May 1, 1962 PER SVEN E. FREDRIKSSON ETAL 3,032,289

COIL CONVEYOR FOR ROLLING MILL

Filed May 26, 1958 5 Sheets-Sheet 1

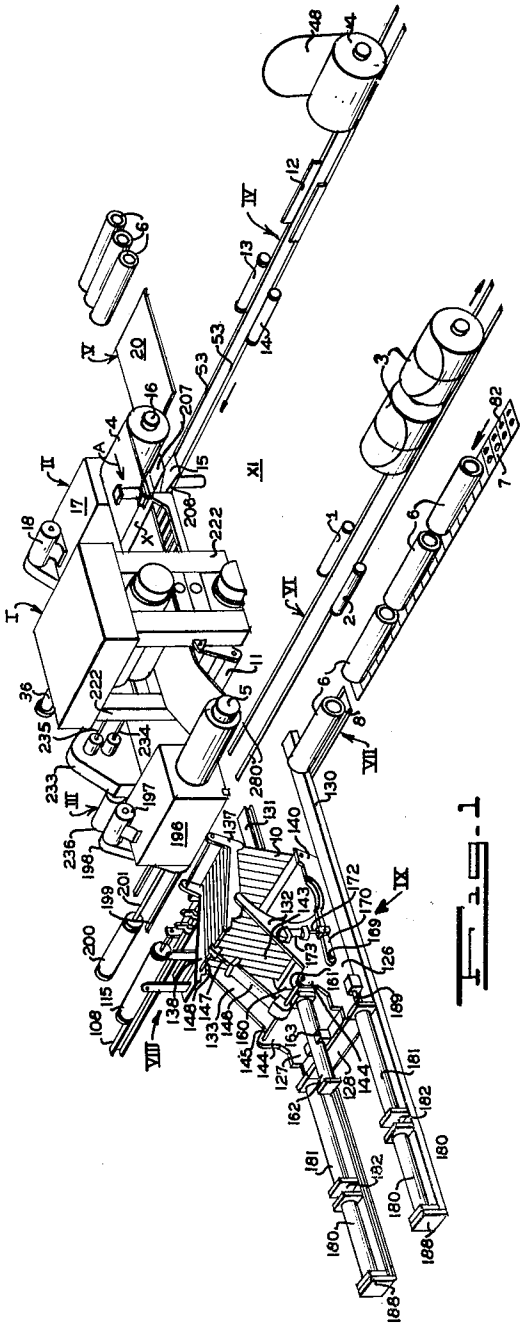


Fig. 1

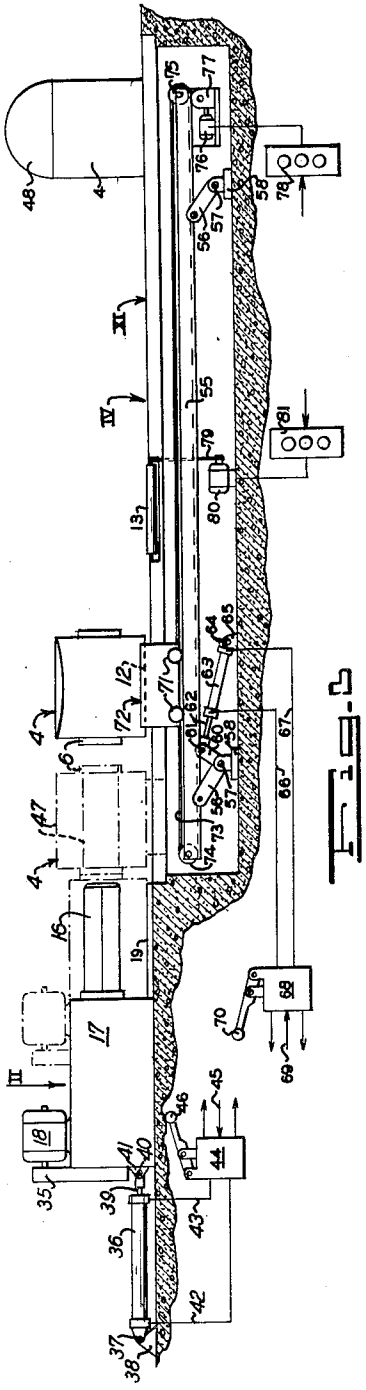


Fig. 2

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COIL CONVEYOR FOR ROLLING MILL

Filed May 26, 1958 5 Sheets-Sheet 2

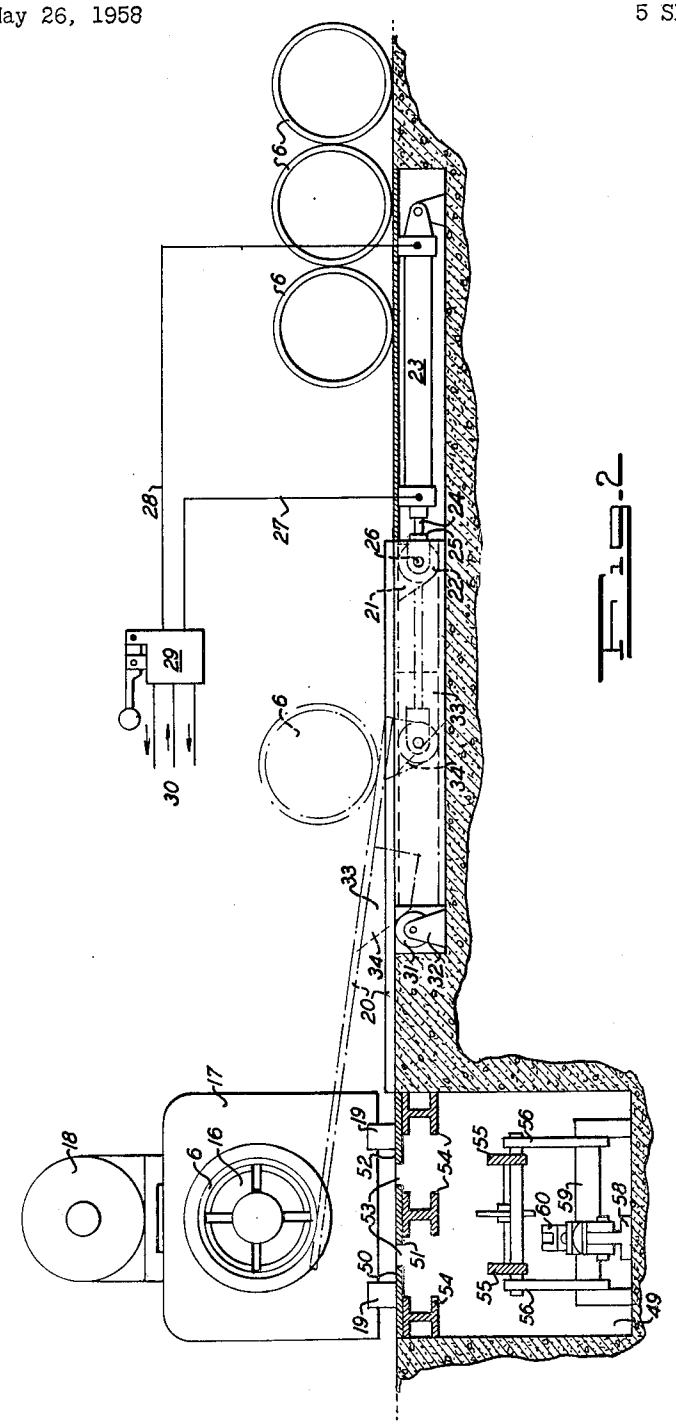
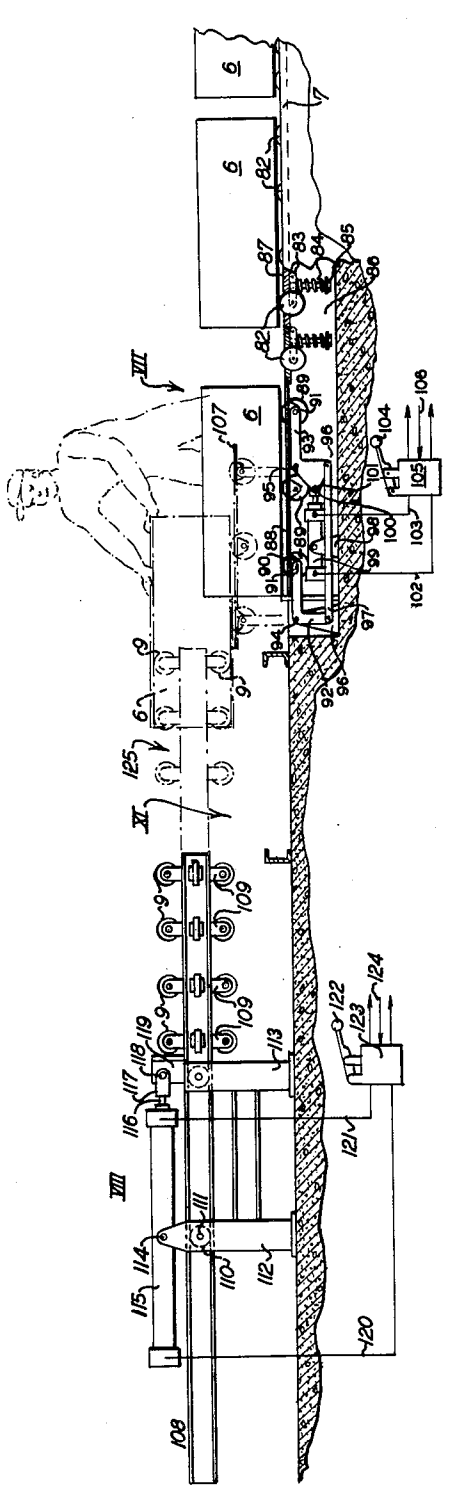


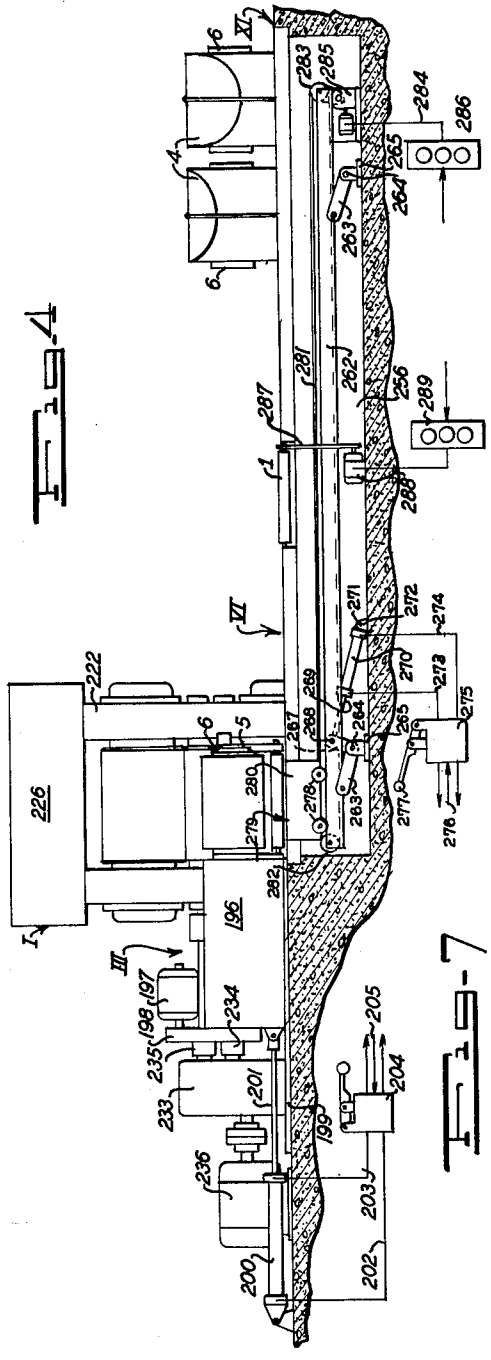
Fig. 2

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COIL CONVEYOR FOR ROLLING MILL

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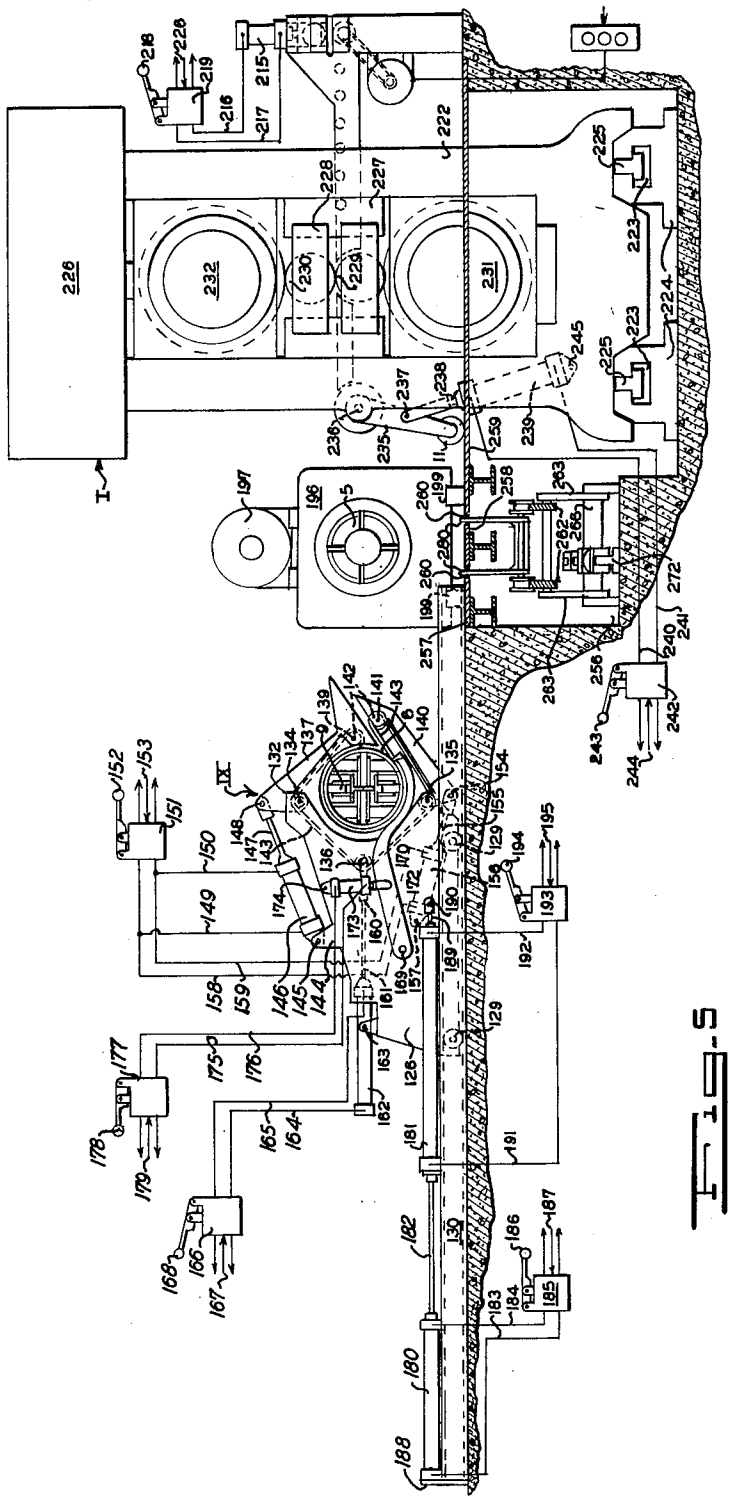


FIG. 5

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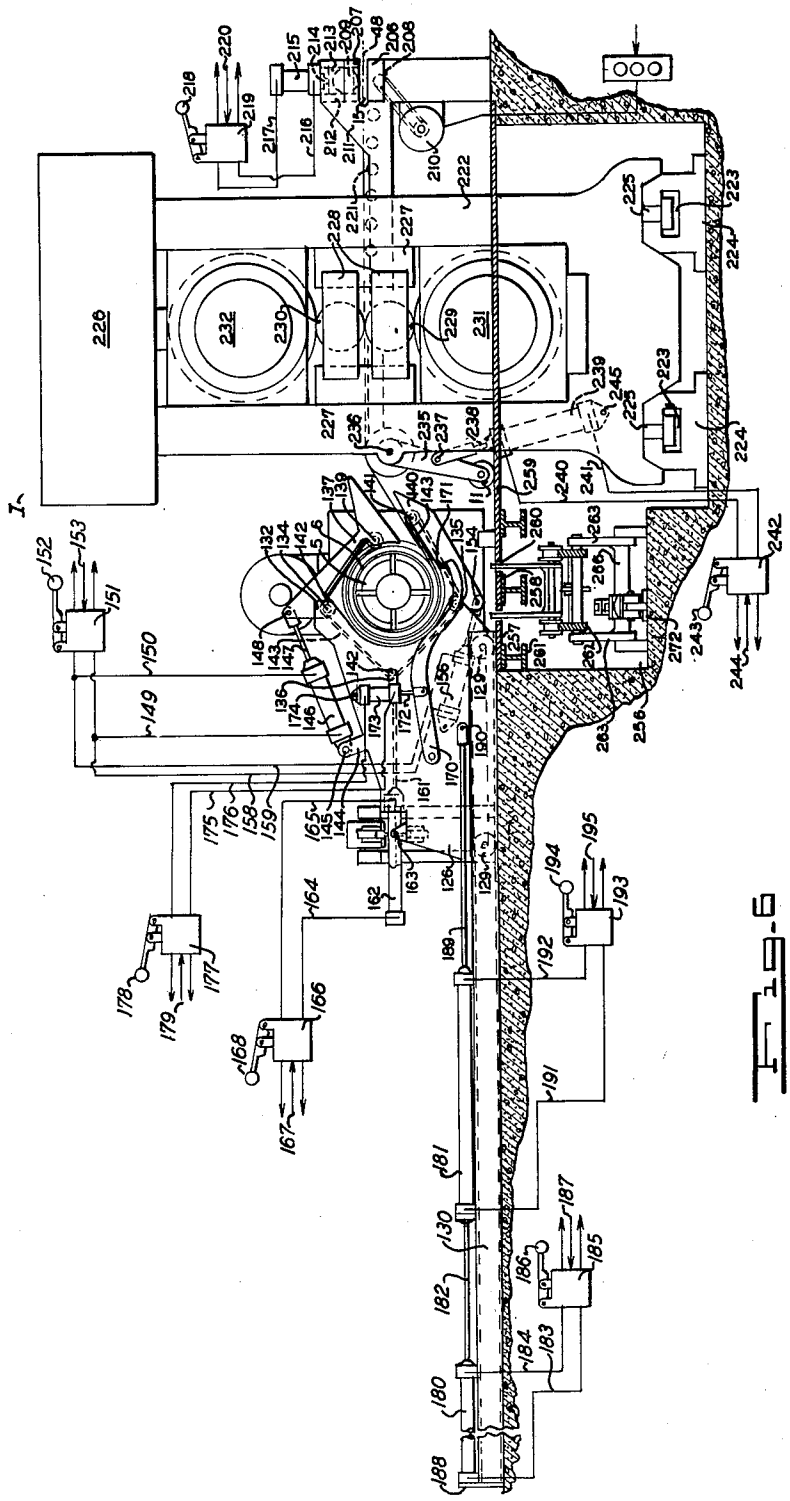


Fig. 6

United States Patent Office

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COIL CONVEYOR FOR ROLLING MILL

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12 Claims. (Cl. 242—79)

The present invention relates to a method in the supply and discharge of the work in plate rolling mills.

The invention also relates to a work handling equipment in plate rolling mills for carrying out the method according to the invention.

The main object of the invention is to provide a method and a plant for the handling of the work, which is supplied to and discharged from the rolling mill respectively, which plant will operate with a high grade accuracy and with minimum manual effort.

A further object of the invention is to provide a handling plant, which renders possible from a floor surface surrounding the rolling mill in a convenient way, raising and introduction of the work into the rolling mill and removal of said work and putting down ready-rolled work on substantially the same floor surface.

A further object of the invention is to provide a handling plant for the work in a rolling mill which to a minimum extent will encumber the floor surface surrounding said rolling mill thus facilitating walking and truck traffic around the rolling mill thereby preventing accidents.

A further object of the invention is to provide handling equipment for the work in a rolling mill by means of which the time required for the supply and discharge of the work may be reduced to a minimum.

A further object of the invention is to provide handling equipment for the work in a rolling mill by means of which damage to the work will be reduced to a minimum.

A further object of the invention is to provide handling equipment for the work in rolling mills, by means of which coils of rolled material on a coiler drum may be conveniently aligned with an accurately entered on a decoiler.

A further object of the invention is to provide handling equipment for the work in a rolling mill by means of which coiler drums may be accurately aligned with and transferred to an oncoiler.

A further object of the invention is to provide handling equipment for the work in a rolling mill, by means of which the coils may be easily rotated about their own axes for placing the end of the strip in a correct position for introduction into the rolling mill.

The invention will now be more clearly explained with reference to an embodiment thereof diagrammatically shown in the attached drawings and in connection therewith further objects of the invention will be set forth.

In the drawing:

FIGURE 1 is a perspective view of a strip mill, representing an arbitrary type of rolling mill, and handling equipment associated with said rolling mill for the work which is to be introduced into and removed from it, respectively.

FIGURE 2 is a vertical side elevation partly in a longitudinal section of the decoiler side of the rolling mill showing a device associated with the handling equipment for returning empty coiler drums to a magazine store or the like after decoiling.

FIGURE 3 is a vertical projection of the decoiler side of the rolling ill illustrating a device for supplying coils wound onto coiler drums to be decoiled in the rolling mill.

FIGURE 4 is a vertical elevation of a supply means for empty coiler drums incorporated in the handling equipment.

FIGURE 5 is a vertical side elevation partially in longitudinal section of the rolling mill and its oncoiler side together with a wrapper incorporated in the handling equipment in a prepared position for advancing a coiler drum to an oncoiler.

FIGURE 6 is a view similar to FIGURE 5 but showing the coiler drum placed upon the coiler and the wrapper in position for coiling the strip end around the drum.

FIGURE 7 is a vertical projection of the oncoiler side and an arrangement for the removal of coils of strip coiled onto said coiler after coiling on the oncoiler of the rolling mill.

With particular reference to FIGURE 1 there is shown in a perspective and diagrammatical view a rolling mill of an arbitrary type and handling equipment characteristic for the invention for the work which is to be passed through the rolling mill.

In order to explain principally the procedure in supplying and removal of the work in the rolling mill according to the invention, the main units incorporated in the plant are designated by Roman figures. Thus the rolling mill is generally designated by I, a decoiler means by II, an oncoiler means by III, a supply means for coils of strip by IV, a return means for empty coiler drums by V, a discharge means for oncoiled coils of strip by VI, a supply means for empty coiler drums by VII, a supporting means for supplied empty coiler drums by VIII, a wrapper means by IX, a feed roll means by X and a floor surrounding said rolling mill by XI.

Principally the method according to the invention is carried out in the following way.

The strip entered in the rolling mill in the direction of the arrow A will be rolled down to a suitable size and coiled after the rolling operation as will be evident from FIGURE 1 by the oncoiler means III, incorporating an expandible and collapsible coiler. After completion of the oncoiling of the rolled down work, a carriage located below the floor XI of the rolling mill and movable in the longitudinal direction of the coiler is raised above the floor surface, which carriage is provided with supporting plates and incorporated in the discharge means VI. The carriage will receive and support the rolled coil of strip whereafter the oncoiler means III will be removed in an axial direction at right angles to the rolling mill, whereby the coil of strip will entirely rest upon the carriage. The carriage and the rolled coil of strip is thereafter moved on a path located below the floor and the carriage may be lowered when required, for instance at the motor operated supporting rolls **1** and **2**, in order to rotate the coil so that its trailing ends will be placed in a suitable position, for instance for cutting, tying by metal wire or the like whereafter the carriage will again be caused to raise the coil and to move it into a position at a longer distance from the rolling mill for storing. Coils of strip removed in such a way are designated by reference numeral **3** in FIGURE 1.

According to the above, before the end of the strip or plate leaving the rolling mill can be coiled onto the expandible coiler **5** incorporated in the coiler means III, steps have to be taken to guide this end and to positively coil it around an empty coiler drum placed on said coiler **5**. Such empty coiler drums designated by reference numeral **6** are placed on a roller conveyor **7** arranged substantially level with the floor, on which conveyor the empty drums are successively transferred to a special raisable platform **8** for empty coiler drums incorporated in the supply means VII, which platform not only raises the empty coiler drum VI located thereon to a predeter-

mined level but also partially introduces it into the path of the wrapper IX. The level is adapted in such a way that the drum can be transferred conveniently by hand from the supply means VII to the supporting means VIII, which substantially is constituted of a number of rollers 9. When the drum thus has been moved the wrapper means IX is advanced in a direction towards the rolling mill and in doing so in a known way by means of endless strips or chains 10, encircles said drum, so that it will be retained therein and aligned in position for being transferred to the coiler 5. The supporting means VIII is returned to its rear position so that the drum will be carried entirely by the wrapper means IX in a way which will become evident as the description proceeds.

After the ready-coiled coil has been removed from the coiler 5, in accordance with the above, the oncoiler means III is moved in a direction from the path of operation of the rolling mill whereafter the wrapper IX is moved further forwardly towards the rolling mill to a predetermined position, wherein the empty drum located in it will be coaxially aligned with said coiler 5. When the oncoiler means III is returned into its operating position close to the rolling mill the coiler 5 is simultaneously entered in the drum and caused to expand so as to grip the drum thereon. In this position the plant is prepared for receiving an end of strip leaving the rolling mill which is principally caught between the outer wall of the drum and the belts or chains of the wrapper means IX. Due to the fact that the belts or chains are of the endless type and arranged so that they can move they press the rolled strip inwardly against the drum to form a tightly wound coil. After a suitable number of coils have been oncoiled for retaining the leading end of the strip the wrapper IX is returned to its rear position. When the strip has been ready-rolled on the drum a holding roller 11 is moved towards the coiler so that the strip cannot decoil at the end of the coiling operation. The carriage incorporated in the discharge means VI is raised above the floor for supporting the ready-coiled coil. After collapsing the coiler 5 the ready coil resting upon the supporting plates of said carriage may be removed and carried to a storing place which is indicated by the coils 3 lying on the floor surface XI.

Returning now to that side of the rolling mill from which the supply originally took place and assuming that continued reduction of the plate of the coils of strip is to be carried out which is preceded by shifting the rolling mill I, for instance a coil 4 previously rolled is transferred from the storing place at the discharge means VI to a special storing place on the floor XI above the supply means which substantially is constituted of a raisable and lowerable carriage movable beneath the floor and in other respects in all details coincides with the discharge means VI. Any metal wire tie adapted to prevent the coil from opening is removed whereafter the carriage, the supporting plates 12 of which protrude through the floor and which are at first lowered below the coil 4 to raise it afterwards, will transport the coil 4 now resting upon the supporting plates 12 in a direction towards the rolling mill. If it is deemed necessary the coil is lowered onto a rotating means comprising two motor driven rolls 13 and 14 so as to be rotated into such position that the free end of the coil will be brought into correct position for being entered in the rolling mill. After this has been performed the carriage 72 (FIG. 3) is again caused to raise the coil 4 moving it further inwards towards the rolling mill and decoiler means II. The end of the strip is then entered through a guide 15 arranged for it between the rolls of the feed roller means X, which is finally caused to grip the end of the strip. The decoiler means II, which was removed earlier, is simultaneously or subsequently moved inwards towards the rolling mill and its expandable coiler 16 again enters into the drum of the coil which as a result of the raising of the supporting plates XII has been coaxially aligned with said coiler 16. The coiler 16 is expanded whereafter decoiling may immediately be started and the strip supplied to the rolling mill I for a rolling operation and for continued handling on the discharge side of the rolling mill in accordance with the above description.

The apparatus will next be more particularly described with reference to FIGURES 2–7 inclusive showing the different details and their function and also the method proper in a more exhaustive way.

Referring particularly to FIGURE 2 which is a vertical elevation showing the decoiler means II and part of the handling equipment on the supply side of the rolling mill, reference numeral 17 designates a housing enclosing a gearing for the coiler 16. The coiler 16 is driven via the enclosed gearing (not shown) by an electric motor 18. The housing 17 rests on guides 19, on which the decoiler means II may be moved towards and away from the rolling mill at right angles to the same.

In order, after decoiling of the coil 4 rolled on the coiler drum 6 in a convenient way to remove the empty drum 6 as will be evident from FIGURE 2 the special discharge means V is arranged for empty coiler drums. This means substantially comprises a pivotable plate or platform 20, which is provided on its underside with pairs of brackets 21, in which supporting wheels 22 are mounted. Placed behind the platform 20 and below the surface of the floor XI is a hydraulic cylinder 23, the protruding piston rod 24 of which is connected via a yoke 25 with the shaft 26 of the wheels 22. The cylinder 23 is connected by way of lines 27 and 28 via a reversible valve 29 through the line 30 to a source of compressed fluid (not shown) whereby the supply of compressed fluid may alternately take place through the conduits 27 and 28.

The platform 20 with its forward end rests in a substantially horizontal position on wheels 31, mounted in brackets 32. Arranged on the underside of the platform 20 in register with the respective wheels 31 are cam members 33, which are adapted when displacing the platform 20 in a direction towards the decoiler means II to slide, on the oblique edge 34 up the wheels 32 thereby carrying the platform 20, as is indicated by dash-and-dot lines, forwardly beneath the coiler 16 to assume an inclined position. Such movement of the platform is obtained by supplying pressure fluid through line 28 by means of the valve 29 so that the piston rod 24 will displace the platform 20 in a direction towards the decoiler means II, the cam surface 34 on the member 33 placing the platform 20 in a slanting position. After the platform 20 has been set into this slanting position with its forward end beneath the coiler 16 and the coiler collapsed the coiler means II is removed on guides 19 so that the empty coiler drum 6 will be entirely supported by the platform 20, down which it will roll due to gravity after the coiler 16 has been entirely removed out of the empty drum. A rolling empty drum 6 is shown in the figure by dash-and-dot lines. Drums removed in this way will roll to a storing place or the like as represented by the drums 6 to the right on the drawing.

In FIGURE 3 the decoiler means II proper is shown in a longitudinal elevation and the supply means IV for coils 4 on coiler drum 16 in the decoiler means II, the floor of the rolling mill being broken to show the details of the supply means IV. It will be evident from the left part of the drawing how the gearing of the decoiler means II in the gear housing 17, by means of power from the electrical motor 18 through the belt or chain gearing 35, drives said coiler 16. Further it will be seen how the decoiler means II may be displaced forwardly and backwardly in its longitudinal direction on the guides 19 by means of a hydraulic or pneumatic cylinder 36, which is pivoted at 37 to a stationary bracket 38. The piston operating in the cylinder 36 is pivoted at its outer end 39 on the pivot 40 on the gear housing 17 by means of a bracket 41. Furthermore the cylinder 36 is connected by means of two lines 42 and 43 via a reversible valve 44 to a source

of pressure medium (not shown) by way of line 45. By operating the handle 46 of the valve 44 the supply of fluid may be alternately brought about in both lines 42 and 43, whereby the piston 39 is caused to displace the coiler means II in a desired direction on the rails 19, for instance from the operative position indicated by dash-and-dot lines 47 into the ineffective position indicated by full lines in the drawing.

In order that the coiler 16 in a convenient way and with accuracy will be able to transfer coils in accordance with FIGURE 3 a storing place is arranged for such coils 4 at a distance from the rolling mill, at which metal wires tied around the coils are removed so that each coil thus presents outwardly turned strip ends 48. As will be more clearly evident from FIGURE 2 and also FIGURE 3 an elongated pit 49 is formed in the floor of the rolling mill, which extends at right angles to the rolling mill and beneath the coiler 16 when in its operative position. The pit is covered as will be evident from FIGURE 2 at the floor level by means of a number of plates 50, 51 and 52, which are placed at some distance from each other so as to form elongated slots 53 between them. These slots in view of requirement to pass on the floor should be as narrow as possible so that they neither obstruct walking and truck traffic nor in other respects contribute to accidents. In order that the relatively thin plates 50, 51 and 52 should resist possible deflection under load said plates are sustained by I-beams designated by 54.

As will be particularly evident from FIGURE 3 pairs of beams or rails 55 extend longitudinally of the pit 49 which beams are also indicated in FIGURE 2. The beams are carried by link members 56 which are pivotally mounted at 57 in brackets 58 which are anchored at the bottom of the pit 49. Arranged at each end of the rails are pairs of such link members 56, which are rigidly connected to a shaft 59. Rigidly connected to the shaft 59 at one end of the beams 55 is a lever 60, which at 61 is pivoted to a piston rod 62 of a pneumatic or hydraulic cylinder 63, which in turn at 64 is pivotally connected to a bracket 65, which is anchored to the bottom of the pit 49. The cylinder 63 is connected by way of lines 66 and 67 via a reversible valve 68 to a source of pressure (not shown) connected to the line 69. By adjusting the handle 70 of the valve pressure can be alternately applied in the lines 66 and 67 whereby the piston 62 in the cylinder 63 may be brought to move alternately in one direction or the other. If thus the piston 62 in FIGURE 3 is displaced to the right by applying pressure in the line 66 the links 56 are caused to rotate in a clockwise direction, whereby the beams or rails 55 are lowered. The beams 55 carry a movable carriage 72 equipped with the wheels 71, which has two upwardly extending supporting plates 12, also shown in FIGURE 1. Each one of these supporting plates may freely pass in the longitudinal slots 53 above the pit 49 and the carriage 72 is raised and lowered by means of the rails 55 under the influence of the piston 62 which will be evident from FIGURE 3. The carriage is displaced on the rails 55 by means of a wire or a chain 73 which runs over pulleys 74, 75 mounted at the ends of the beams 55. The wire or chain is actuated by an electric motor 76 via a gearing means generally designated by 77 and the operation of the electric motor is brought about by means of a switch 78 in known manner.

Thus, it will be evident that it is possible by means of the piston and cylinder means 62, 63 to raise the carriage 72 to an upper position wherein its supporting plates 12 extend upwardly through the slots 53 above the pit 49, in which raised position the carriage obviously also may be moved along said slots. Furthermore the carriage 72 may be lowered by said piston and cylinder means so that the supporting plates 12 of the carriage 72 will be located entirely below the surface of the floor XI.

Arranged approximately midway of the pit 49 are driven supporting rolls 13 and 14 shown in FIGURE 1 which by means of a chain or belt 79 or the like are driven by an electric motor 80 which is controlled by means of a switch of a known kind designated by 81.

The mode of operation of the supply means IV for the coils 4 just described is substantially as follows. If in accordance with FIGURE 3 the coil 4 is assumed to be stored to the right in the figure, the motor 76 is started via the switch 78 so that the carriage 72 will move to the right in the figure. At the same time or later on the valve 68 is operated via the handle 70 whereby the rails 55 are lowered so that the supporting plates 12 of the carriage will be lowered below the level of the floor. The carriage 72 may now be moved directly below the stored coil 4 whereafter it, by adjusting the valve 68 and therewith raising of the rails 55, may be raised so that its supporting plates 12 are brought upwardly through the slots 53 beneath the coil 4 which is thereby raised and will come to rest upon the carriage 72.

In order to be able to direct the free ends 48 of the coil into a suitable position for a later introduction into the rolling mill, the carriage is caused to stop just above both rolls 13 and 14 and to be lowered by operating the valve 68 so that the supporting plates 12 will move down below the level of the floor. Since the coil 4 now entirely rests on both rolls 13 and 14, it will be possible by operating the motor 80 by means of the switch 81 to rotate the coils in a desired direction for placing said end of the strip 48 in a correct position. After this has taken place by manipulating the valve 68 the carriage may again be raised with the coil whereafter by manipulating the switch 78 the motor 76 may be caused to displace the carriage 72 on the rails 55 in a direction towards the rolling mill. The carriage is stopped in the position of the coil 4 indicated by dash-and-dot lines 47 in order to be able to be entered into the rolling mill. It may also be noted that the rails are always raised by their actuating members to a predetermined uppermost position, whereby the coil will be coaxially aligned with the coiler 16.

As will be evident from FIGURE 3 the decoiler means II with the coiler 16 is retracted in its rear position which it occupied after removing the coiler 16 out of an empty drum in accordance with FIGURE 2 and the corresponding description. After the carriage 72 and the coil 4 has been moved to a prepared position for introduction into the rolling mill pressure medium is supplied through line 42 by operating the valve 44, whereby the piston rod 39 displaces the decoiler means II in such a way that the coiler 16 is moved in collapsed condition into the drum 6 of the coil 4. After completed movement of the decoiler means II the pressure in line 42 is varied so that the decoiler means II will remain in its operating position whereafter the coiler 16 is caused to expand and to lock the drum 6. Before the rolling operation begins certain steps should be taken on the other side, the oncoiling side, of the rolling mill and FIGURE 4 illustrates how empty coiler drums 6 are placed in prepared position for being supplied at the oncoiler means III.

The roller conveyor generally mentioned in connection with FIGURE 1 and designated by VII in FIGURE 4 includes a number of rolls 82 arranged in double rows. In order that these rows may not unnecessarily form a hindrance for walking or truck traffic they are resiliently mounted, whereby at the passage of a truck they are pressed down by the weight of said truck level with the floor. Each such roller 82 is mounted for rotation in a yoke 83, which is pressed by a helical spring 84 threaded onto a suitable bolt 85 against the underside of the floor. In this position the rolls 82 extend sufficiently high above the floor in order that the empty coiler drums 6 may be rolled upon them in the direction of the roller conveyor forwardly towards the supply means VII proper, which forms the end station for the transport taking place on the floor at right angles to the rolling mill. The pit 86 in the floor provides space for the details of the roller conveyor 7 and is covered level with the floor by a suit-

able plate 87. Arranged in continuation of this roller conveyor in a direction towards the rolling mill is a platform 88 which also presents two rows of rollers 89, of which one row is shown in FIGURE 4. All rollers 89 are mounted in brackets 90 attached to the underside of the platform 88. Arranged in said bracket on pivots 91 at the outer pairs of rollers are bell cranks 92 and 93 pivoted on pivots 94, 95 in fixed brackets 96 anchored into the bottom of the pit 86. The lower arms of the bell cranks 92, 93 are pivotally connected with each other by means of a link 97. Pivotally mounted in a further fixed bracket 98 anchored in the bottom of the pit 86 is a pneumatic or hydraulic cylinder 99, the piston rod 100 of which is pivotally connected with the reinforced lower arm of the bell crank 93 at a point 101. The cylinder 99 is connected by way of lines 102, 103 via a valve 105 shiftable by means of a handle 104 to a source of pressure (not shown) connected to the line 106 and by operating the valve 105 the piston rod 11 may be caused to turn the bell cranks 92 and 93 about their mountings 94 and 95, respectively, so that the platform 88 and the rollers 89 will occupy the position indicated by dash-and-dot lines 107. The platform is raised in this way to a predetermined upper level and furthermore the platform 88, while being raised, is caused to be displaced closer to the path of operation of the wrapper IX which as will be evident as the description proceeds will facilitate the supply of the coiler drum 6.

The left side of the figure illustrates the supporting means VIII for receiving coiler drums 6 supplied in the above way. The supporting means VIII incorporating the rollers 9 indicated in connection with FIGURE 1 presents an I-beam 108 movable in its longitudinal direction in the forward end of which four rows of rollers are arranged at right angles to each other by means of yoke members 109. The beam 108 rests on either side upon wheels 110 which are mounted on pivots 111 in supports 112 and 113, which are fixed to the floor XI. Resting at the upper part of the support 112 is a hydraulic or pneumatic cylinder 115 mounted for rotation on pivots 114, which cylinder is provided with a protruding piston rod 116, which through the intermediary of a yoke 117 and a pivot 118 is pivotally connected to the bracket 119 fixed to said beam 108. The cylinder 115 is connected via a line 120 and a line 121 and a valve 123 operable by means of a handle 122 to a source of compressed medium (not shown) connected to the line 124. By shifting the handle 122 of the valve 123 pressure may be alternately applied to the lines 120 and 121. Providing the supporting means VIII occupies the original position shown in FIGURE 4 and the handle 122 of the valve 123 is operated in such a way that compressed fluid is applied in the line 120 the piston rod 116 via the bracket 119 will displace the beam 108 and all rollers 9 mounted thereon to a definite outermost position to the right which is indicated by dash-and-dot lines 125 on the drawing. In this position, as previously mentioned, the platform 88 (position 107) together with its rollers will be in a very close connection with the rollers 9 in their advanced position and for that reason the worker indicated in the drawing may easily by hand transfer the empty coiler drum 6 resting on the platform 88 onto the rollers 9 to a definite position above the surface of the floor. By operating the valve 105 by means of the handle 104 the platform 107 may be returned to its lower home position shown in the drawing in full lines in a position adapted for receiving the next coiler drum 6.

When a coiler drum 6 is thus moved into position for the final step of supply, the wrapper IX is caused to operate primarily to take over the supporting of said coiler drum 6 so that the supporting means VIII can be returned to its starting position by operating the handle 122 of the valve 123.

FIGURE 5 illustrates the construction of the wrapper IX. Referring at the same to FIGURE 1 the wrapper IX substantially comprises two vertical mouth-like frames 126 and 127 which are connected at their lower part by cross members 128. Mounted on each frame are two wheels 129 running on rails 130 and 131 having the form of U-beams placed so that their flanges face each other. The wheels 129 then run between the flanges of respective beams whereby the arrangement is prevented from tilting. Both corners or projections 132 and 133 respectively of the frames 126 and 127 are connected with each other by means of a cross rod or shaft 134. A similar shaft 135 connects both lower parts of said frames. Furthermore a tension roller 136 is arranged in the space between said frames 126 and 127, which, however, is not fixed to the frames but movable between them in a way which will be evident from the description as it proceeds. The shaft 134 forms a mounting for two swingable jaws 137 and 138 arranged in a spaced relation and which at their forward extremities are connected by means of a further rod or shaft 139.

The shaft 135 in turn forms a mounting for a pair of lower swingable jaws 140, only one of which is shown in FIGURES 1, 5 and 6. Both said lower jaws 140 are connected by a shaft 141. All shafts 134, 135, 139 and 141 and tension roller 136 carry rotatable sleeves or drums 142 over which endless belts or chains 143 run which in accordance with FIGURE 1 are placed in a spaced relation to each other in the cross direction of the arrangement.

Fixed to brackets or projections 144 on each frame 126 and 127 is a shaft 145, midway of which a hydraulic or pneumatic cylinder 146 is pivotally connected. The piston rod 147 projecting from the cylinder is mounted midway of a shaft 148 which joins both upper jaws 137 and 138. The cylinder 146 is connected by way of lines 149 and 150 and a control valve 151 provided with an operating handle 152 to a source of compressed fluid (not shown) connected to the line 153. Both lower jaws 140 are joined in a similar way to a cross shaft or rod 154 to which a piston rod 155 is pivoted which rod operates in a hydraulic or pneumatic cylinder 156. This in turn is pivotally mounted on a shaft 157 fixed to both frames 126 and 127. The cylinder 156 is connected by way of lines 158 and 159 to the valve 151 previously mentioned and to the source of compressed medium represented by line 153 which means that both piston rods 147 and 155 are operated in unison.

Both ends of the shaft 136 are fixed to a yoke member 160 which in turn is connected to the piston rod 161. This rod operates in a hydraulic or pneumatic cylinder 162 which is pivotally mounted at the bracket 163 on the cross member 128. The cylinder 162 is connected by way of lines 164 and 165 and a control valve 166 to a source of compressed medium represented by the line 167, the passage of compressed medium being controlled by means of the operating handle 168. Pivotally mounted about pivots 169 on the outer sides of the frames 126 and 127 are supporting arms 170, only one of which is shown in FIGURES 1, 5 and 6. These supporting arms 170 are adapted to carry and on a predetermined level accurately to align coiler drums 6 supplied and are provided for this reason with suitable adjustable supporting pins or the like 171, on which the drum will rest. The supporting arms 170 are respectively and pivotally connected with each piston 172, which operates in the cylinder 173 which is pivotally mounted on pivots 174 on each frame 126 and 127. The cylinder 173 is connected by way of lines 175 and 176 and a control valve 177 provided with an operating handle 178 to a source of compressed medium represented by line 179. By applying pressure in either conduit 175, 176 the arms 170 may be raised and lowered.

Arranged for the displacement towards and away from the rolling mill I of the described wrapper means IX are, on the one hand, rear pairs of hydraulic or pneumatic cylinders 180 and, on the other, forward similar pairs of

cylinders 181. Pistons 182 operate in the cylinders 180. The cylinders 180 are connected by way of lines 183 and 184 via a control valve 185 provided with an operating handle 186 to a source of compressed medium represented by the line 187. Whereas both rear cylinders 180 are fixed to the rails 130 by means of rear supports 188 the cylinders 181, however, are freely movable on the rails 130 for reasons which will be evident as the description proceeds. The piston rods 189 operating in the cylinders 181 are connected by means of pins 190 with frames 126 and 127 respectively. The cylinders 181 are connected by way of lines 191 and 192 via a control valve 193 provided with an operating handle 194 to a source of pressure represented by the line 195.

The intention of the doubled pairs of cylinders 180 and 181 is to bring about in a convenient way a stepwise movement of the wrapper means IX to different stations. Thus, starting out from the rear or ineffective position of the wrapper shown in FIGURE 1 it will be seen that both cylinders 180 and 181 are located close to each other and the piston rods retracted. If, with the reference to FIGURE 5, pressure is applied in this position in the conduit 183 the piston rods 182 will displace the cylinders 181 to a first station, whereafter by applying pressure in the line 191 the piston rods 189 may be caused to carry the wrapper a further feeding step forwardly into a position substantially representing the end station of the feeding of the wrapper IX. It will be evident from FIGURE 6 how the piston rod 189 has been moved out of its cylinder 181.

FIGURE 4 illustrates how an empty coiler drum 6 by means of the rollers 9 is supplied to the supporting means VIII. In accordance with FIGURE 5 the drum 6 is still carried by said rollers 9 but the wrapper IX and its jaws 137, 138 and 140 together with the belts or chains 143 have formed an annular part which encircles the drum 6. In order to explain the mode of operation during this operation reference is again made to the starting position of the wrapper means IX in FIGURE 1, from which it will be evident how both said movable pairs of jaws and associated chains or belts 143 form a planar curtain 10. By applying pressure in this position (FIGURE 1) in lines 183 (FIGURES 5 and 6) in cylinders 180 the wrapper means IX will be moved forwardly in a direction towards the rolling mill I, the curtain 10 striking the empty drum 6 resting on the rollers 9. The curtain 10 then yields inwardly at the same time as pressure is applied in cylinders 146 and 156 which will cause the jaws 137, 138 and 140 to close and contribute to cause the belts 143 starting an operation of encircling the periphery of the drum 6. In order that the belts of the curtain 10 may have a sufficient length a pressure is supplied at the same time in the cylinder 162 whereby the roller 136 is moved forwardly slackening the belts 143 so that they will gradually encircle the periphery of the drum until occupying the final position shown in FIGURE 5. Thereafter compressed medium is supplied to the cylinders 173 whereby the arms 170 are raised to a predetermined upper position in which the drum 6 will merely rest upon said arms aligned by the pins 171.

In this position wherein the drum 6 is entirely supported and coaxially aligned in the wrapper IX, pressure is supplied in line 121 (FIGURE 4) whereby the piston rod 116 will again bring the beam 108 and the rollers 9 into their rear ineffective position shown in this figure, wherein the supporting means VIII is entirely retracted out of the path of movement of the wrapper IX.

The next step is to transfer the empty drum 6 to the coiler 5 in the oncoiler means III shown in FIGURES 1, 5, 6 and 7. This oncoiler means III is constructed equivalently to the decoiler means II and substantially comprises a housing 196 which encases a gearing (not shown) for driving the expandable coiler 5 by means of an electric motor 197 arranged on the top of the housing, which motor by means of belt or chain gearing 198 (FIGURES 1 and 7) drives said gearing. Th oncoiler means III is displaceable at right angles towards the path of operation of the rolling mill on guides 199. This displacement is carried out by means of a hydraulic or pneumatic cylinder means in which the cylinder as will be evident from FIGURES 1 and 7 is designated by 200 and the piston rod by 201. The outer end of this piston rod 201 is rigidly connected in a suitable way to the gearing house 196. As will be evident from FIGURE 7, this cylinder 200 is connected by way of lines 202 and 203 via a control valve 204 to a source of compressed medium represented by line 205.

In order that the drum in the wrapper IX in FIGURE 5 will be transferred to the coiler 5 the coiler means III should at first be removed out of the path of operation of the wrapper means IX into a rear position, which is brought about by applying pressure in line 203. Pressure is thereafter applied in the line 191 (FIGURE 5), whereby the piston rod 190 will move the wrapper IX into a fixed forward position as will be evident from FIGURE 6. The drum 6 when resting on the arms 170 is coaxially aligned with the coiler 5 and the coiler means III now in accordance with FIGURE 7 is again moved forwardly into its operating position, the collapsed coiler being entered into the drum 6 in order to expand after completed movement, whereby the drum 6 will be locked on the coiler 5. Since the arms 170 are not necessary any longer to hold the drum 6 in position, since it is now carried directly by the coiler 5 the pressure in the line 175 (FIGURE 5) is reduced by reversing the handle 178, whereby the arms 170 are lowered. After all the above described operations have been completed the oncoiler means III and wrapper means IX are in a prepared position for receiving and coiling the rolled strip leaving the rolling mill.

Further it has previously been indicated how the end 48 of the strip (FIGURES 1 and 3) of the coil 4, by rotation on the supporting rollers 13 and 14 before being supplied to the coiler 16, was caused to occupy a suitable position for the introduction into the guide 15. The guide 15 comprises two lips 206 and 207 (see also FIGURE 6) which will guide the end 48 of the strip in between two feed rollers 208, which is driven by an electric motor 210, and 209, serving as a holding roller, the roller 209 being mounted for displacement in a frame 211 located above the rolling mill I in a guide 212. Arranged on slides 213 in guides 212 are pistons 214 operating in hydraulic or pneumatic cylinders 215, which are connected by way of lines 216 and 217 via a control valve 219 provided with an operating handle 218 to a source of compressed fluid represented by line 220. For entering the end 48 of the strip, a pressure is suitably applied in line 216 so that the holding roller 209 is kept in a raised position. After the coiler strip has been entered in position on the decoiler 16 and this coiler has been expanded and the end 48 of the strip placed in a desired position between both feed rollers 208 and 209 the pressure is instead applied in line 217 whereby the holding roller 209 is pressed against the strip 48 pressing it into contact with the driven feed roller 208, whereby the end 48 of the strip on the roller conveyor 221 is fed into the rolling mill I.

The rolling mill, which may be of an arbitrary type, since it is not directly covered by the present invention, comprises two housings 222, which rest on rails 224 or the like provided with grooves 223, by means of which the rolling mill I may be fixed in position in said grooves 223 by means of suitable fixing members 225. The upper part of the rolling mill I includes a cover generally designated by 226, which contains mechanism for the setting of the rolling mill. Movably arranged in guide-like members 227 are two bearing blocks 228, one at each end of the working rolls 229 and 230 rotatably mounted therein. The working rolls are backed up by two supporting rolls 231 and 232, which may be vertically adjusted in a suit-

able way so as to obtain a desired rolling space between the working rolls 229 and 230. The working rolls are driven via a gearing 233 and shafts 234 and 235 by an electric motor 236 shown in FIGURES 1 and 7.

When the end 48 of the strip, with reference to the above, is advanced onto the roller conveyor 221 it is gripped between both working rolls 229 and 230 and rolled down to a desired size whereafter the strip is passed out of the rolling mill I above a supporting roll. The end 48 of the strip is guided by the jaws 137 and 140 inwardly towards the coiler drum 6 and the coiler 5 started. By this the end 48 of the strip is gripped between the drum 6 and belts or chains 143 and caused to encircle the drum 6 tightly. After a number of coils have been wound so as to hold the leading end of the strip in position the wrapper means IX is moved back into its rear position in a way which will be described in detail later on. When substantially the entire strip 48 has been rolled and coiled onto the coiler 5 the holding roller 11 which is mounted for rotation on arms 235 is brought against the coil of strip. These arms are mounted for rotation about shafts 236. The turning movement is brought about by means of a piston rod 238 pivotally mounted at 237 which operates in a hydraulic or pneumatic cylinder 239. The cylinder 239 is connected by way of lines 240 and 241 and the control valve 242 provided with the operating handle 243 to a source of compressed fluid represented by the line 244. When thus pressure is supplied in the line 241 the piston 238 is pressed upwardly whereby the cylinder 239 turning about its pivot 245 as well as the arms 235 are turned upwardly until the holding roller 11 engages the coil wound onto the coiler 5. The coiler 5 is now caused to rotate as long as the holding roller 11 has securely pressed the end of the strip against the remainder of the coil.

Returning of the wrapper means IX into its rear prepared position is brought about in the following manner. The operating handle 152 of the valve 151 and the operating handle 168 of the valve 166 are reversed whereby the jaws 137, 138 and 140 are opened and the belts or chains 143 drawn backwardly by the piston rod 161 to occupy the position of these chains or belts illustrated in FIGURE 1. The entire wrapper means IX is now returned in stepwise manner by operating the operating handle 186 and 194 of the respective valves 185 and 193 and can now again start a loading operation for an empty coil drum 6.

For the removal of the coil 3 of the strip thus ready-coiled together with the coiler drum 6 the following steps have to be taken utilizing the discharge means VI which in all details coincides with the supply means IV (FIGURE 3) for the coils 4 of strip at the decoiling side of the rolling mill but which for the purpose of explanation also is shown in FIGURE 7, wherein 256 designates a relatively elongated pit which extends at right angles to the rolling mill in beneath the decoiler 5, when in its working position. The pit 256 as will be evident from FIGURES 5 and 6 is covered in the floor level by a number of plates 257, 258 and 259, which are placed at some distance apart so that narrow elongated slots 260 are formed between them. These slots should be as narrow as possible in view of the fact that they must not form a hindrance to walking or truck traffic or in other respects contribute to accidents. In order that the relatively thin plates should be able to resist possible deflections all of them are sustained by I-beams designated by 261.

As will be particularly evident from FIGURE 3 but is also indicated in FIGURES 5, 6 and 7, a pair of beams or rails 262 extend along the pit 256. The beams are supported by link members 263, which are pivotally mounted on a pivot 264 in brackets 265, which are anchored in the bottom of the pit 256. Arranged at each end of the beams are a pair of arms 263 which are rigidly connected to the shaft 266 which in turn carries a lever 267 rigidly connected thereto, which at 268 is pivotally connected to a piston rod 269 in a pneumatic or hydraulic cylinder 270, which in turn at 271 is pivotally connected to a bracket 272 anchored in the bottom of the pit 256. The cylinder 270 is connected by way of lines 273 and 274 via a valve 275 to a source of compressed fluid represented by line 276. By operating the handle 277 of the valve pressure may be applied alternately in lines 273 and 274 whereby the piston 269 may be caused to move to and fro. If thus the piston 269 in FIGURE 7 is moved to the right by applying pressure in line 273 the links 263 are brought to swing in a clockwise direction, whereby the beams or rails 262 are raised. The beams 262 support a carriage 279 provided with wheels 278 which has two upwardly extending supporting plates 280 shown in FIGURES 5 and 6 and also indicated in FIGURE 1. Each one of said supporting plates may freely move above the pit 266 in the longitudinal slots 260 and the carriage is raised and lowered by the pistons 269 actuating the beams 262 to be raised and lowered as will be evident from FIGURE 7. The carriage is moved upon the beams by means of a wire or chain 281 which passes over pulleys 282, 283 mounted in the ends of the beams 262. This wire or chain is driven by means of an electric motor 284 via a gearing means generally designated by 285. The operation of the electric motor occurs by means of a switch 286. It should be appreciated that the carriage 279 may be raised to an upper position by means of the piston or cylinder arrangement 269, 270 so that the supporting plates 280 protrude upwardly through the slots 260 over the surface of the floor XI. In this position obviously the carriage may be moved along said slots. Furthermore the carriage 279 by said piston and cylinder arrangement may also be lowered so that the supporting plates on the carriage 279 will be located entirely below the surface of the floor.

Approximately midway of the path of movement of the carriage the driven supporting rollers 1, 2 shown in FIGURE 1 are arranged, which by means of a chain or a belt 287 are driven by an electric motor 288 which is operated by means of a switch of a known kind designated by 289.

The mode of operation of the arrangement just described when removing ready-wound coils of strip from the coiler 5 will now be described.

After removal of the wrapper means IX into its position as shown in FIGURE 1, the trailing end of the ready-coiled strip is retained on the coil by the holding roller 11 in a prepared position for being transported away. This transport is carried out by means of the above described discharge means VI. By operating the valve 275 (FIGURE 7) the beams 262 are raised to such a position that the supporting plate 280 of the carriage 279 will extend above the surface of the floor. Since the carriage 279 was in proper position below the ready-coiled coil by further operation of the valve 275 it will finally come to rest entirely upon the supporting plate 280 of the carriage, thus also preventing decoiling of the end of the strip. The holding roller 11 shown in FIGURES 1, 5 and 6 may now be turned downwardly by operating the valve 242 so as to occupy the position illustrated in said figures. Simultaneously therewith by operating the valve 204 after having collapsed the coiler 5 the oncoiler means III may be returned to its rear ineffective position. The coil or strip now entirely rests upon the carriage 279 and by starting the motor 284 the carriage may be caused to move to the left into a position just above the rollers 1 and 2, in which position the beams 262 are temporarily lowered by operating the valve 285. By this the coil of strip will come to rest upon the rollers 1 and 2 and may be rotated by means of the motor 288 into a suitable position for further treatment of the free end of the strip such as cutting, straightening and the like. Thereafter the carriage 279 is again raised to support the coil during its continued transport to be laid down and stored. After lowering the carriage 279

it will be returned to the prepared position shown in FIGURE 7, whereafter the operating cycle may be repeated.

Finally it may be mentioned that the empty coiler drum 6 from the storing place generally indicated in FIGURE 1 and put down on the supply side of the rolling mill are transferred by means of trucks or the like to the roller conveyor 82 in order to be entered in the working process again. If it is desired further to roll down the coils of strip designated by 3 in FIGURE 1 said coils are also carried by trucks to the storing place of the supply means IV, where the tying wire is removed and the supply is brought about in a way previously described.

The above described method relates to rolling of strips having so small thickness of the material that drums are required in order to prevent the coil of strip from collapsing after being removed from the coiler. Contrary thereto that is when the strip material has such a thickness that the coil of strip will be self-supporting no drum is required and obviously the associated operations in the handling process will be dispensed with.

It will be evident that the described technique according to the invention for the handling of the work passing through the rolling mill is a convenient technique which may be carried out with maximum accuracy and with minimum loss of time. The arrangements indicated within the handling plant are further simplified as far as possible in view of the demand for measures to insure safety and in view of the weights to be handled. Due to the arrangement of the aiding means under the floor of the rolling mill the invention additionally insures that this floor will be substantially unencumbered so that walking and traffic will not be obstructed which is a particularly new and useful feature in connection with rolling mills.

As far as the valves are concerned which are shown in connection with each hydraulic and pneumatic cylinder said valves may suitably be assembled in an operating control center.

Having now described the invention what we claim as new and desire to secure by Letters Patent, is:

1. In a rolling mill, apparatus comprising means for conveying an empty drum to a predetermined position, wrapper means for encircling said empty drum in part and supporting the same at said position, control means for moving said wrapper means and thereby said drum toward a determinable position, oncoiler means for engaging said drum internally and rotating the drum with the latter engaged by said wrapper means at said determinable position whereby a strip of material can be rolled onto the drum between the latter and said wrapper means, said wrapper means being adapted for disengaging from said drum independently of the operation of said oncoiler means and being further adapted for being retracted from said determinable position by said control means during rotation of said drum by said oncoiler means, and discharge means for radially engaging said drum and axially removing said drum from said oncoiler means with said strip of material rolled on said drum.

2. Apparatus as claimed in claim 1 comprising holder means for maintaining the strip against said drum with said wrapper means withdrawn.

3. Apparatus as claimed in claim 1 wherein the first said means comprises an elongated member extensible transversely of said wrapper means, rollers on said member for engaging internally of said drum, carriage means for transporting said drum to said member and elevating said drum to a position for transfer onto said rollers, and means for retracting said member and therefore said drum to said predetermined position.

4. Apparatus as claimed in claim 1 wherein said wrapper means comprises frame means, jaws pivotal on said frame means and adapted to engage said drum, endless means supported at least in part on said jaws and adapted to be looped thereby about said drum, and control means for controlling said jaws.

5. Apparatus as claimed in claim 4 wherein said wrapper means further comprises means coupled to the endless means for controlling the tensioning thereof.

6. Apparatus as claimed in claim 1 wherein said control means includes two connected piston and cylinder arrangements sequentially operated for conveying said empty drum to said predetermined and determinable positions respectively.

7. Apparatus as claimed in claim 1 wherein said oncoiler means comprises an expansible mandrel for engaging said drum.

8. Apparatus as claimed in claim 1 wherein said discharge means includes carriage means displaceable in axial direction relative to the drum on said oncoiler means to a position beneath said drum, and means to elevate said carriage means to a position to support said drum so that said oncoiler means can be withdrawn.

9. Apparatus as claimed in claim 8 wherein said discharge means further includes roller means, said carriage means being operatively disposed with respect to said roller means to deposit the drum thereupon for rotational adjustment.

10. Apparatus as claimed in claim 9 comprising a supply drum having strip wound thereon, carriage means for conveying the supply drum to a supply position, roller means operatively disposed with respect to said carriage means to roll the supply drum to align the end of the strip roughly in position for processing, guide means for guiding said end to position the same exactly for processing, and expansible means for engaging said supply drum internally whereby the supply drum can be rotated to feed strip from said drum.

11. Apparatus as claimed in claim 10 comprising means operatively disposed with respect to said expansible means and displaceable between a horizontal position wherein interference with the supply drum with strip thereon is avoided and an inclined position wherein the empty supply drum can be received and discharged.

12. Apparatus as claimed in claim 11 comprising a floor having slots therein aligned with said expansible means, said carriage means including displaceable rails beneath said slots, means for raising and lowering said rails beneath said slots, a carriage on said rails, means for displacing said carriage along said rails, and sides on said carriage aligned with said slots and extending through the same according to the position of said rails.

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