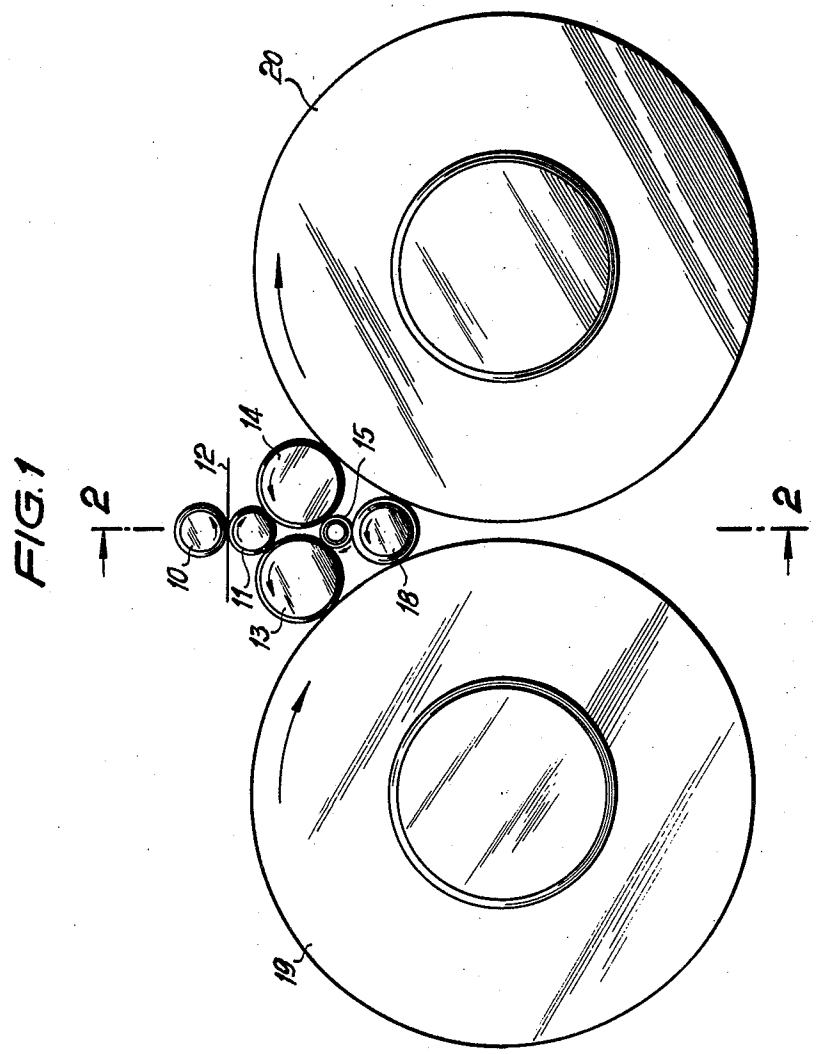
July 23, 1963 H. S. METZGER 3,098,403

ROLLING MILL STRUCTURE

Filed April 11, 1960 4 Sheets-Sheet 1

FIG. 1



INVENTOR

H. S. Metzger

By Glascock Downing Seebold

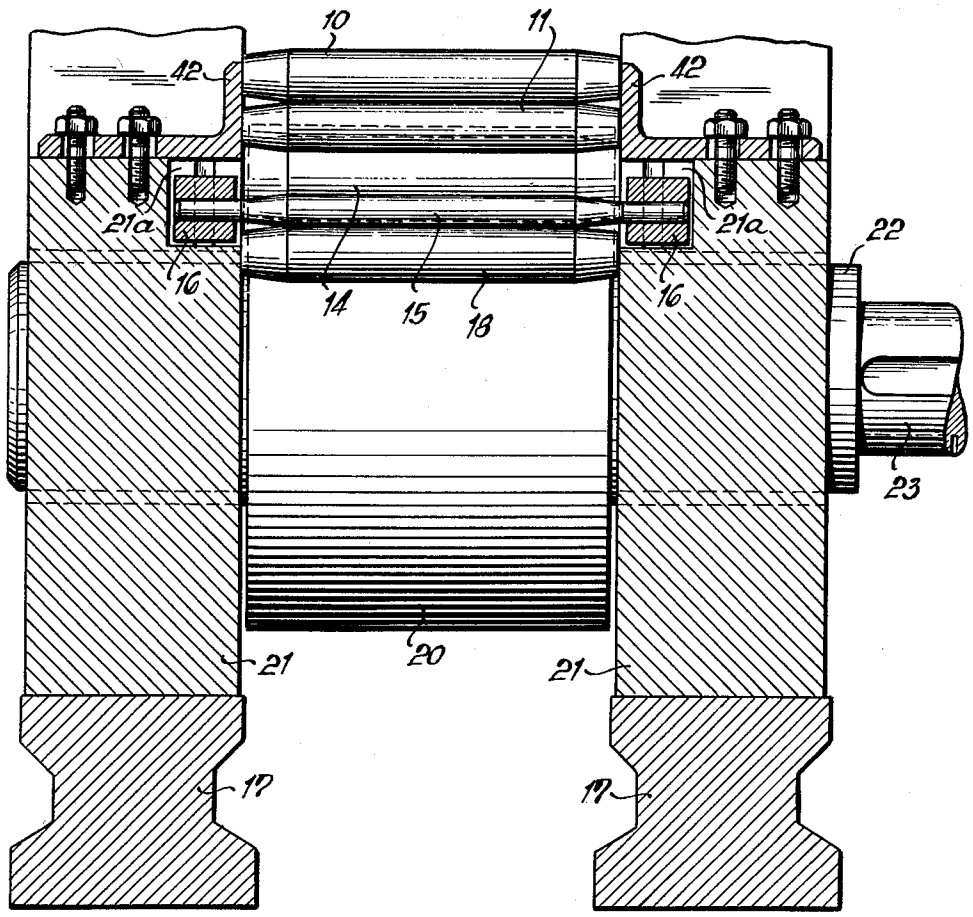
ATTYS.

July 23, 1963 H. S. METZGER 3,098,403

ROLLING MILL STRUCTURE

Filed April 11, 1960 4 Sheets-Sheet 2

FIG. 2



INVENTOR

H. S. Metzger

By Glascock Downing Seebold

ATTYS.

July 23, 1963 H. S. METZGER 3,098,403

ROLLING MILL STRUCTURE

Filed April 11, 1960 4 Sheets-Sheet 3

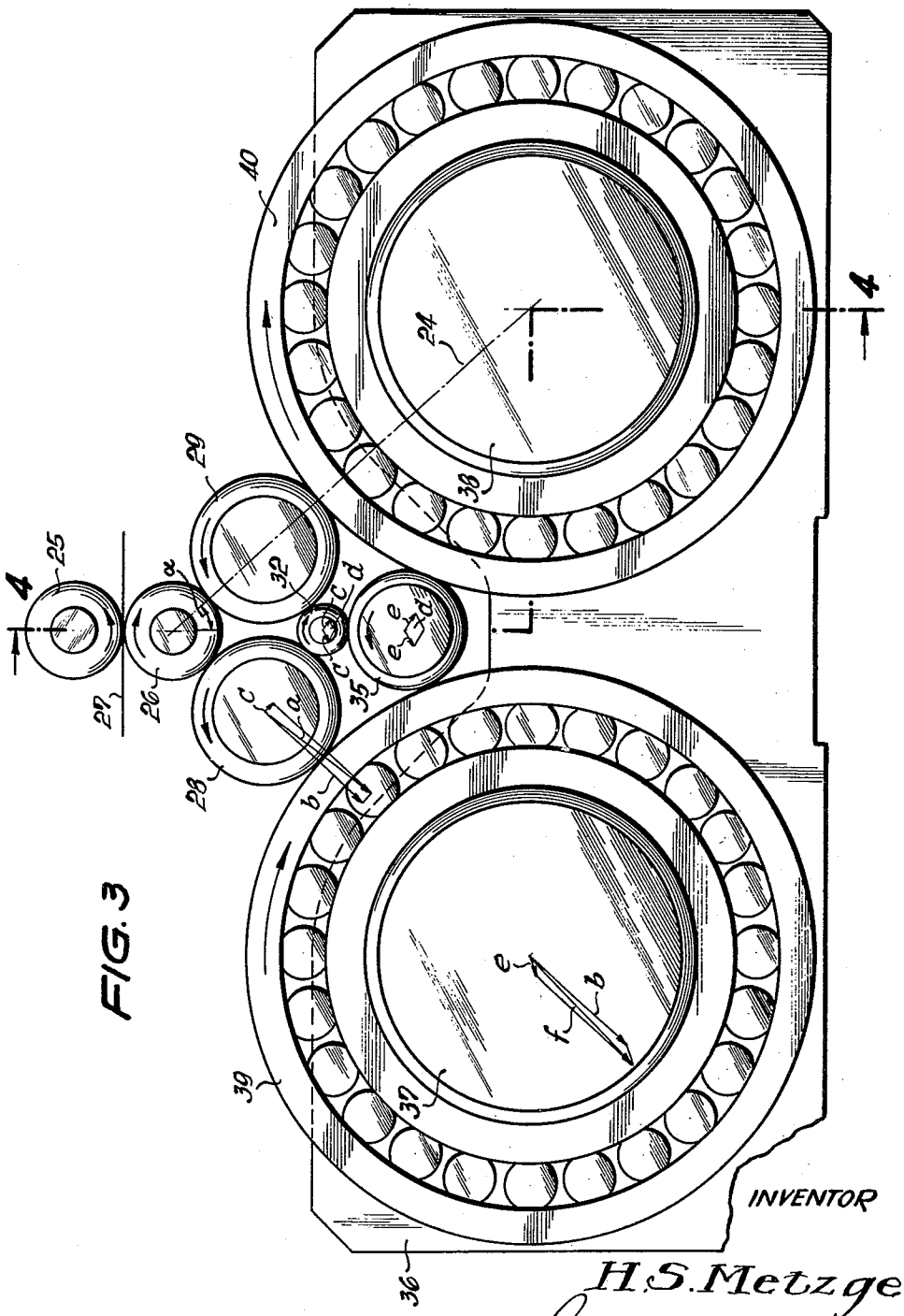


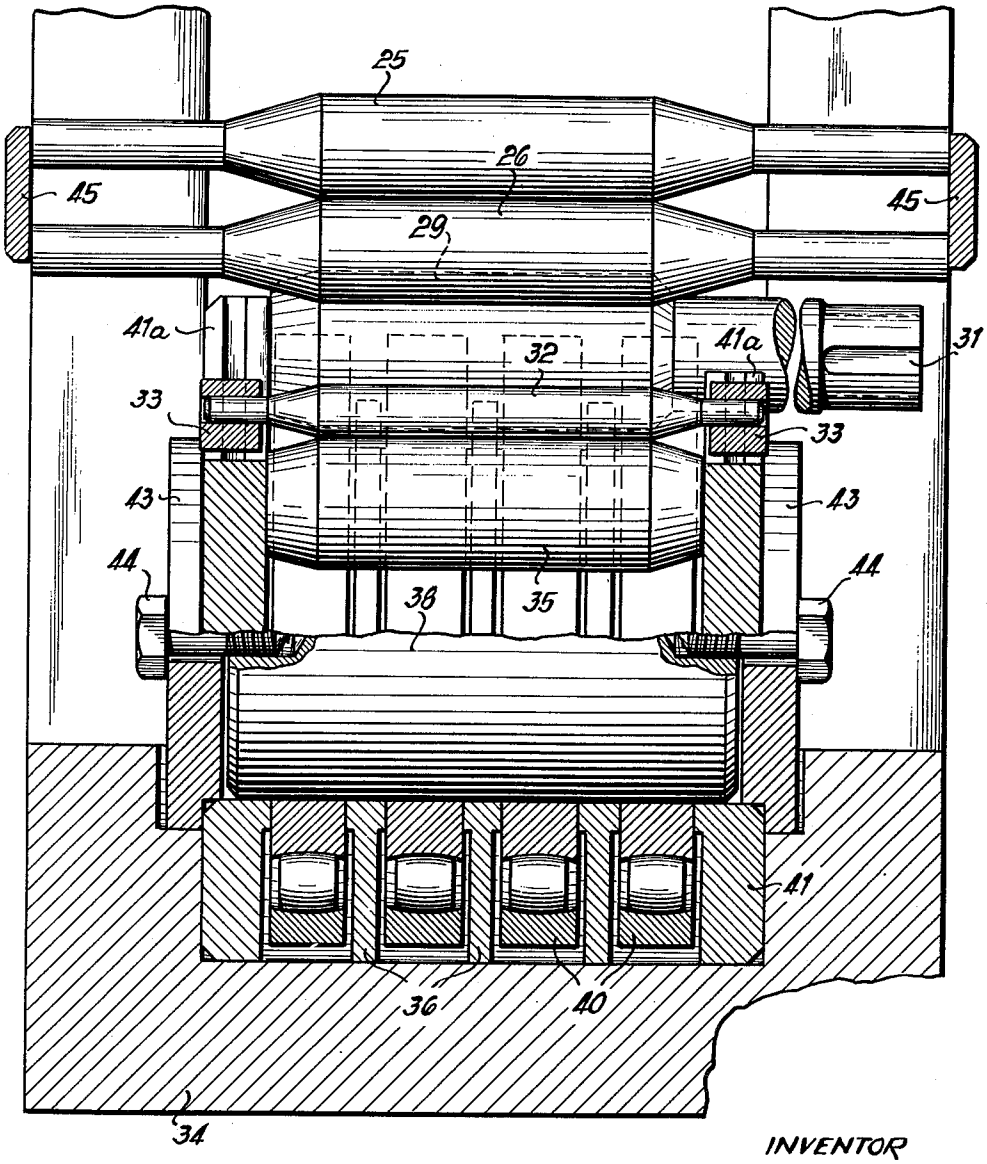
FIG. 3

July 23, 1963 H. S. METZGER 3,098,403

ROLLING MILL STRUCTURE

Filed April 11, 1960 4 Sheets-Sheet 4

FIG. 4



INVENTOR

H. S. Metzger

By Pearson Downing Reebold

ATTYS.

United States Patent Office 3,098,403 Patented July 23, 1963

3,098,403

ROLLING MILL STRUCTURE

Hans Siegfried Metzger, St. Ingbert (Saar), Germany, assignor to Moeller & Neumann G.m.b.H., St. Ingbert (Saar), Germany

Filed Apr. 11, 1960, Ser. No. 21,203
Claims priority, application Germany Apr. 11, 1959
7 Claims. (Cl. 80—38)

This invention relates to metal working and more particularly to a rolling mill structure specifically designed to make possible the use of working rolls of abnormally small diameters.

In certain types of rolling mill operations, it is desirable to utilize working rolls of relatively small diameters, but in mills where the working rolls are directly driven, the minimum diameter of rolls which may be utilized has been determined by the strength of the rolls in relation to the capacity thereof for transmitting the necessary torque. As a result of this strength factor, it has not been possible in mills of this type to reduce the diameter of the working rolls as much as desirable.

Various solutions to this problem have been proposed and tested and one of these solutions involves the use of ten rolls, including the working roll on each side of the rolling plane. The working rolls in this type of mill are supported and driven frictionally by intermediate and backing rollers and in addition to the space required for accommodating the large number of rolls required in this type of mill there is also the question of cost of manufacture and maintenance which is obviously relatively high. Other solutions have involved relatively complex supporting and driving rollers arranged in various relationships and in which relatively complex supporting structure for the various rolls has been employed and obviously these mills also present troublesome questions of space requirements and cost.

It has been found that a satisfactory solution to the problem of utilizing working rolls of abnormally small diameters may be provided by utilizing a particular arrangement of seven rolls, including the working roll on each side of the rolling plane and this solution materially reduces the space and cost requirements when compared with the previously utilized twenty roll mills.

It is accordingly an object of the invention to provide a rolling mill structure which may be conveniently and economically constructed and which will occupy a minimum of space while providing for the use of working rolls of abnormally small diameters.

A further object of the invention is the provision of a rolling mill structure permitting the use of working rolls of abnormally small diameters and in which such working rolls are supported and driven by a system of rollers, this system including a pair of relatively large backing rollers which are driven and which in turn frictionally drive the working rolls through the remainder of the roll system.

A still further object of the invention is the provision of a rolling mill structure permitting the use of working rolls of abnormally small diameters and utilizing a system of rolls for supporting and frictionally driving the working rolls and in which it is necessary to provide bearing supports for only a pair of relatively large driven backing rolls and one relatively small center roll disposed in the plane of the axes of the working roll.

Another object of the invention is the provision of a rolling mill structure permitting the use of working rolls of abnormally small diameters and in which the working rolls are supported and frictionally driven by additional rolls and in which the rolls to which driving power is applied may be of relatively large diameter thereby providing adequate strength for transmission of the necessary torque.

A further object of the invention is the provision of rolling mill structure permitting the use of working rolls of abnormally small diameters and in which the working rolls are supported and frictionally driven by additional rolls and in which the contacting surfaces of all of the rolls may be continuous from end to end.

A still further object of the invention is the provision of a rolling mill structure permitting the use of working rolls of abnormally small diameters, each working roll being engaged and supported by a pair of horizontally spaced intermediate rolls which also engage a pair of horizontally spaced relatively large diameter driven backing rolls, the intermediate rolls also being engaged by a central roller disposed in the plane of the axes of the working rolls with such central roller being supported in vertically movable bearings and also a supporting roll disposed in the plane of the axes of the working rolls and engaging the center rolls, as well as the two backing rollers, the roll system providing for support and frictional drive of the working rollers.

Another object of the invention is the provision of a rolling mill structure permitting the use of working rolls of abnormally small diameters and in which each working roll is supported by a pair of horizontally spaced driven intermediate rolls, which intermediate rolls are in turn engaged and supported by horizontally spaced backing rolls of relatively large diameter, the intermediate rolls also being engaged by a central roll disposed in the plane of the axes of the working rolls and supported in bearings for vertical movement, such central roll being in turn engaged by a supporting roll which also engages the two backing rolls.

A further object of the invention is the provision of rolling mill structure permitting the use of working rolls of abnormally small diameters and in which such working rolls are supported by a pair of driven intermediate rolls which in turn are supported by relatively large diameter backing rolls, the backing rolls being formed as a series of axially spaced individual rollers mounted on fixed axes, the intermediate rolls also being engaged by a central roll disposed in the plane of the axes of the working rolls and supported in bearings for vertical movement, there also being a supporting roll engaging the central roll and the two backing rolls.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a diagrammatic view showing the arrangement of rolls and a rolling mill structure constructed in accordance with this invention;

FIG. 2 a sectional view taken substantially on the line 2—2 of FIG. 1;

FIG. 3 a diagrammatic view similar to FIG. 1, but showing a modified form of the invention; and

FIG. 4 a sectional view taken substantially on the line 4—4 of FIG. 3.

With continued reference to the drawings, there is shown in FIG. 1 a diagrammatic illustration of an arrangement of rolls in a rolling mill structure of this invention and as shown therein, there are provided working rolls **10** and **11** disposed above and below respectively, the rolling plane as indicated by the heavy line **12**. The working rolls **10** and **11** are of abnormally small diameters when compared to the diameters of the working rolls in mills in which the working rolls are directly driven and furthermore, it is to be noted that the working rolls **10** and **11** are not supported in bearings, but are supported and driven in a manner which will presently appear. The supporting and driving roll system for both of the working rolls **10** and **11** is the same and consequently, only the supporting and driving

roll system for the working roll **11** is shown and described and it is to be understood that this system is also duplicated for the working roll **10**.

As clearly shown in FIG. 1 of the drawing, the working roll **11** is engaged and supported by a pair of horizontally spaced intermediate rolls **13** and **14** and these intermediate rolls are freely movably radially and are not supported by bearings or other similar structure. Disposed in the plane of the axes of the working rolls **10** and **11** and located immediately below the intermediate rolls **13** and **14** is a center roll **15** which engages the intermediate rolls **13** and **14** and the center roll **15** is rotatably supported in bearings **16** mounted for vertical movement in slots **21***a* of the chocks **21** which are disposed in the mill frame **17**. A supporting roll **18** is disposed directly below the center roll **15** in the plane of the axes of the working rolls **10** and **11** and the supporting roll **18** engages the center roll **15**.

A pair of horizontally spaced relatively large diameter backing rolls **19** and **20** are rotatably mounted in chocks **21** carried by the mill frame **17** and the shafts **22** are provided with suitable coupling means **23** for driving the backing rolls **19** and **20**. As clearly shown in FIG. 1, the backing rolls **19** and **20** engage the supporting roll **18** and also engage the intermediate rolls **13** and **14**. For this reason, the backing rolls **19** and **20** support and frictionally drive the entire roll system, including the working rolls **10** and **11**.

As mentioned above, there are no supporting bearings provided for the working roll **11**, the intermediate rolls **13** and **14** and the supporting roll **18** and these rolls are maintained in the position shown in FIG. 1, by reason of the relative diameters of the rolls, together with their placement and the distribution of forces present in the roll system. With particular reference to FIG. 3, there is shown by means of force diagrams, the distribution of forces in the roll system and this distribution of forces applies for both the form of the invention shown in FIG. 1 and the modified form of the invention shown in FIG. 3. As shown in FIG. 3, the downward force exerted by the working roll **11** is resisted by the intermediate rolls **13** and **14** and such downward force for each intermediate roll **13** and **14** is represented by the vector *a* and this force resolves into the two components *b* and *c*. As shown, the direction of the force of component *b* is through the axis of backing roll **19** and also, of course, through backing roll **20**. The direction of the component *c* is through the center of the center roll **15** and, of course, the component *c* is impressed on the center roll **15** from both of the intermediate rolls **13** and **14** resulting in the forces *c* as indicated by the vectors in FIG. 3 and such component *c* provide a resultant downward force represented by the vector *d* which is resisted by the supporting roll **18**. Since the supporting roll **18** is in turn supported by the backing rolls **19** and **20**, the downward force *d* resolves into two components *e*, the direction of which is through the center of the roll **19** and through the center of the roll **20** and as a result of the force components *d* and *e* exerted on the backing rolls **19** and **20**, the resultant force and direction thereof resisted by the backing rolls **19** and **20** is represented by the vector *f* as shown in FIG. 3. Furthermore, as shown in FIG. 3, in order for the intermediate rolls **13** and **14** to remain in operative position it is necessary that the axes of intermediate rolls **13** and **14** be disposed inwardly of lines between the axis of the working roll **11** and the axes of the backing rolls **19** and **20**, as represented by the line **24** in FIG. 3. If the axes of the intermediate rolls **13** and **14** were to lie outside of the line **24**, such intermediate rolls **13** and **14** would not remain in operative position, but as a result of the position of such axes inwardly of the line **24**, as well as the direction of forces exerted on the rolls, the intermediate rolls **13** and **14** will maintain their operative positions as shown in the drawings. As mentioned above, the center roll **15** is supported in bearings for vertical movement, but lateral movement of such roll is not permitted and this is for the reason that lateral movement of the roll **15** would cause the intermediate rolls **13** and **14** to shift out of a horizontal plane and would also move the axis of one of these rolls outside of the line **24**, thereby allowing such roll to become displaced and destroy the utility of the structure.

As a result of the above described rolling mill structure, the diameter of the working roll **11**, as well as the diameters of the intermediate rolls **13** and **14** may be so selected as to provide for the desired small diameter working roll and at the same time, permit the axes of the intermediate rolls **13** and **14** to remain inwardly of the line **24**, thereby insuring that the intermediate rolls **13** and **14** remain in operative position at all times. The rolls **10**, **11**, **13**, **14** and **15** are axially secured by angular plates **42** and by the chocks **21** and the plates **42** are detachably fixed on the chocks **21** for permitting convenient changing of working rolls **10** and **11**.

With particular reference to FIGS. 3 and 4, there is shown a somewhat modified form of the invention in which working rolls **25** and **26** are disposed above and below the rolling plane indicated by the line **27** and the working roll **26** is engaged and supported by intermediate rolls **28** and **29**. In this form of the invention, the intermediate rolls **28** and **29** are driven through suitable coupling means **31**.

As in the previously described form of the invention, the intermediate rolls **28** and **29** are engaged by a center roll **32** disposed in the plane of the axes of working rolls **25** and **26** and the support roll **32** is carried by bearings **33** slidably mounted in slots **41***a* of the bearing frames **41** which are disposed in the mill frame **34**. Disposed directly below the center roll **32** and in the plane of the axes of the working rolls **25** and **26** is a support roll **35** and no bearings are provided for mounting this roll.

Two outer bearing frames **41** are mounted on the mill frame **34** and fixed axles **37** and **38** are carried by the bearing frames **41**.

Rotatably mounted on the axles **37** and **38** are a series of axially spaced backing rolls **39** and a series of axially spaced backing rolls **40**. Backing rolls **39** engage and support the support roll **35** and also the intermediate roll **28**. In a similar manner, backing rolls **40** engage and support the support roll **35** and the intermediate roll **29**. The force distribution in this form of the invention is the same as that described above in connection with the first form of the invention and also it is necessary in this form of the invention for the axes of the intermediate rolls **28** and **29** to be disposed inwardly of the line **24** between the center of the working roll **26** and the centers of the backing rolls **39** and **40**. The form of the invention shown in FIG. 3 is designed primarily to provide additional strength for resisting greater rolling loads than is possible with the arrangement of FIG. 1 and in view of the nature of the backing rolls **39** and **40** of FIG. 3 in which the same comprise axially spaced individual rolls, such rolls cannot be properly driven and consequently, it is necessary to provide the driving power through the intermediate rolls **28** and **29**, as mentioned above and rolls **28** and **29** must be of a sufficient size to transmit the required torque. The rolls **25** and **26** are axially fixed by plates **45** which are detachably secured to the mill frame **34**.

Referring to FIGS. 3 and 4, it must be noted that the spaced backing rolls **39** and **40** are constructed as self-aligning roller bearings and are held in place by spacer plates **36**. The outer bearing frames **41**, the inside rings of the backing rolls, as well as the intermediate plates **36** form a unit with the axles by means of covers **43**,

which, by means of screws 44, are pulled against the end faces of the axles 37 and 38 and the bearing frames 41.

In view of the above it will be seen that there has been provided by this invention a relatively simple, yet highly efficient arrangement for rolling mills and one which permits the use of abnormally small working rolls, as well as a structure in which the number of rolls is reduced to a minimum and furthermore, the space requirements are kept as small as possible.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. Rolling mill structure including two working rolls, one of said rolls being disposed above and the other disposed below the rolling plane, two pairs of horizontally spaced intermediate rolls freely movable radially in all directions, one pair engaging one working roll and the other pair engaging the other working roll to support and drive the same, center rolls positively guided for vertical movement only in the plane of said working rolls and engaging each pair of said intermediate rolls, said center rolls being movable vertically with respect to all other rolls, supporting rolls disposed in the plane of said working rolls and engaging each of said center rolls and a pair of positively driven horizontally spaced backing rolls of relatively large diameter with respect to the other rolls, said backing rolls engaging said intermediate rolls and said supporting rolls to support and drive the same and thereby drive said working roll, the axes of said intermediate rolls being disposed inwardly of lines between the axes of said working rolls and the axes of the respective backing rolls, whereby said intermediate rolls are maintained in operative position, the engagement between all of said rolls being frictional only, whereby torque is transmitted from any of said rolls to an engaging roll solely by friction.

2. Rolling mill structure including two working rolls, one of said rolls being disposed above and the other disposed below the rolling plane, two pairs of horizontally spaced intermediate rolls, one pair engaging one of said working rolls and the other pair engaging the other of said working rolls to support and drive the same, center rolls positively guided for vertical movement only in the plane of said working rolls and engaging each pair of said intermediate rolls, said center rolls being movable vertically with respect to all other rolls, supporting rolls disposed in the plane of said working rolls and engaging each of said center rolls and a pair of positively driven horizontally spaced backing rolls of relatively large diameter with respect to the other rolls, said backing rolls engaging said intermediate rolls and said supporting rolls to support and drive the same and thereby drive said working roll, the axes of said intermediate rolls being disposed inwardly of lines between the axes of said working rolls and the axes of the respective backing rolls, whereby said intermediate rolls are maintained in operative position, the engagement between all of said rolls being frictional only, whereby torque is transmitted from any of said rolls to an engaging roll solely by friction.

3. Rolling mill structure including two working rolls, one of said rolls being disposed above and the other disposed below the rolling plane, respectively, roll supporting and driving structure on one side of said rolling plane including a pair of horizontally spaced intermediate rolls

engaging one of said working rolls to support and drive the same, a center roll disposed in the plane of said working rolls and engaging said pair of intermediate rolls, a supporting roll disposed in the plane of said working rolls and engaging said center roll and a pair of horizontally spaced backing rolls of relatively large diameter with respect to the other rolls, said backing rolls engaging said intermediate rolls and said supporting roll to support the same, the axes of said intermediate rolls being disposed inwardly of lines between the axes of one of said working rolls and the axes of the respective backing rolls, whereby said intermediate rolls are maintained in operative position, the engagement between all of said rolls being frictional only, whereby torque is transmitted from any of said rolls to an engaging roll solely by friction, said center roll being fixed against lateral displacement and positively guided for vertical displacement only in the plane of said working rolls and relative to the other rolls, the vertical movement of said center roll serving to compensate for wear of the rolls.

4. Rolling mill structure as defined in claim 3 in which said intermediate rolls are positively driven.

5. Rolling mill structure including two working rolls, one of said rolls being disposed above and the other disposed below the rolling plane, two pairs of positively driven horizontally spaced intermediate rolls, one pair engaging one of said working rolls and the other pair engaging the other of said working rolls to support and drive the same, center rolls positively guided for vertical movement only in the plane of said working rolls and engaging each pair of said intermediate rolls, said center rolls being movable vertically with respect to all other rolls, supporting rolls disposed in the plane of said working rolls and engaging each of said center rolls and a pair of horizontally spaced backing rolls of relatively large diameter with respect to the other rolls, said backing rolls engaging said intermediate rolls and said supporting rolls to support the same, the axes of said intermediate rolls being disposed inwardly of lines between the axes of said working rolls and the axes of the respective backing rolls, the engagement between said working rolls and said intermediate rolls being frictional only, whereby torque is transmitted from said intermediate rolls to said working rolls solely by friction.

6. Rolling mill structure as defined in claim 5, in which each backing roll comprises a fixed shaft and a plurality of axially spaced rollers rotatably mounted on said shaft, there being supports for said shaft at opposite ends and at least at one intermediate point.

7. Rolling mill structure as defined in claim 5, in which each backing roll comprises a fixed shaft and a plurality of axially spaced rollers rotatably mounted on said shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

222,973	Wilmot	Dec. 23, 1879
1,621,284	Slick	Mar. 15, 1927
1,964,893	Rohn	July 3, 1934
2,160,767	Wadsworth	May 30, 1939
2,181,173	Catulle	Nov. 28, 1939
2,776,586	Sendzimir	Jan. 8, 1957
2,807,178	Grob	Sept. 24, 1957

FOREIGN PATENTS

713,348	Great Britain	Aug. 11, 1954
869,276	Great Britain	June 28, 1957
885,385	Germany	Aug. 3, 1953
1,178,590	France	Dec. 15, 1958
1,188,990	France	Mar. 16, 1959