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Petros

[11] **3,866,455**

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[54] **MILL ROLL CHANGING SYSTEM INCLUDING A ROLL BUGGY**

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[52] **U.S. Cl.** **72/239**

[51] **Int. Cl.** **B21b 31/10**

[58] **Field of Search** 72/239, 238

[56] **References Cited**

UNITED STATES PATENTS

3,323,345	6/1967	Lyle et al.	72/239
3,559,441	2/1971	Lemper et al.	72/239
3,698,226	10/1972	Eibe	72/239

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[57] **ABSTRACT**

A buggy for changing mill rolls and the like comprises first and second supports mounted thereon. Each of said supports terminates in a roll neck socket adjacent a front or mill end of said buggy, with each of said sockets being shaped to closely receive a roll neck of an associated one of said mill rolls and to support said roll in cantilevered fashion. An arrangement is provided for advancing and withdrawing said buggy relative to said mill for insertion and withdrawal of said rolls when so cantilevered. In another embodiment, the buggy includes at least one such support mounted thereon and optionally with an arrangement for elevating the support relative to the buggy.

11 Claims, 5 Drawing Figures

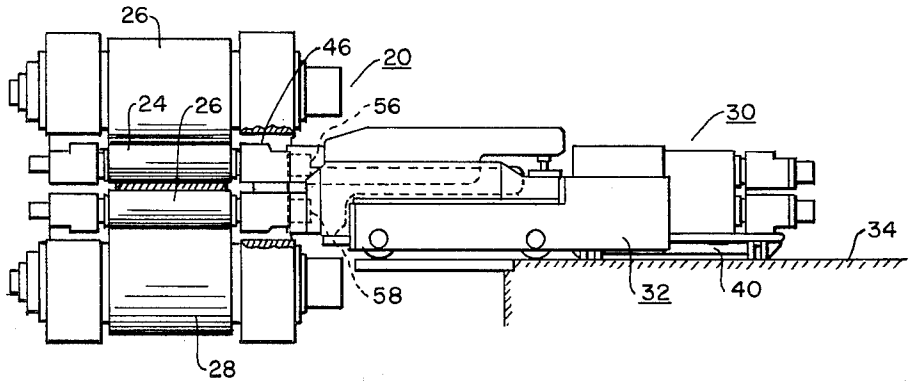


Fig. 2

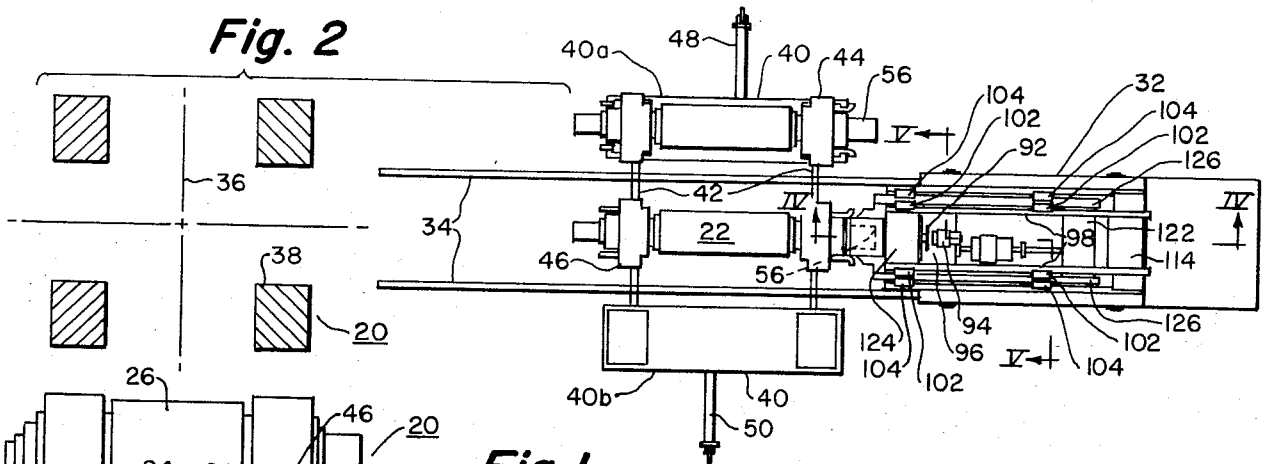


Fig. 1

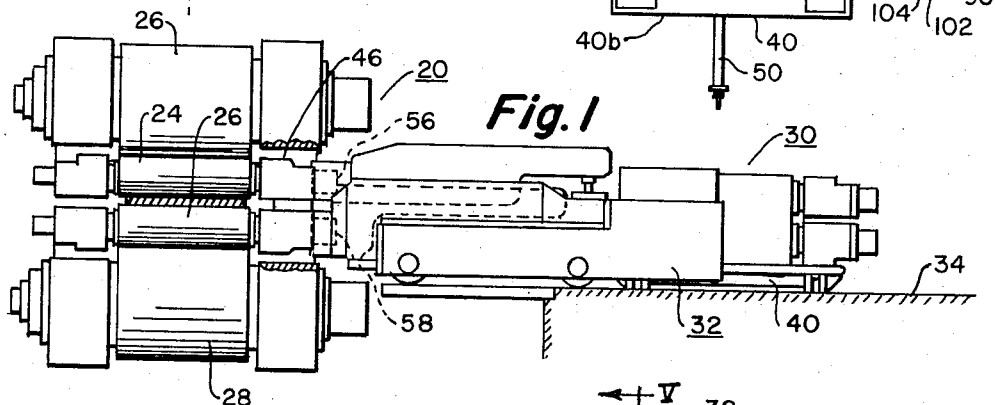


Fig. 3

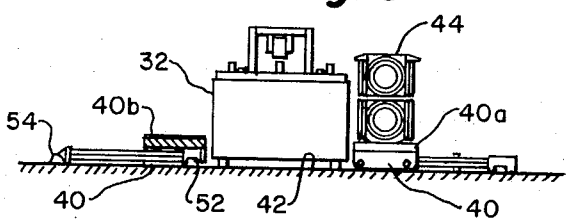


Fig. 4

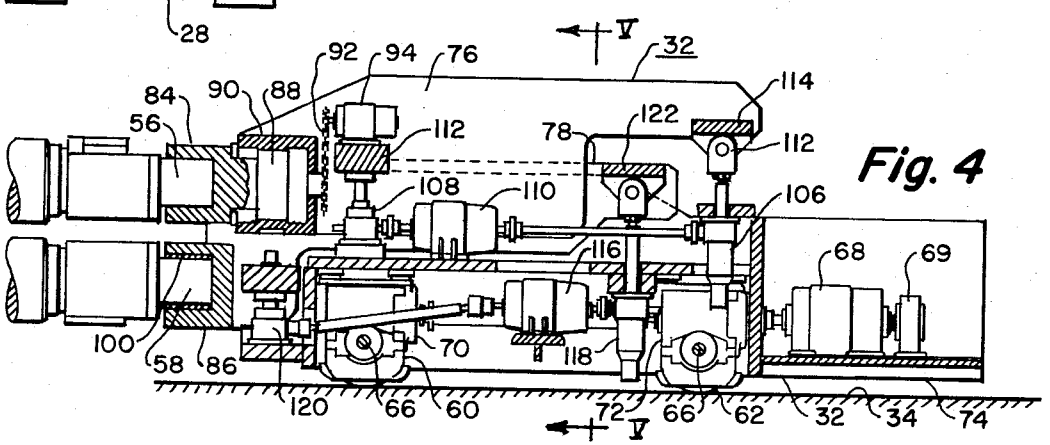
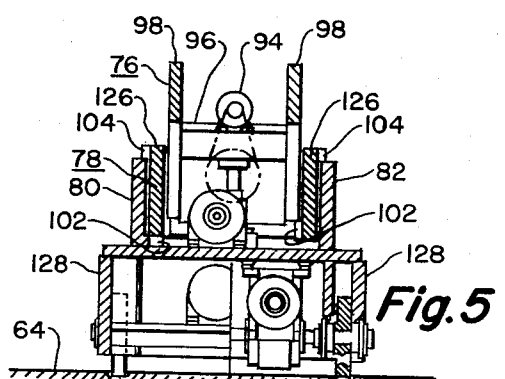


Fig. 5



MILL ROLL CHANGING SYSTEM INCLUDING A ROLL BUGGY

Certain aspects of the present invention are related to the invention of my copending, coassigned application entitled Mill Roll Changing System Including A Cantilevered Roll Assembly filed concurrently herewith, Ser. No. 429,344.

The present invention relates to a system for inserting and withdrawing the rolls of a rolling mill and more particularly to a system of the character described employing improved buggy and porter devices.

Although the invention is described in conjunction with four-high mill stand of a cold mill, it will be apparent as this description proceeds that the invention can be readily designed for a hot mill and for other types of rolling mills. Thus, each installation of the invention involves specific differences in size, space, availability etc. The invention is particularly advantageous in ready adaptability to existing rolling mills, as only a very limited amount of foundation change is required.

Known forms of roll changing systems suffer from one or more disadvantages and difficulties of operation. The original manual system, of course, involves considerable mill down-time, attendant loss of production, and personnel hazard. Changing the rolls of more than one or two mill stands at a time was virtually impossible owing to equipment and personnel limitations. Many of these known systems require extensive foundation changes, and installation as a practical manner was effectively limited to newly constructed rolling mills. In other roll changing systems, owing to mechanical complexity and area requirements, only one or a limited number of mill stands could be serviced. These and other roll changing systems necessitated many obstructions at or in the mill floor area adjacent the mill stands with attendant tripping and other personnel hazards.

The roll changing system of the present invention is admirably and unexpectedly designed to reduce undue mechanical complexity and to facilitate maintenence. The present system can be installed in conjunction with existing rolling mills without extensive and costly mill shutdowns. Roll changing equipment according to the invention can be installed wherever desirable, in conjunction with each stand of a rolling mill so that any or all of such stands can be changed simultaneously. Handling of the work rolls by a crane is eliminated, along with roll damage frequently caused by this and other known handling techniques. In many applications, my novel roll changing system can be employed in addition to transfer the mill rolls to and from the roll shop. The only alteration required in the rolling mill proper is provision of conventional means for holding the roll chocks in line during handling.

I accomplish these and other desirable ends of the invention and overcome the disadvantages of the prior art by providing a buggy for changing mill rolls and the like, said buggy comprising first and second support mounted thereon, each of said supports terminating in a roll neck socket adjacent a front or mill end of said buggy, each of said sockets being shaped to closely receive a roll neck of an associated one of said rolls and to support said mill roll in cantilevered fashion, and means for advancing and withdrawing said buggy from said mill for insertion and withdrawal of said mill rolls when so cantilevered.

I also desirably provide a similar roll changing buggy wherein means are provided for elevating at least one of said supports so that the distance between said roll neck sockets can be varied to accommodate faced mill rolls having differing facial diameters.

I also desirably provide a changing system for a rolling mill or the like, said system comprising a self propelled buggy, at least two transfer cars, first rail means for said buggy and extending transversely of a pass line of said rolling mill, second rail means for said transfer cars and extending generally parallel to said pass line, said first rail means being generally aligned with a roll inserting and withdrawing window of a mill stand forming part of said rolling mill, means for propelling said buggy along said first rail means and for propelling said transfer cars along said second rail means, and roll supporting means on said buggy shaped for engagement with a roll neck or at least one of said mill rolls for supporting said one mill roll in cantilevered fashion, said transfer cars being shaped for passage beneath said one mill roll when so supported on said buggy, and elevating means coupled to said supporting means for raising and lowering said one mill roll relative to said transfer cars.

I also desirably provide a similar roll changing system wherein a second roll support is provided and elevating mechanism is provided for said second roll support so that varying distances between said roll necks can be accomodated and so that said pair of rolls can be raised and lowered as an assembly relative to said transfer cars.

I also desirably provide a buggy for changing mill roll and the like, said buggy comprising a support movably mounted thereon, said support terminating in a roll neck socket adjacent a front or mill end of said buggy and shaped to closely receive a roll neck of an associated one of said mill rolls for supporting the mill roll in cantilevered fashion, and means for advancing and withdrawing said buggy from said mill for insertion and withdrawal of said mill roll when so cantilevered.

I am aware of a number of roll changing systems, typified for example by the U.S. Pat. Nos. to

Stover et al.	3,451,244
Simmonds	3,611,779
Sevenich et al.	3,695,080
Eibe	3,698,226

None of these Patents nor any combination thereof discloses the novel features of the invention as pointed out above.

During the foregoing discussion, various objects, features and advantages of the invention have been set forth. These and other objects, features and advantages of the invention together with structural details thereof will be elaborated upon during the forthcoming description of certain presently preferred embodiments of the invention and presently preferred methods of practicing the same.

In the accompanying drawings I have shown certain presently preferred embodiments of the invention and have illustrated certain presently preferred methods of practicing the same, wherein:

FIG. 1 is a side elevational view of mill rolls as positioned within a typical four-high mill stand of a rolling mill, together with the roll changing apparatus of the invention;

FIG. 2 is in general a top plan view of the roll changing apparatus substantially as shown in FIG. 1 but showing the apparatus supporting work rolls withdrawn from the mill stand;

FIG. 3 is a rear elevational view of the roll changing apparatus as shown in FIG. 1;

FIG. 4 is an enlarged longitudinally sectioned view of the roll changing apparatus as shown in FIG. 2 and taken along reference line IV—IV thereof; and

FIG. 5 is the cross sectional view of the roll changing apparatus shown in FIG. 2 but taken along reference line V—V thereof;

With reference now to the drawings in greater detail an exemplary form of the invention shown therein is manipulatable with respect to a mill stand portions of which are denoted by the reference number **20** (FIGS. 1 & 2). Typically, the mill stand **20** is of the four-high variety and includes work rolls **22, 24** and back up roll **26, 28.**

The roll changing system or apparatus **30** proper includes a self-propelled buggy **32** which is driven along a pair of rails or tracks **34.** The tracks **34** as better shown in FIG. 2 extend transversely of the mill stand **20** and its pass line **36** as evident from a comparison of FIGS. 1 and 2 the motorized buggy **32** is driven between the positions evident in FIGS. 1 and 2 respectively in order to engage the work rolls **22, 24** for withdrawal thereof (FIG. 1) and thereafter to move the work roll assembly as a unit through and from the mill stand window **38** (FIG. 2) rearwardly to one of the side shifting transfer cars **40** (FIGS. 1–3). The transfer cars **40** are structured for movement along a pair of rails or tracks **42** which extend generally parallel of the rolling mill and its pass line **36** or transversely of the buggy track **34** (FIGS. 2 and 3).

A pair of the transfer cars **40** desirably are provided such that one of the cars for example car **40*a*** supports a replacement work roll assembly **44** at a position laterally and out of the way of the roll changing buggy **32,** and its track **34** while the buggy is withdrawn to the rear or away from the mill stand **20** and carries with it a used roll assembly **46.** At the position of the roll changing buggy **32** and of the used roll assembly **46,** as shown in FIG. **2,** the vacant transfer car **40*b*** can be moved to a position between the buggy rails **34** (or to the right, as viewed in FIG. 3) and thus directly beneath the used roll assembly **46** so that the latter can be lowered directly onto the empty transfer car **40*b***.

In the illustrated form of the invention, the transfer cars **40*a*, 40*b*** are moved along their rails or tracks **42** by suitable traction means, in this example piston and cylinder arrangements **48, 50** respectively. Desirably the cylinders **48, 50** are somewhat off set relative to the center lines of the transfer cars **40** (FIG. 2) so as to accomodate in side by side relation similar cylinders for transfer cars (not shown) are of adjacent mill stands. As evident from FIG. 3 the cars **40** are arched or otherwise constructed so that the adjacent end portions of the cylinders **48, 50** extend beneath the platform structure of the transfer cars **40** for connection at **52** (FIG. 3) or the far side of the transfer car relative to the floor anchor **54** of the cylinder. This accommodates a cylinder of longer stroke without sacrifice of floor space.

When the transfer car **40*b*** has been loaded as aforesaid it is then withdrawn to the position thereof shown in FIG. 2 together with the used roll assembly **46** so that the other transfer car **40*a*** and the replacement roll assembly **44** can in turn be moved between the buggy rails **34** for engagement of the replacement roll assembly **44** by the buggy **32** and subsequent insertion through window **38** and into the mill stand **20.**

In order to facilitate the aforementioned withdrawal and insertional operations relative to the work roll assemblies **44, 46** and the loading and unloading of these roll assemblies relative to the transfer cars **40*a*, 40*b***, the work roll assemblies desirably are engaged and supported in cantilevered fashion by the buggy **32.** Transportation of the mill rolls in cantilevered fashion poses a number of problems. Firstly, the work roll necks **52,** 54 must be securely engaged by the cantilevering structure of the buggy **32.** Secondly, the buggy **32** and its roll supporting components must be structured such that the used work roll assembly **46** can be accurately withdrawn in a linear fashion from the mill stand window **38** without damage to the roll assembly **46** or to adjacent and sometimes closely spaced components of the mill stand **20.** Thirdly, the buggy **32** must be configured such that the roll engaging component can be accurately raised and lowered under the weight and torque loadings imposed thereon by the cantilevered work roll assembly **44** or **46.** Finally, at least one of the roll engaging members of the buggy **32** must be adjustable horizontally and vertically relative to the other roll engaging member in order to accommodate work rolls of differing facial diameters and the inevitable vertical displacement of the adjacent ends of the roll necks **56,** 58.

One arrangement for thus transporting and cantilevering the work roll assemblies **44, 46** during the respective roll changing operations, is shown in FIG. **1–3** but is illustrated in greater detail in FIGS. **4** and **5.** The overall structure of the self-propelled, roll-changing buggy **32,** including the aforementioned cantilevering components, will now be described in greater detail. As evident from the Figures the buggy **32** is heavily constructed and includes a pair of railway trucks **60, 62** for engagement with the buggy rails **34,** which if desired can be machined into the mill floor structure **64** as evident from FIG. **5.** In the illustrated embodiment, the trucks **60, 62** including their axles **66** are rotated together by suitable driving mechanism including in this example electric motor **68** and a speed reducer **70** or **72** coupled to each of the axles **66** and to the motor **68.** Power is thus applied to both sets of railway trucks **60,** 62 in this example of the invention.

Desirably the relatively heavy drive motor **68** and tachometer **69** are housed in a rearward extension **74** of the buggy **32** to aid (along with the rather heavy construction of the buggy itself) in counterbalance the considerable weight of the cantilevered work roll assembly **44** or **46.**

In order to support the work roll assembly in cantilever fashion on the buggy **32** a pair of cantilevering and elevatable supports **76, 78** are provided respectively for the upper and lower work rolls of the work roll assembly (FIGS. **4** & **5**). The supports **76, 78** are spacedly and slidably mounted on the buggy **32.** In furtherance of this purpose a pair of relatively rigid upright stabilizing plates **80, 82** are spaced outwardly of the roll supports **76, 78** as evident from FIGS. **2** and **5** of the drawings. Each of the cantilevering roll supports **76, 78** terminates at its forward or mill end in a roll neck receiving socket **84** or **86,** respectively. To compensate for slight vertical misalignments of the roll necks **56, 58** of

the work rolls, one of the roll neck sockets, for example the socket **84**, includes a screw driven shank **88** mounted in a second and larger socket **90** therefor also mounted on the upper roll support **76**. The screw mechanism **88** is driven by transmission denoted generally by reference character **92** and a suitable drive, for example electric motor **94** typically mounted on platform **96** extending between vertical plates **98** of the upper roll support **76**. The upper roll neck socket **84** thus can be adjusted horizontally of the buggy **32** and of the lower roll neck socket **86**. Desirably the roll neck sockets **84, 86** are sized for insertion of the largest anticipated roll neck **56, 58**, and where smaller roll necks are encountered, a suitable liner such as that denoted at **100** can be inserted in one or both of the sockets **84, 86**.

The upper and lower roll supports **76, 78** are guided in their elevating movements (effected by elevating mechanisms presently to be described) by pairs of guideway plates denoted generally at **102, 104** and secured in this example respectively to inner and outer surfaces of the lower support vertical plates **126**. The guide plates **102, 104** cooperate with complementary guide ways formed on the juxtaposed surfaces of the stabilizing plates **80, 82** and on the upper support vertical plates **98**. Thus the upper and lower cantilevering supports **76, 78** are precisely guided in their elevating movements with respect to the buggy **32** and to one another.

The upper cantilevering structure or support **76** is elevated by a pair of gear housings **106, 108** to which a suitable drive means for example electric motor **110** is coupled. The gear housings which in this example each include a worm and worm gear are connected through their output shafts and clevis joints **112** to the forward platform **96** (mentioned previously) of the upper framework **76** and a rearward platform **114** likewise extending between the vertical plates **98** of the upper support **76**.

The lower elevating support **78** is provided with a similar elevating mechanism including electric motor **116**, gear mechanisms **118, 120** which are similarly coupled to platforms **122, 124** extending between the aforementioned vertical plates **126** of the lower elevating framework **78**. As evident from FIG. **4** the various elevating mechanisms for the upper and lower supports **76, 78** are mounted on platform structures extending between the stabilizing plates **80, 82** or between the outer housing plates **128** of the buggy **32**, as evident from FIGS. **4** and **5**.

With the arrangement just described, the elevating and cantilevering supports **76, 78** and the roll neck sockets **84, 86** respectively can be positioned precisely to receive the roll necks **56, 58** in respective of the facial diameters of the work rolls, within the structural limits of the buggy components. This is essential as work rolls of differing diameters frequently are substituted during a given shift or turn. In addition, the elevating feature of the cantilevering supports **76, 78** permit the buggy roll sockets **84, 86** to be adjusted to the precise elevation of the total work roll assembly **44** or **46** depending upon the height of the transfer car **40** in the case of the roll assembly **44** or upon the diameter of the lower back up roll **28** and/or the size of elevation of other related components of the mill stand **20**.

From the foregoing it will be seen that a novel and efficient Mill Roll Changing System Including a Roll Buggy has been described herein. The descriptive and illustrative materials employed herein are utilized for purposes of exemplifying the invention and not in limitation thereof. Accordingly, numerous modifications of the invention will occur to those skilled in the art without departing from the spirit and scope of the invention. Moreover, it is to be understood that certain features of the invention can be used to advantage without a corresponding use of other features thereof.

I claim:

1. A buggy for changing mill rolls and the like, said buggy comprising first and second supports mounted thereon, each of said supports terminating in a roll neck socket adjacent a front or mill end of said buggy, each of said sockets being shaped to closely receive a roll neck of an associated one of said mill rolls and to support said mill roll in cantilevered fashion, means on said buggy for elevating at least one of said supports with respect to said buggy and to the other of said supports so that the distance between said roll neck sockets can be varied, and means for advancing and withdrawing said buggy from said mill for insertion and withdrawal of said mill rolls when so cantilevered.

2. The combination according to claim **1** wherein additional means are provided for similarly elevating said other support.

3. The combination according to claim **2** including upstanding complementary stabilizing plates rigidly secured to said supports and to said buggy respectively in juxtaposition to one another.

4. The combination according to claim **1** wherein means are provided for longitudinally advancing and withdrawing one of said roll neck sockets relative to the other so that said sockets can accommodate vertical misalignments of said roll necks.

5. The combination according to claim **1** wherein said buggy is self-propelled and at least part of the driving mechanism therefor extends rearwardly of the buggy proper to aid in counterbalancing a mill roll carried in cantilevered fashion by said buggy.

6. The combination according to claim **5** including stabilizing plates secured respectively to said supports and to said buggy in juxtaposition to one another, said plates stabilizing said one support during elevation thereof and both of said supports against rotation with respect to said buggy.

7. A buggy for changing mill rolls and the like, said buggy comprising first and second supports mounted thereon, each of said supports terminating in a roll neck socket adjacent a front or mill end of said buggy, each of said sockets being shaped to closely receive a roll neck of an associated one of said mill rolls and to support said mill roll in cantilevered fashion, and means for advancing and withdrawing said buggy from said mill for insertion and withdrawal of said mill rolls when so cantilevered, means for elevating each of said supports relative to said buggy and to one another so that the distance between said roll neck sockets can be varied to accommodate face mill rolls having differing facial diameters, each of said supports including a pair of upstanding spaced plates, and a number of complementary guideways formed between said plates and between a pair of juxtaposed stabilizing plates rigidly secured to said buggy.

8. A changing system for the mill rolls of a rolling mill or the like, said system comprising a self propelled buggy, at least two transfer cars, first rail means for said

buggy and extending transversely of a pass line of said rolling mill, second rail means for said transfer cars and extending generally parallel to said pass line, said first rail means being generally aligned with a roll inserting and withdrawing window of a mill stand forming a part of said rolling mill, means for propelling said buggy along said first rail means and for propelling said transfer cars along said second rail means, and a pair of roll supports on said buggy shaped for engagement with the roll necks of a pair of said mill rolls for supporting said mill rolls in cantilevered fashion, said transfer cars being shaped for passage beneath said one mill roll when so supported on said buggy, and elevating means coupled to said roll supports for elevating said mill rolls and said supports relative to one another and to said buggy and to said transfer cars and for accommodating varying the center line distances between said mill rolls during such elevation.

9. The combination according to claim **8** including juxtpoased plate members rigidly secured to said supports and to said buggy for stabilizing individual elevating movements of said supports with respect to one another and to said buggy and transfer cars.

10. A buggy for changing mill rolls and the like, said buggy comprising a support movably mounted thereon, said support terminating in a roll neck socket adjacent a front or mill end of said buggy and shaped to closely receive a roll neck of an associated one of said mill rolls for supporting the mill roll in cantilevered fashion, means for elevating said support with respect to said buggy, said support including an upstanding plate, complementary guideway means formed between said support plate and a juxtaposed stabilizing plate rigidly secured to said buggy, and means for advancing and withdrawing said buggy from said mill for insertion and withdrawal of said mill roll when so cantilevered.

11. The combination according to claim **1** including upstanding complementary stabilizing plates rigidly secured in juxtaposition to said one support and to said buggy respectively.

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