July 25, 1933. J. R. COE 1,919,202

ROLLING MILL

Filed May 27, 1931 4 Sheets-Sheet 1

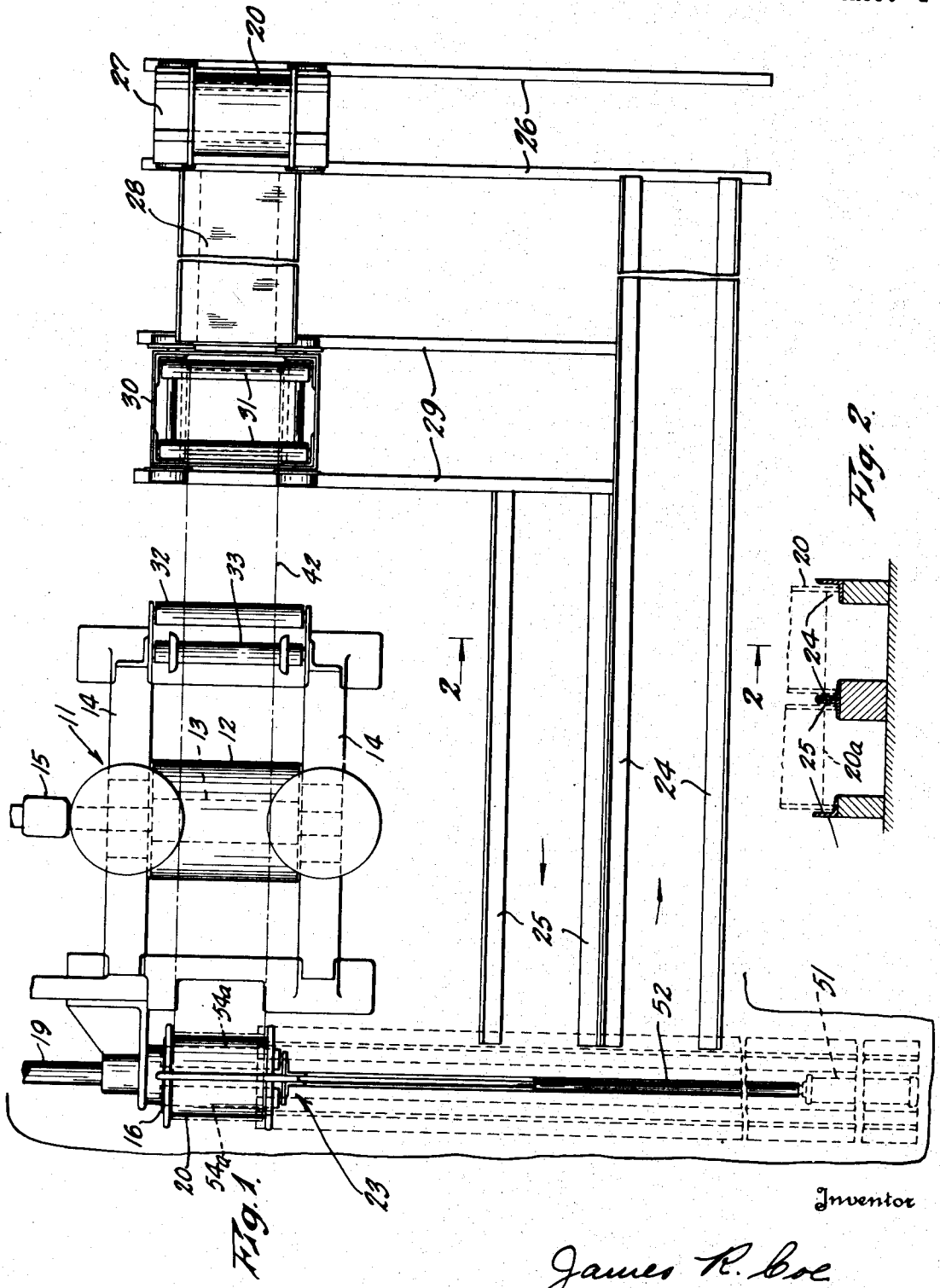


Fig. 1.

Fig. 2.

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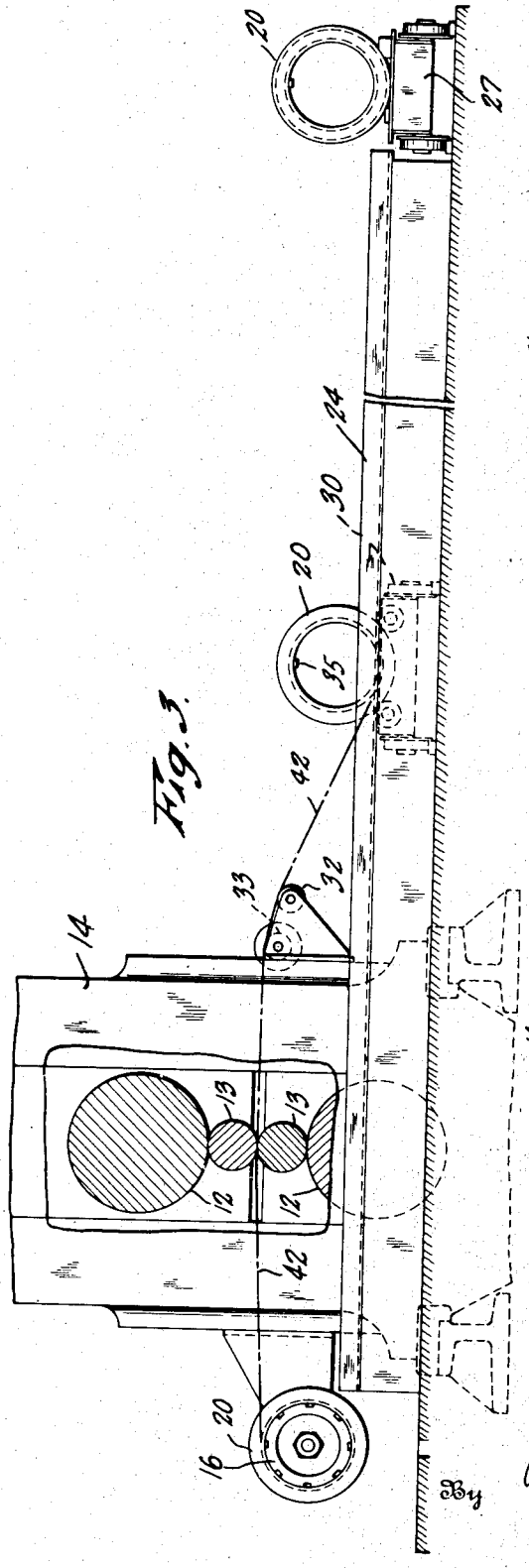


Fig. 3.

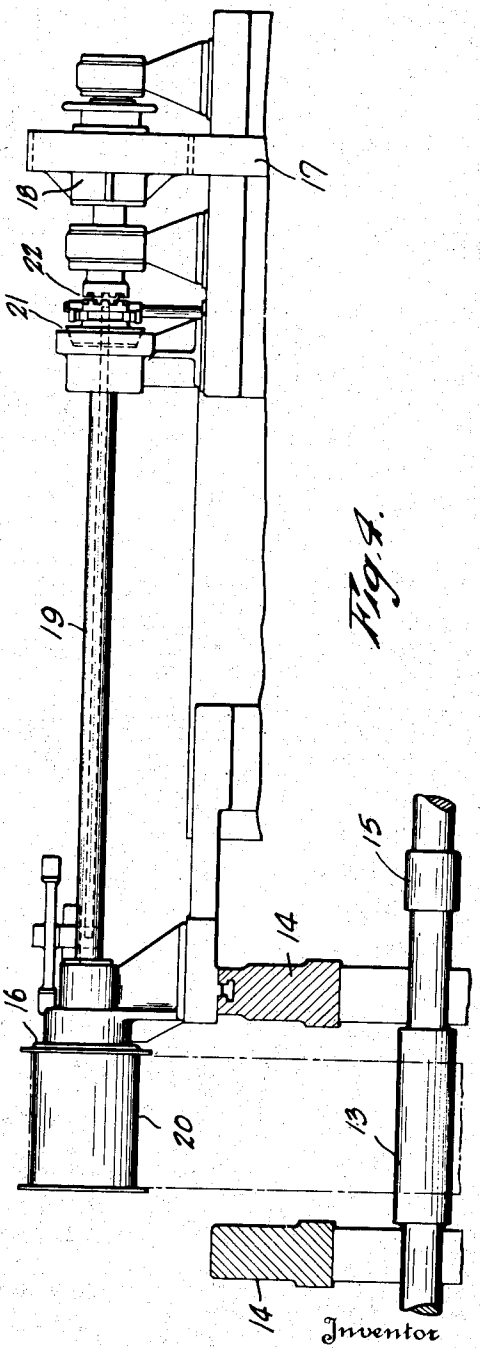


Fig. 4.

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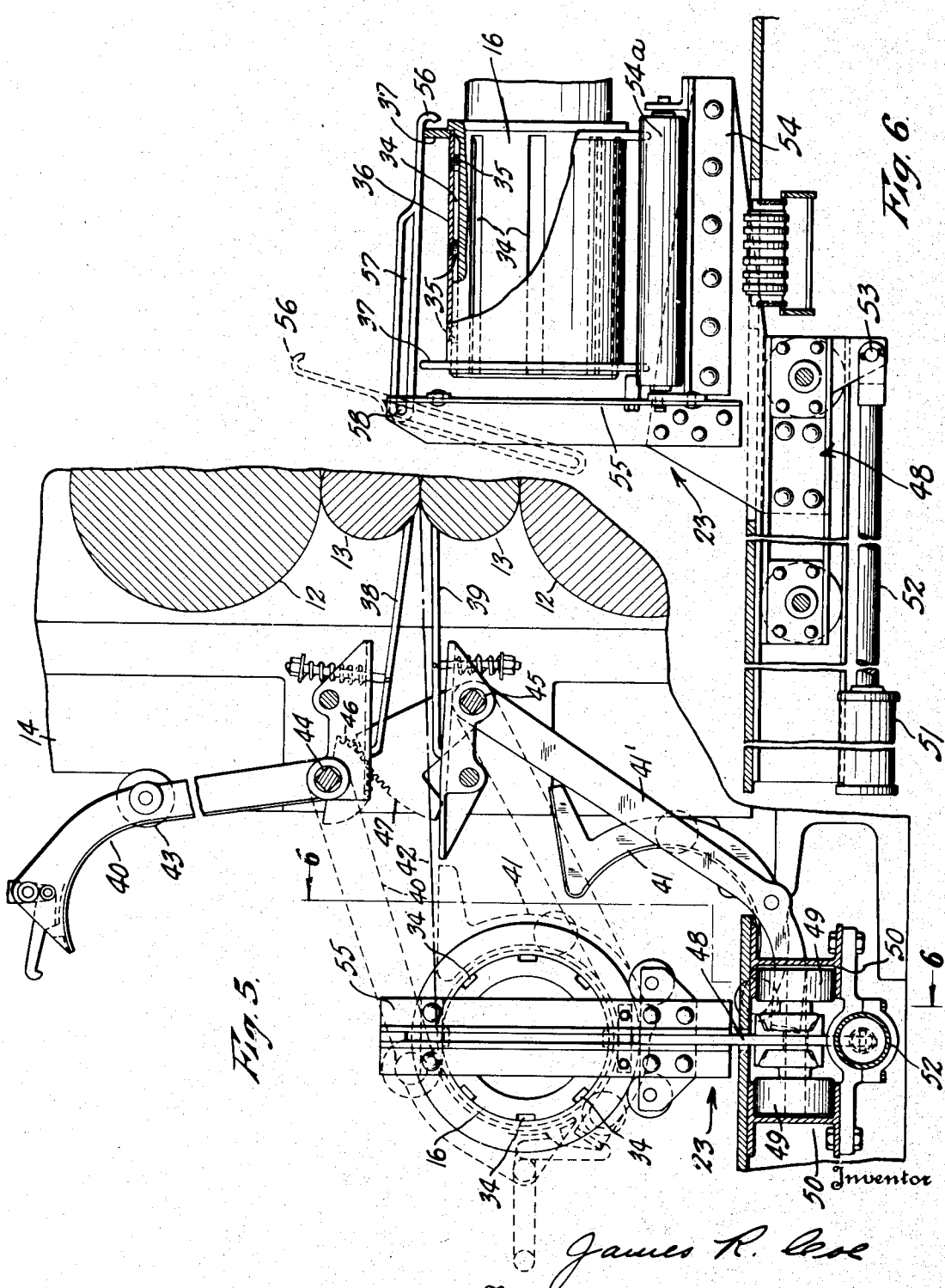


Fig. 5.

Fig. 6.

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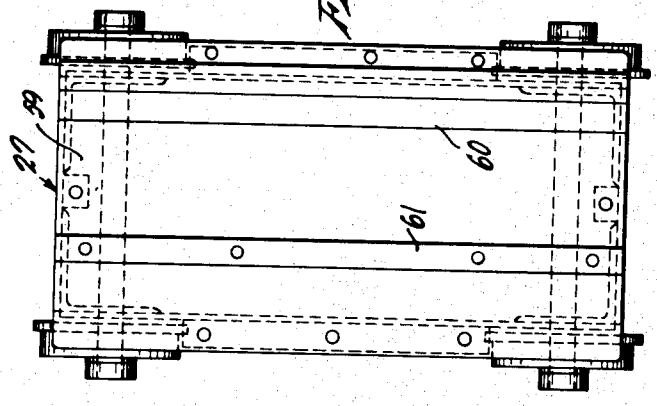
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ROLLING MILL

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Fig. 9.



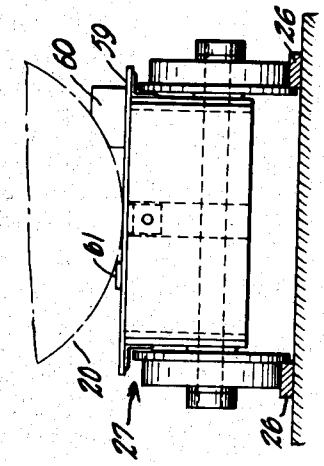


Fig. 10.

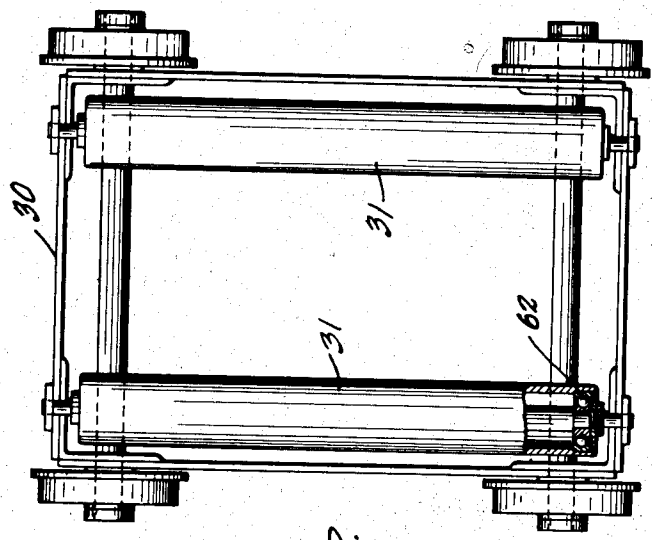


Fig. 7.

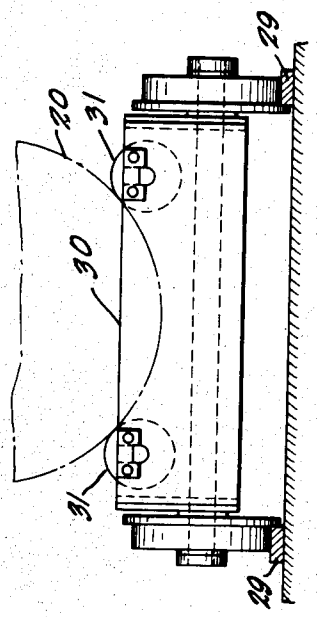


Fig. 8.

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UNITED STATES PATENT OFFICE

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ROLLING MILL

Application filed May 27, 1931. Serial No. 540,301.

This invention relates to rolling mills, particularly rolling mills for rolling strips of flat metal which can be wound or coiled on spools or reels to facilitate handling, and an object of the invention is to provide a simple means of effectively handling this metal in heavy coils to and from the rolling mill with a minimum of labor. It is also an object of the invention to provide a means of handling this metal which will protect both the edges and surface of the metal from damage and waste that would naturally occur if the metal in comparatively thin gauges were transported and handled in open coils without protection.

This method and apparatus is of particular value in connection with fourhigh and similar rolling mills in which the metal can be passed through the rolls many times without intermediate annealing and cleaning operations, and it is also of special value when rolling coils of great weight which is beyond the ability of a man to lift or carry.

In the accompanying drawings I have shown the device as used in connection with a fourhigh rolling mill, but of course it is not necessarily limited to use with this type of mill, but may be used with any similar type of rolling mill.

With the foregoing and other objects in view the invention consists in certain novel features of construction, arrangement of devices, and method of handling the metal, as will be more fully disclosed in connection with the accompanying drawings. In these drawings:

Fig. 1 is a top plan view showing somewhat diagrammatically the arrangement of the devices in connection with a rolling mill for handling the metal to advantage;

Fig. 2 is a detailed vertical section taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a side elevation looking from the right of Fig. 1 and with parts of the roll shown in section;

Fig. 4 is a top plan view of the winding mechanism, and showing the roll housings in section;

Fig. 5 is a vertical section through the rolls and a portion of the transfer coil mechanism indicating the coil mechanism in elevation;

Fig. 6 is a partial section and a partial side elevation of a coiling drum and transfer mechanism, the section being substantially on line 6—6 of Fig. 5;

Fig. 7 is a top plan view of a transfer car that may be used;

Fig. 8 is end elevation thereof;

Fig. 9 is a top plan view of another car; and

Fig. 10 is an end view thereof.

The method and operation of rolling the metal according to this invention consists in

1st. Winding the metal on heavy spools or reels as it leaves the rolling mill;

2nd. Removing the loaded spool from the winding block or shaft to a storage track; and

3rd. Receiving an empty spool from the storage and placing it on the winding drum.

The above operations all take place on the back or delivery side of the rolls.

4th. Unwinding the metal from a spool or reel rotatably mounted on a transfer car;

5th. Then moving the transfer car back to place the empty spool in a storage space; and

6th. Receiving a loaded spool from storage space and transferring it to the proper position in front of the rolls.

These later operations take place on the front or receiving side of the rolls.

Referring more particularly to Fig. 1, a rolling mill is indicated at 11. The mill shown is a fourhigh mill having relatively large backing rolls 12 for the relatively small working rolls 13 suitably mounted in bearings in the housing 14, with the work rolls driven from any suitable means not shown, through couplings indicated diagramatically at 15.

To the rear of the rolls is a winding drum 16 driven from the roll shaft or the roll driving mechanism by any suitable means such for example as a chain drive indicated diagrammatically at 17 in Fig. 4 operating through a friction clutch 18. The drum 16 is adapted to carry a reel or spool 20 on which the metal is wound. The drive for the shaft 19 is arranged to drive the spool at a somewhat higher surface speed than the sur-

face speed of the working rolls so as to hold the metal straight and taut and to wind it tightly on the spool, the clutch being adapted to compensate for this higher surface speed. A brake mechanism 21 may be provided to stop rotation of the shaft 19 and the loaded spool after it is disconnected from the drive by releasing the clutch 22, so that after a spool is filled a minimum of time is lost in bringing it to rest so that it can be removed from the winding drum. The winding mechanism and the means for removing the loaded spool and placing an empty spool in its place on the winding drum will be more fully described later.

This spool removing and transfer device is indicated at 23 in Fig. 1, and it is adapted to transfer a loaded spool from the full line position in back of the roll shown in Fig. 1 to a position in alignment with the storage track 24 running at substantially right angles to the path of movement of the transfer device. Thus this transfer mechanism 23, after removing the filled spool from the winding drum 16, transfers it to the end of the storage track 24 on to which it may be easily rolled from this transfer device as indicated in dotted lines at 20 in Fig. 2. This storage track can be made of any length desired so as to hold at one time as many spools as it is found desirable. This track 24 is for storing loaded spools. At one side of it and between it and the rolls is a parallel storage track 25 for storing empty spools 20—*a*.

At the rear end of the storage track 24 is a cross transfer track 26 on which is a transfer mechanism such as a transfer car 27. This car may be moved to alignment with the rear end of the track 24 to receive a loaded spool 20 from this track and transfer it to the storage track 28 in alignment with the rolling mill 11. At the forward end of this second storage track 28 and between it and the rolls is a second transfer track 29 leading between the front end of the storage track 28 and the rear end of the storage track 25 for the empty spools. Movable in this transfer track 29 is a conveyor means for empty spools which is also adapted to support a loaded spool or reel while the metal is being unwound therefrom to pass through the rolls. This transfer mechanism may be of any suitable type, but is shown as a car 30 carrying rollers 31 on which the flanges of the spool or reel may rest, or the surface of the wound metal may be supported, to permit the spool or coil to turn while the metal is being unwound therefrom. When this car is in the position of Fig. 1 a loaded spool may be rolled on to it from the storage track 28, and after the metal has been removed from this spool the car 30 may be shifted on the transfer track 29 to a position in alignment with the rear end of the storage track 25 so that the empty spool may be rolled from this car on to this storage space or track. Any suitable guide rolls 32 and 33 may be provided to guide the metal from the spool on the transfer mechanism 30 to the inlet side of the rolls.

Referring now more particularly to Figs. 5 and 6 it will be seen that the winding and blocking mechanism comprises a drum 16 mounted on a shaft 19 (Fig. 4) driven as above described. This block is provided in its surface with a plurality of longitudinal keyways or grooves 34 to receive a key or similar driving means 35 on the inner surface of the reel or spool 36. In the present instance the members 35 are shouldered studs riveted to the body of the reel so as to project inwardly from the inner surface thereof and extend into one of the keyways 34, but lie flush with the outer surface of the spool so as not to mar the surface of the metal wound thereon. The spool also has flanges 37 at its opposite ends to guide the metal during the winding and unwinding operations, and also to protect the edges of the metal during handling.

As the metal comes through the rolls 13 it is guided by the guides 38 and 39 to the guide members 40 and 41 of the winding and blocking mechanism, which as shown in dotted lines Fig. 5 extend around and embrace the body of the spool, and as the strip of metal indicated by the dot and dash line 42 passes between these members and the spool its free end is guided around the spool which is being rotated by its drive mechanism, and after that is overlapped a few times, the guide members may be removed from the spool to the full line position and the strip will continue to be wound around the spool. The guide members 40 and 41 carry rolls 43 which reduce the friction of the metal and assist in causing the free end to be wrapped around the spool and prevents its marring the surface of the metal. The guide member 40 is pivoted at 44 and guide 41 is mounted on arms 41′ pivoted at 45 on suitable shafts which are connected by the gear segments 46 and 47 so that they move together. It will be seen that when the arms are in their full line position everything is clear about the spool to permit the use of the means to withdraw the filled spool from the drum to transfer it to a storage space, and to permit mounting of an empty spool on the drum.

The body of the spool 36 is purposely made of a large diameter to enable it to hold a considerable weight of metal without material difference between the inside and outside diameters of the coil to reduce the amount of slippage in the friction clutch 18 to a minimum, and to maintain a practically uniform tension on the metal during the rolling and coiling operation. As this spool or reel must be of very heavy construction to withstand the crushing effect of the metal

wrapped very tightly around it, and also to resist flange wear caused by the rolling during the transfer and unwinding operations, they are so heavy that it is impossible for a man to lift or carry them even when empty, and mechanical means is therefore provided for handling both empty and loaded spools or reels to and from the winding and unwinding positions at the rolls.

For loading an empty spool or reel on to the winding drum and removing a loaded spool from this drum I employ a transfer mechanism 23 including a car indicated as a whole at 48 which is arranged to slide back and forth to and from the winding drum. This car has wheels 49 running in tracks 50 and is actuated by any suitable means, such as an air cylinder 51 operating a piston connected to a piston rod 52 which is in turn connected to the car at 53. The air to the cylinder 51 may be controlled by any suitable valves, not shown, to shift the car back and forth on its track. The car carries a projecting horn 54 on which is mounted a pair of rolls 54—*a*, the horn and rolls being designed to clear the arm 41′ of the blocking mechanism when in the full line position of Fig. 5. The rolls 54—a support the reel or spool 36 by having the edges of the flanges 37 run on the rolls, and permit the spool to be rotated to bring the key members 35 in alignment with any one of the keyways 34 in the winding drum. The car 38 is further provided with a push plate 55 adapted to engage the end of the spool or reel to push it on to the block or drum 16, and the car also carries a pulling hook 56 adapted to engage over the flange of the spool for pulling a loaded spool from the drum. This hook may be provided with a slot 57 to receive the hinge pin 58 to permit the hook to be lifted and drawn out of operating position when desired.

It is to be noted that withdrawal of the car 48 from the positions of Figs. 5 and 6 downwardly as viewed in Fig. 1, or to the left as viewed in Fig. 6, will draw the filled spool from the winding block 16 and will carry this spool to a position in front of the end of the storage track 24. In this position the filled spool may be merely rolled from the car 48 on to the storage track 24. This car 48 can now be advanced to a position in front of the storage 25 for the empty spools and one of them can be rolled on to the car. The car can then be advanced to place this empty spool on the drum 16, and then after the car has been withdrawn the coiler mechanism 40 and 41 can be placed around the spool as indicated in dotted lines Fig. 5 and the rolling of a new strip commenced.

Operation.—In regular operation metal of comparatively heavy gauge or any gauge which it is desired to roll coiled on the spools, preferably to approximately the same outside diameter as the spool flanges, will be delivered to this rolling mill by overhead crane or other conveying apparatus from the previous rolling or annealing operation in batches containing somewhere between 20 and 50 coils or spools. These loaded spools will be placed on the storage track 28 and rolled successively on to the transfer and supporting mechanism 30 from which the metal may be unwound while passing through the rolls 13 and wound as above described on to a spool or reel mounted on the drum 16. While the spool is supported on the car 30 the flanges run on the rolls 31 permitting the metal to readily unwind from the spool as it passes into the rolling mill. The transfer mechanism such as the car 30 can now be used to transfer this empty spool from the position in front of the rolls to a position in front of the rear end of the empty spool storage track 25, and the spools merely rolled from this car on to this storage track to await its turn in receiving another coil of metal. Transfer car 30 can then be returned to the full line position of Fig. 1 in alignment with the front of the rolls 13 and the storage track 28 where another filled spool can be rolled on to it and the metal therefrom rolled in the same manner. The spool on the drum 16 on which the rolled metal has been wound can be withdrawn from this drum by the transfer mechanism 23 and placed in the storage track 24 as above described.

After the entire batch of coils of the metal has been passed through the rolls and wound on spools as described, the rolls 13 can be set or adjusted for the next operation during which the strips of metal will be successively unwound from one loaded spool on to another spool until the entire batch has been rolled a second time and this operation of rolling from spool to spool in batches will be repeated as often as may be necessary to reduce the thickness of the metal to any desired point. After which, the metal being still on spools, will again be transferred by a crane or other conveyor mechanism to any desired place in the mill where it may be unwound from the spools and passed through the next operation, which may be any desired, such for example as, annealing, slitting, or flattening and cutting to lengths etc, the empty spools in any case being returned to the rolling mills for further loading.

It is to be noted that in the above operation the spools of each batch are loaded on the storage track 24 and then for the next rolling operation after resetting the rolls of the rolling mill, they are transferred from this storage track to the storage track 28 by means of transfer mechanism at the rear end of the storage track 24, such as the transfer car 27. From storage track 28 the loaded spools are rolled in succession on to the transfer and supporting mechanism 30 by which they are

held when the metal is being unwound from the spools. The empty spool is carried by this car to a position in front of the storage track 25 for empty spools. Metal unwound from the spools in front of the rolls from car 30 is wound on the spool on the drum 16. This spool is then removed from the drum by car 48 and transferred to a position in front of the storage track 24. Car 48 is then moved in front of storage track 25 to receive therefrom an empty spool which is carried by this car and placed on the drum 16. Thus the cycle is repeated as many times as required for the entire batch of spools or coils.

As intimated above various type of transfer mechanism may be used for transferring the loaded spools from the storage track 24 to the storage track 28, and for transferring the empty spools from the position in front of the rolling mill to the storage track 25. However, the cars 27 and 30 have proven satisfactory. Car 27 as shown comprises merely a suitable structural steel construction involving a platform 59 of about the level of the tracks 24 and 28 so that the spools may be easily rolled from one to the other. A block 60 prevents the spool from rolling off the car, and a removable block 61 is provided to retain it on the car during the transfer operation. The rolls 31 on the transfer and spool holding car 30 are preferably mounted on anti-frictional bearings 62 to facilitate as far as possible the unwinding of the metal from the spool. Although the tracks 26, 27 and 28 as shown in the drawings are arranged for having the coils or spools rolled by hand it will of course be evident that power driven conveyors or any other suitable transferring and supporting mechanism may be used.

It will be evident from the foregoing description that this construction and arrangement provides a simple method of handling metal in heavy coils to and from a rolling mill with a minimum of labor, and also that both the edges and the surface of the metal are protected from damage and waste that would naturally occur if the metal in comparatively thin gauges were transported and handled in open coils without the protection offered by the spools or reels.

Having thus set forth the nature of my invention, what I claim is:

1. In a device of the character described, a rolling mill, means at the outlet side of the mill for carrying and rotating a spool on which to wind the metal after being rolled, separate storage means for loaded and empty spools respectively at one side of the mill, means for transferring a loaded spool from the winding device to the first storage means, and means for shifting said transfer means to a position to receive an empty spool from the second storage means and transfer it to the winding mechanism.

2. In a device of the character described, a rolling mill, a winding mechanism at the outlet side of said mill including means for supporting and rotating a spool on which the metal is to be wound, a storage means for loaded spools extending at one side of the mill, a storage means for empty spools between the first storage means and the mill, a transfer means for withdrawing a loaded spool from the winding mechanism and moving it to the first storage means, and means for operating the transfer means to a position to then receive an empty spool from the second storage means and deliver it to the winding mechanism.

3. In a device of the character described, a rolling mill, a winding mechanism at the outlet side of the mill including a rotatable drum having one or more longitudinal grooves in its surface, a transfer mechanism including means for rotatably carrying a spool adapted to be placed on said drum, said spool having means to enter one of said grooves to drive the spool, means for driving the drum to wind metal on the spool, and said transfer mechanism including means to withdraw a loaded spool by shifting it longitudinally from the drum and to then carry it to a given location.

4. In a device of the character described, a rolling mill, a winding mechanism at the outlet side of the mill including a support for rotating a spool on which the metal is to be wound as it leaves the mill, a storage means for empty spools, a separate storage means for loaded spools, movable transfer mechanism for carrying an empty spool from the first storage means and placing it on the support, said transfer mechanism including means for withdrawing a loaded spool from the support and carrying it to the second storage means, and means for operating the transfer mechanism.

5. In a device of the character described, a rolling mill, a winding mechanism at the outlet side of the mill including a support for rotating a spool on which the metal is to be wound as it leaves the mill, separable guide means to embrace the spool to guide the free end of the metal strip around the spool, said guide means being movable away from the spool, a storage means for empty spools, a separate storage means for loaded spools, and transfer mechanism for withdrawing a loaded spool from the winding mechanism and carrying it to the second storage means and receiving an empty spool from the first storage means and placing it in the winding mechanism, said transfer mechanism being mounted to clear the guide means when they are away from the spool.

6. In a metal rolling device, a rolling mill, a winding mechanism at the outlet side of the mill adapted to rotate a spool to wind the metal thereon as it leaves the mill, a storage means for loaded spools at one side

of the mill, a second storage means for empty spools, transfer means for transferring a loaded spool from the winding mechanism to the first storage means and transferring an empty spool from the second storage means to the winding mechanism, means for supporting a loaded spool on the front side of the rolling mill to permit the metal to be unwound therefrom as it passes through the mill, means for transferring a loaded spool from the first storage means to said supporting means, and means for transferring an empty spool from said supporting means to the second storage means.

7. In a metal rolling device, a rolling mill, a winding mechanism at the outlet side of the mill adapted to rotate a spool to wind the metal thereon as it leaves the mill, a storage means for loaded spools at one side of the mill, a second storage means for empty spools, mechanism for transferring a loaded spool from the winding mechanism to the first storage means and for transferring an empty spool from the second storage means to the winding mechanism, means for transferring a loaded spool from the first storage means to a position in front of the rolls, and means for transferring an empty spool from said latter position to the second storage means.

8. In a metal rolling device, a rolling mill, a storage means for loaded spools in line with the mill at the front side thereof, a storage means for loaded spools at one side of the mill, a storage means for empty spools at one side of the mill, means for transferring loaded spools from the second storage means to the first storage means, and means for receiving a loaded spool from the first storage means and supporting it in front of the mill while the metal is being unwound therefrom to pass through the mill and for transferring the empty spool to the third storage means.

9. In a metal rolling device, a rolling mill, a storage means for loaded spools in line with the mill at the front side thereof, a storage means for loaded spools at one side of the mill, a storage means for empty spools at one side of the mill, means for transferring loaded spools from the second storage means to the first storage means, means for receiving a loaded spool from said first storage means and supporting it in front of the mill while the metal is being unwound therefrom to pass through the mill and for transferring the empty spool to the third storage means, means at the rear side of the mill for winding the metal or a spool as it leaves the mill, and means for transferring a loaded spool from the winding means to the second storage means and an empty spool from the third storage means to the winding means.

10. In a metal rolling device, a rolling mill, means at the rear of the mill for winding strip metal from the mill on flanged spools, a storage track for loaded spools at one side of the mill on which the spools may roll on their flanges, a similar storage track for empty spools between the first track and the mill, and transfer means for withdrawing a loaded spool from the winding means and delivering it to the first storage track, said transfer means being also capable of receiving an empty spool from the second storage track and delivering it to the winding means.

11. In a metal rolling device, a rolling mill, means at the rear of the mill for winding strip metal from the mill on flanged spools, a storage track for loaded spools at one side of the mill on which the spools may roll on their flanges, a similar storage track for empty spools between the first track and the mill, transfer means for taking a loading spool from the winding means and delivering it to the first storage track and for receiving an empty spool from the second storage track and delivering it to the winding means, a third storage track at the forward side of the mill in alignment therewith, a cross transfer means for taking a loaded spool from the first track and delivering it to the third track, means for receiving a loaded spool from the third track and supporting it while the metal is unwound therefrom to pass through the mill, and a second cross transfer means for carrying the empty spool to the second storage track.

12. In a device for rolling metal, a rolling mill, a rotatable drum at the rear of the mill for carrying a flanged spool to wind the metal thereon as it leaves the mill, a transfer mechanism including a track and a car running thereon, rolls on said car mounted for supporting a spool with its flanges resting on said rolls to turn on its flanges, means on the car to engage a spool to hold it against longitudinal movement thereon, and means for shifting the car to withdraw a loaded spool from the drum and to apply an empty spool thereto.

13. In a device for rolling metal, a rolling mill, a rotatable drum at the rear of the mill for carrying a flanged spool to wind the metal thereon as it leaves the mill, a transfer mechanism including a track and a car running thereon, rolls on said car for supporting a spool with its flanges resting on the rolls to turn thereon, an upright wall carried by the car at one end of said rolls adapted to engage an end of a spool to force it onto the drum as the car moves toward the drum, a movable hook means mounted on the car to engage a flange of the spool to withdraw it from the drum, and means for shifting the car to withdraw a loaded spool from the drum and apply an empty spool thereto.

14. The method of rolling metal which comprises delivering to a storage means adjacent the rolling mill a batch of loaded flanged spools on which the metal to be rolled

is wound, supporting the spools in succession in front of the mill to permit the metal to be unwound therefrom as it passes through the mill, transferring empty flanged spools in succession from a storage space to a winding means at the rear of the mill, winding the metal as it leaves the mill on to the empty spools, transferring the latter spools from the winding means to a storage space, transferring the filled spools from their storage space to the supporting means in front of the mill, transferring the empty spools from the latter means to the storage space for empty spools, resetting the rolls of the mill after the entire batch has been rolled, and then again passing the metal through the reset mill by the same manipulation of the loaded and empty spools.

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