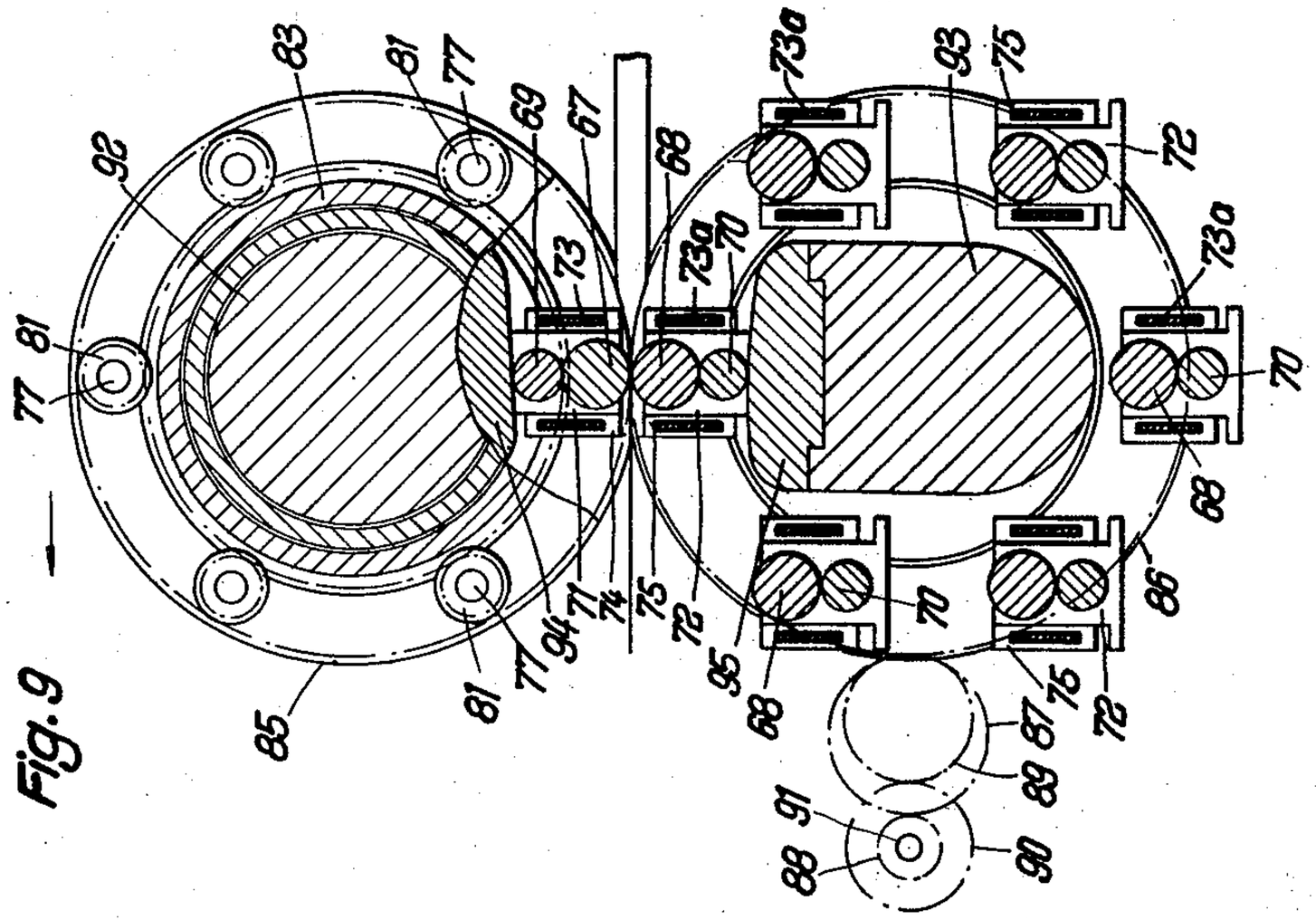

Fig. 9

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Fig. 10

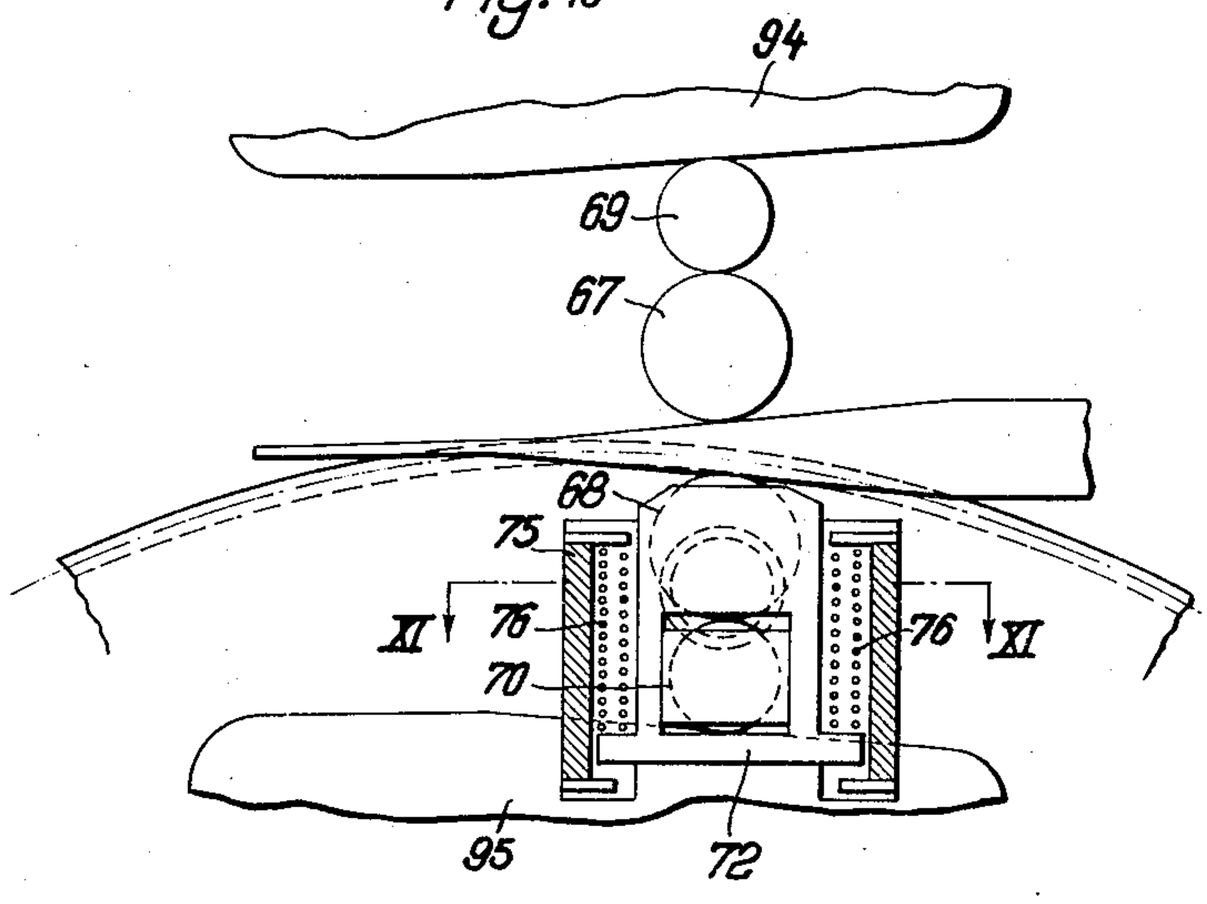


Fig. 11

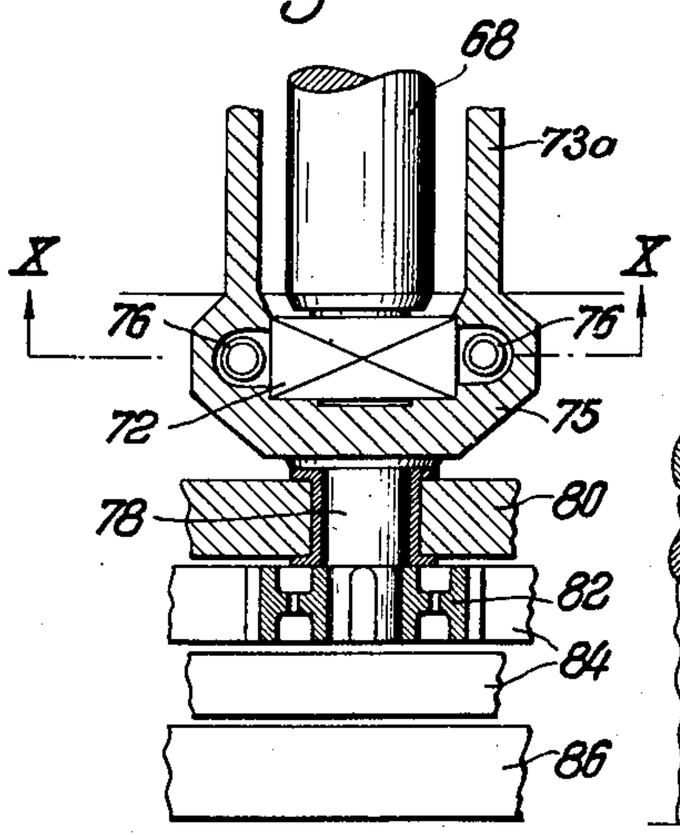
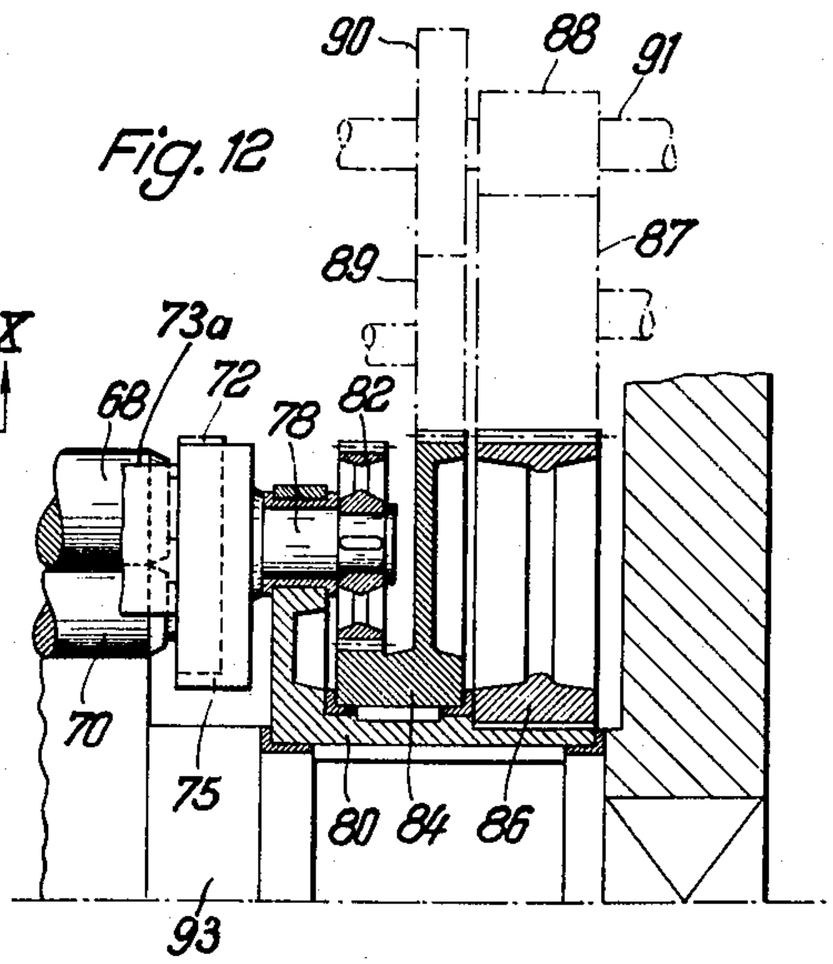


Fig. 12



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ROLLING MILL

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Application September 2, 1954, Serial No. 453,741

Claims priority, application Germany September 18, 1953

9 Claims. (Cl. 80—38)

The present invention relates to the art of rolling stock, more particularly metallic stock.

The invention is particularly directed to such an installation which includes at least one pair of working or shaping rollers which during the rolling operation roll along the stock to be rolled and during such operation are supported by intermediate or backing rollers which latter during contact of the working or shaping rollers with the stock roll on stationary tracks.

The invention is particularly directed to such an arrangement in which the intermediate or backing rollers, during contact of the working rollers with the stock, roll on guide tracks or surfaces having portions initially converging, subsequently parallel and then diverging in relation to the direction of feed of the stock.

In accordance with the present invention, the rolling installation provides for continuous rolling and during which process the working and intermediate rollers are connected with driving means guided about stationary endless tracks, and while the working rollers effect the shaping of the stock the central axes of these rollers and the intermediate rollers lie in a common plane perpendicular to the direction of rolling. From another aspect the distance between successive shaping rollers is greater than the shaping distance lying between them.

The present invention has for an object to provide an apparatus for rolling stock in which the above mentioned characteristics are attained while avoiding the conventional large and expensive roller journals, thus providing an installation which as demonstrated by tests provides a particular efficient and safe rolling operation.

The invention substantially consists in a rolling installation or arrangement in which rigid roller cages are journalled for rotation about stationary roller supporting members and which cages carry the shaping and intermediate rollers which rollers are mounted or arranged in pairs.

The mounting of the rollers is such that the pairs of shaping and working rollers swing relative to one another.

The invention provides an arrangement in which the shaping rollers can be pivoted by means of levers to the roller cages and can be connected through a linkage of the four links or quadrangular type with the intermediate rollers and also with a control lever which includes a roller that is spring pressed against a curvi-linear control path.

As a further aspect of the invention the shaping and intermediate rollers can be journalled with their trunnions in housings which are slidable in guides with spring means incorporated between the housing and guides and in which arrangement the guides are journalled in roller cages and include trunnions having planetary gears thereon in mesh with control wheels or gears rotatably mounted on the roller cages.

Further and more specific objects will be apparent from the following description taken in connection with the accompanying drawings illustrating two embodiments of the invention, and in which:

Figure 1 is an end view partly in section and partly in elevation of one form of a rolling installation;

Figure 2 is a sectional view taken on lines II—II of Figure 1;

Figure 3 is a perspective view on an enlarged scale showing certain components of the roller mountings in detail;

Figure 4 is a cross sectional view taken on lines IV—IV of Figure 1;

Figure 5 is a view on an enlarged scale illustrating a detail of Figure 2;

Figure 6 is a fragmentary view partly in section and partly in elevation taken on lines VI—VI of Figure 5;

Figure 7 is a fragmentary view partly in section and partly in elevation taken on lines VII—VII of Figure 5;

Figure 8 is a view similar to Figure 1 but illustrating a modified form of rolling installation;

Figure 9 is a sectional view taken on lines IX—IX of Figure 8;

Figure 10 is a view on an enlarged scale and partly in section illustrating a detail of Figure 9 and taken on lines X—X of Figure 11;

Figure 11 is a fragmentary view partly in section and partly in elevation and taken on lines XI—XI of Figure 10; and

Figure 12 is a fragmentary view partly in section and partly in elevation of the details illustrated in Figures 10 and 11, and including a showing of the drive mechanism.

With particular reference to the embodiment of Figures 1–7, the rolling installation includes roller standards **32** and **33** between which are fixedly supported in superimposed relationship stationary, roller shaped supporting members. These supporting members **20, 21** are engaged by uniformly spaced angularly related intermediate rollers **25** and **26**. The rollers **25** engage supporting member **20** and rollers **26** engage supporting member **21**. During the rolling operation the intermediate rollers are guided together with the shaping rollers **16** and **17** for movement about the supporting members in the direction of arrow **18**.

On the portions of the supporting members facing one another are inserted guide pieces **23** and **24** preferably constructed of a material that is highly resistant to wear. These guide pieces include surfaces forming converging track surfaces **23′**, **24′**, and portions providing parallel surfaces **23″** and **24″**. The peripheral surface of the supporting members extends laterally on both sides of the guide pieces beyond the circular path of said members so that the peripheral surface forms converging as well as diverging track portions. This is clear from Figure 2.

As shown in Figure 1 the supporting members are stepped down or reduced between the respective standards and the portions contacted by the rollers **25** and **26**. Roller cages **34** and **35** are mounted for rotation on one of these stepped down or reduced portions of the respective supporting members. These cages are driven as set forth hereinafter and the shaping rollers **16, 17** are respectively pivotally mounted to the cages by levers **36** and **37**. The levers **36** and **37** are fixed to bushings **38** which in turn are journalled in apertures in the respective roller cages **34** and **35**. Rods **39** extend through the bushings **38** carried by the roller cage **34** and rods or pins **40** extend through the bushings **38** carried by the roller cage **35**. At the ends facing the supporting members **20** and **21**, the rods or pins **39** and **40** have respectively rigidly connected therewith levers **41** and **42**. These levers are respectively connected by straps **43** and **44** with supporting trunnions **45, 46** of the intermediate rollers **25, 26** by means of bolts **47** and **48**. This ar-

rangement results in a four-link or quadrangular linkage constituted by the central axes of the rollers and of the pins or bolts 39 and 40 and 47, 48, together with the levers and strap members connecting them, see Figure 5.

In order that during shaping or rolling the central axes of the rollers lie in a common plane perpendicular to the rolling direction, the linkage arrangements are moved about pins 39 and 40 shortly before the intermediate rollers roll onto the converging track sections and the perpendicular relationship of the pairs of rollers is maintained in adaptation to the shape of the respective track sections up to the moment when the intermediate rollers roll off from the parallel track sections or portions. This movement and control of the pairs of rollers is brought about by control levers 49 and 50 splined respectively onto the ends of pins or bolts 39 and 40. On the ends of these control levers are journalled rollers 51 and under the influence of spiraled springs 52, 53 the respective control levers 49 and 50 are spring urged in such direction that the rollers follow curvi-linear control paths 54 and 55. These control paths are provided by internal stationary cams. The springs 52, 53 act between the bushings 38 and thereby levers 36 or 37 respectively and shaping rollers 16 or 17 on the one hand, and the control lever 49 or 50 on the other hand, so that in addition to the fact that the rollers 51 are held against the cams the shaping rollers are constantly urged by the springs 52 or 53 against the respective supporting members.

In order to adjust the roller gap and thereby the final thickness of the stock the lower supporting member 21 is provided with a guide element 56 adapted to be raised and lowered toward or away from the supporting member 20. The guide element 56 carries the inserted guide piece 24 and can be adjusted by means of wedges 57 and 58 that are respectivelv displaceable in opposite directions by means of screw spindles 59, 60 so that the guide element 56 can be adjusted to different heights. If desired, a similar structure including a movable guide element mounted for movement toward and away from the lower supporting member can be incorporated in the upper supporting member.

The roller cages 34 and 35 are respectively provided at their peripheries with ring gears 61, 62 which are in mesh with each other in order to obtain synchronous rotation. The gear rings and thus the cages are driven by pinions 63 fixed to shaft 64.

The stock to be rolled is fed forwardly by a pair of driving rollers 65, 66 with the feed being in such manner that the advance always occurs at the moment when the intermediate rollers have rolled off the parallel track portions and are engaging the diverging track portions with the next successive pairs of intermediate rollers having not yet rolled onto the converging tracks and thus not as yet approaching each other to such an extent that the shaping rollers engage the stock. Thus at any one period only one pair of working rollers is engaged in shaping. The drive for the roller cages and the drive for the feed rollers are derived from the same driving mechanism, not shown.

In the embodiment shown in the Figures 8 to 12 the control of the shaping and intermediate rollers is effected by means of planetary gearing. More particularly these rollers are constantly guided to such relative positions that the central axes of all coacting, shaping and intermediate rollers lie in a common plane perpendicular to the direction of rolling. Also in this form of the invention the spacing of successive rollers is longer than the shaping distance between them. In this modification the shaping rollers 67, 68 and their respective cooperating intermediate or backing rollers 69 and 70 have their trunnions journalled respectively in housings 71, 72. The respective pairs of shaping or working rollers and intermediate rollers are mounted with their housings in a common body 73, 73*a* extending from one side to the other of the rolling installation, which body at its opposite ends forms guides 74, 75. In these guides the housings 71, 72 are

slidable and urged apart by springs 76. The guides 74, 75 are respectively provided with trunnions 77, 78 which are rotatably mounted in roller cages 79 and 80. The roller cages 79 and 80 are journalled on reduced portions of the stationary supporting members 92, 93. At one side of the installation the trunnions 77, 78 are elongated and extend beyond their journalling apertures in the cages and have splined thereon planetary gears 81 and 82 respectively. These gears are respectively in mesh with control wheels 83 and 84 which in turn are journalled on the roller cages 79, 80. On both sides of the respective roller cages are splined ring gears 85 and 86 and which ring gears have the same pitch circle diameter as control wheels 83 and 84 that are mounted between the ring gears and the planetary gears 81, 82.

During a rotation of the roller cages 79 and 80 the guides 74, 75 together with the shaping and intermediate rollers must be turned back by 360° in order to maintain their position in space in which the central axes of each pair of shaping and intermediate rollers lie in a common vertical plane. In order to achieve this result the drive for the control wheels 83, 84 and gear rings 85, 86 are so constructed that the control wheels have a higher rotational speed corresponding to a rotation of the planetary gears with a rotation of the gear rings.

In Figure 9 the pitch circles of driving gears 87 to 90 are drawn in at the place where they are arranged in the installation whereas in Figure 12 these gears are diagrammatically illustrated in dot-dash lines at a place offset from their actual location for the purposes of clarity. Since the gear rings 85 and the control wheel 83 of the upper half of the installation mesh with the gear rings 86 and the control wheel 84 of the lower half of the installation a completely uniform rotation of the axes of the shaping and intermediate rollers is assured. The gear 87 meshes with gear ring 86. The gear 87 is driven by pinion 88 which together with pinion 90 is fixed on a common drive shaft 91. Drive pinion 90 meshes with an intermediate gear 89 which in turn meshes with control wheel 84. The transmission ratio of the gear pairs 87, 88 and 89 and 90 are so selected that for the purpose of turning back the guides 74 and 75 and thereby the shaping and intermediate rollers, the planetary gears 81, 82 with one rotation of the roller cages carry out an additional rotation by 360°.

The construction of the rolling apparatus in this modification otherwise conforms to that of the first embodiment insofar as the general features are concerned. The supporting members 92 and 93 are stationary elements having a vertically elongated cross section. The intermediate rollers 69 and 70 abut guide elements 94 and 95 inserted into the supporting members in advance of the shaping distance and leave these guide elements shortly after the shaping distance. The arrangement can also be carried out so that the shaping rollers first engage the stock and immediately thereafter the intermediate rollers run up onto the guide pieces 94, 95. During the passage through the shaping distance the shaping rollers in rolling off the stock press the intermediate rollers due to the start of the rolling process in the direction toward the guide pieces 94, 95.

As already mentioned the spacing of successive working rollers is greater than the shaping distance between them or, in other words, greater than the length of the deformation surface on the material to be rolled. Consequently during the rolling operation a pair of working rollers will come out of engagement while the successive pair of working rollers have not yet reached the material. This is the position for feeding the material taking place in steps.

The housings 71, 72, in which are journalled the rollers 67 to 70, are slidable in the guides 74, 75 provided in the ends of the common body 73, 73*a* extending across the space between the cages 79 and 80. Springs 76 are arranged on both sides of the housings and between abut-

ments of the housings on the one hand and of the guides on the other hand. By this arrangement the springs have the tendency to hold the intermediate rollers **69, 70** in contact with the guide elements **94, 95**, see Figures 9 and 10.

In the following the movement of the quadrangular linkage as appearing in Figure 5 will be explained in detail. As shown in Figure 2 the central axes of each pair of rollers **16, 25** and **17, 26** lie in a radial plane with respect to the central axes of the supporting members **20** or **21**, when surrounding the circular surface of said members. During the shaping or rolling period the central axes of two pairs of rollers lying between the guide pieces **23, 24** must lie in a common plane perpendicular to the rolling direction, see Figure 2. Consequently each pair of rollers entering the space between the guide pieces must be turned at first in counter-clockwise direction and then after passing the vertical centre line of the guide pieces has to be turned in clockwise direction. These turning movements are executed by the quadrangular linkage. Shortly before the intermediate roller **26** (see Figures 4 and 5) rolls onto the converging track portion **24'** the journalled roller **51** following the curvi-linear control path **55** by the influence of the spiral spring **53** will move outwardly so that the control lever **50** and the lever **42** rigidly connected with said control lever are turned in counterclockwise direction and the strap **44** with the roller **26** is moved to the right. As soon as the roller **51** reaches that part of the control path **55** running inwardly the aforesaid movements will take place in opposite sense.

The installations aforedescribed are adapted for hot as well as cold rolling of bands and with the corresponding shape of the working rollers the installations can be adapted for rolling profile and round rods.

What I claim is:

1. An installation for rolling material especially metallic material including superposed spaced stationary guide means between which material to be rolled passes, a rigid roller cage means rotatably mounted on each guide means, roller means carried by each cage means including working rollers for rolling the material and intermediate rollers, said rollers being mounted in pairs and swingable relative to one another and each pair including a working roller and an intermediate roller.

2. An installation for rolling material especially metallic material as claimed in claim 1 in which levers pivotally connect the working rollers to the roller cage means, a control lever for each pair of rollers, linkage means connecting the working roller of each pair to the associated intermediate roller and control lever, means defining a curvi-linear control path determining the position of the pairs of rollers relative to the material as it passes between and in contact with the working rollers and spring urged follower means carried by the levers for maintaining the same in contact with the means defining the control path.

3. An installation for rolling material especially metallic material as claimed in claim 1 in which the ends of the working and intermediate rollers include trunnions, a housing means journalling the trunnions of each associated pair of rollers, a mounting body common to each associated pair of rollers and extending from one side of the installation to the other, and including guides at its opposite ends, said housing means being slidable in the guides, spring means biased between the guides and the housing means and operative to urge the housings away from the rolling path, the mounting bodies including external trunnions at at least one end and journalled in the roller cage means, planetary gears secured to the last mentioned trunnions and drivable control gears rotatably mounted on each roller cage means and meshing with said planetary gears.

4. An installation for rolling material especially metallic material as claimed in claim 3 in which the central median axis of each roller of each pair of rollers lies in

a common plane perpendicular to the direction of rolling during rotation of the roller cage means, ring gears fastened on the roller cage means, the said controlled gears having the same pitch center diameter as the ring gears and a driving mechanism connected to the control gears and the ring gears and having a transmission ratio such that in order to turn back the planetary gears and thus the mounting bodies, the guides, the housings and thereby the pairs of rollers, the planetary gears with each rotation of the roller cage means effect an additional rotation of 360°.

5. An installation for rolling material especially metallic material as claimed in claim 1 in which at least one of the stationary guide means includes a movable guide element facing a space between the guide means and means for raising and lowering the said element for adjusting the roller gap.

6. In an apparatus for rolling metallic stock, spaced standards, superposed stationary guide means supported between the standards in spaced relation relative to one another, said guide means including facing surfaces defining track portions which with reference to the direction of movement of stock between the said guide means include successive converging parallel and diverging surfaces, roller cage means journalled on each stationary guide means, uniformly spaced pairs of rollers carried by each roller cage means and each pair including a working roller for engaging the metallic stock to be rolled and an intermediate roller for engaging the track surfaces, means mounting the pairs of rollers for swinging movement relative to one another, control means determining the position of the pairs of rollers responsive to rotation of the roller cage means and operative to dispose the rollers of each pair with their axes in a common plane perpendicular to the direction of rolling at least during the interval when the intermediate roller engages the converging and parallel track surfaces and means for synchronously rotating the cage means whereby the successive working rollers of each pair associated with one of the guide means cooperate with the successive working rollers of each pair associated with the other guide means to effect rolling of the stock.

7. In an apparatus for rolling metallic stock as claimed in claim 6 in which the control means includes a stationary internal cam surrounding the axis of the roller cage means, lever means connecting the working roller of each pair to the roller cage means and pivotally mounted relative to the cage means, said control means further including a control lever for each pair of rollers, quadrangular linkage means connected between the control lever and the rollers of each pair, each said control lever including a roller engaging the cam means and means biasing the lever and thus the roller against the cam so that responsive to the rotation of the roller cage means the control lever follows the path determined by the shape of the cam.

8. In an apparatus for rolling metallic stock, spaced standards, superposed stationary guide means supported between the standards in spaced relation relative to one another, said guide means including facing surfaces defining track portions which with reference to the direction of movement of stock between the said guide means include track surfaces approaching and then receding from the median plane betwen the guide means, roller cage means journalled on each stationary guide means, uniformly spaced pairs of rollers carried by each roller cage means and each pair including a working roller for engaging the metallic stock to be rolled and an intermediate roller for engaging the track surfaces, means for synchronously rotating the roller cage means and means for controlling a position of the pairs of rollers during rotation of the cage means so that the central axis of each roller of each pair lies in a common plane perpendicular to the direction of rolling at least during contact with the metallic stock whereby successive working rollers of

each pair carried by one cage means cooperate with successive working rollers of each pair carried by the other cage means to effect rolling with the intermediate roller of each successive pair engaging the track surfaces during rolling.

9. In an apparatus for rolling metallic stock as claimed in claim 8 in which each pair of rollers is swingably mounted relative to the cage means and the control means includes gearing for swinging the pairs of rollers during rotation of the cage means to maintain the central median axis of each roller of each pair in a common plane perpendicular to the direction of rolling during rotation of the cage means.

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