Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

Original Filed June 15, 1951 14 Sheets-Sheet 1

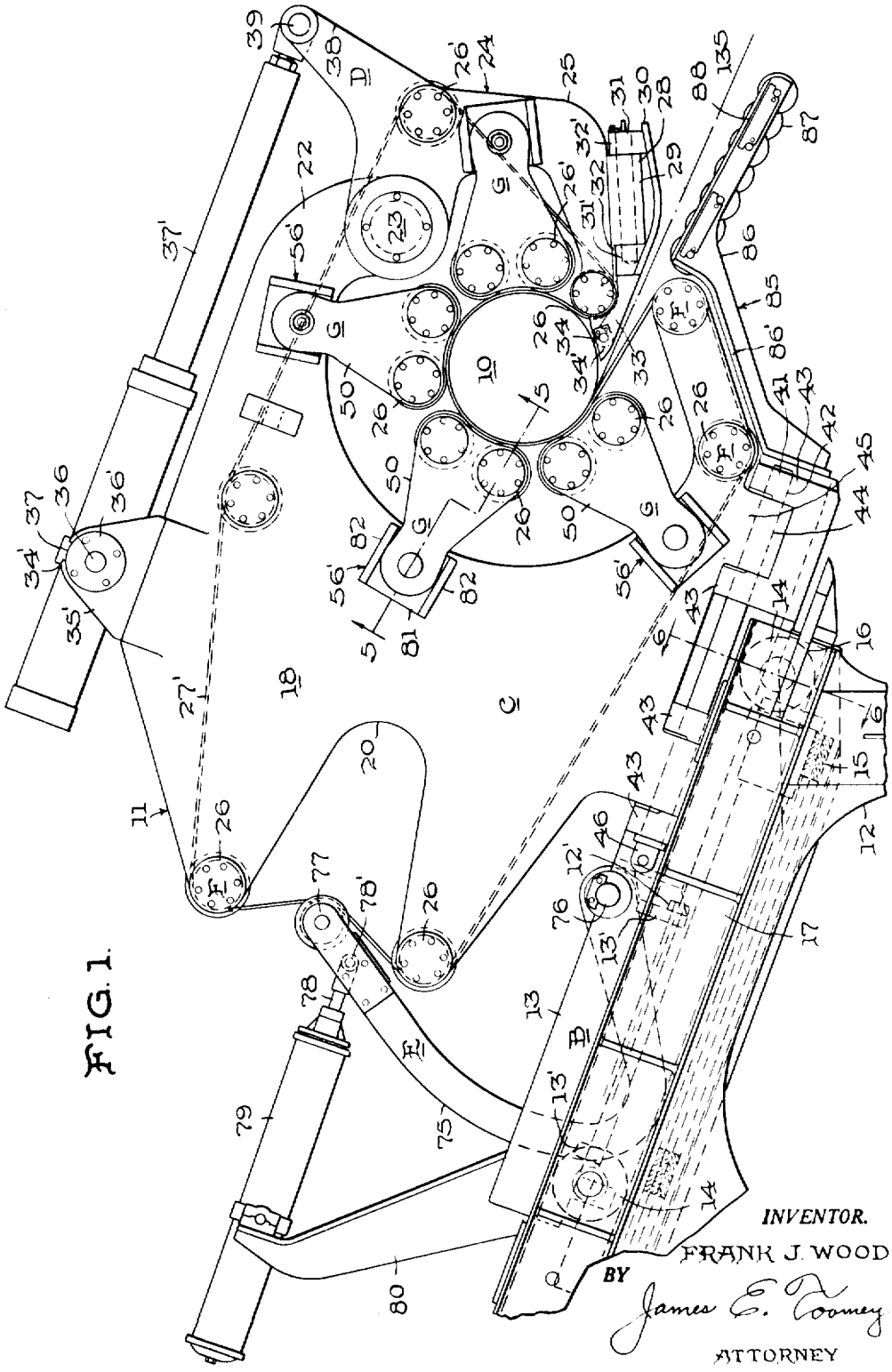


FIG. 1.

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COILING APPARATUS

Original Filed June 15, 1951 14 Sheets-Sheet 2

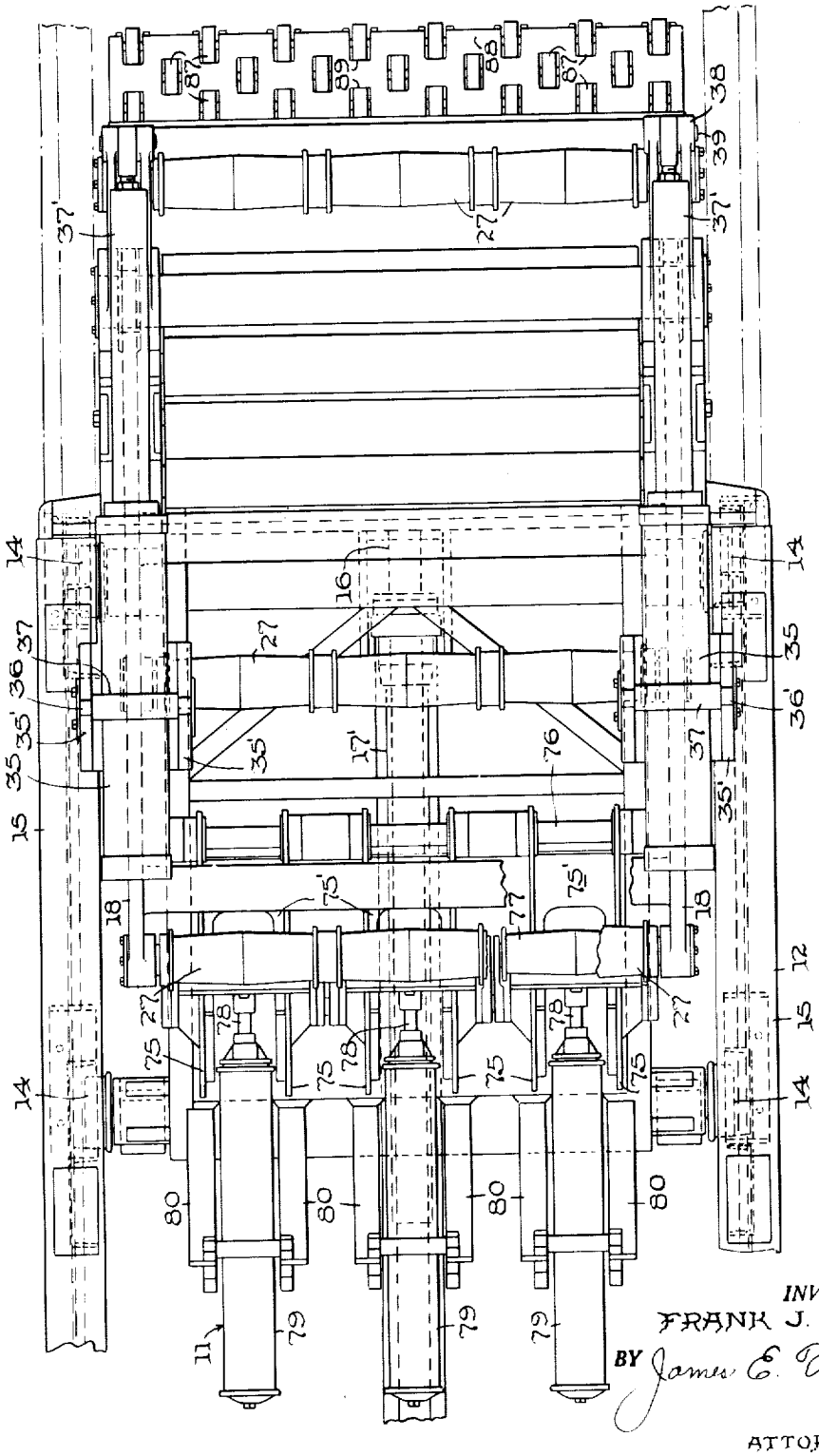


FIG. 2.

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Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

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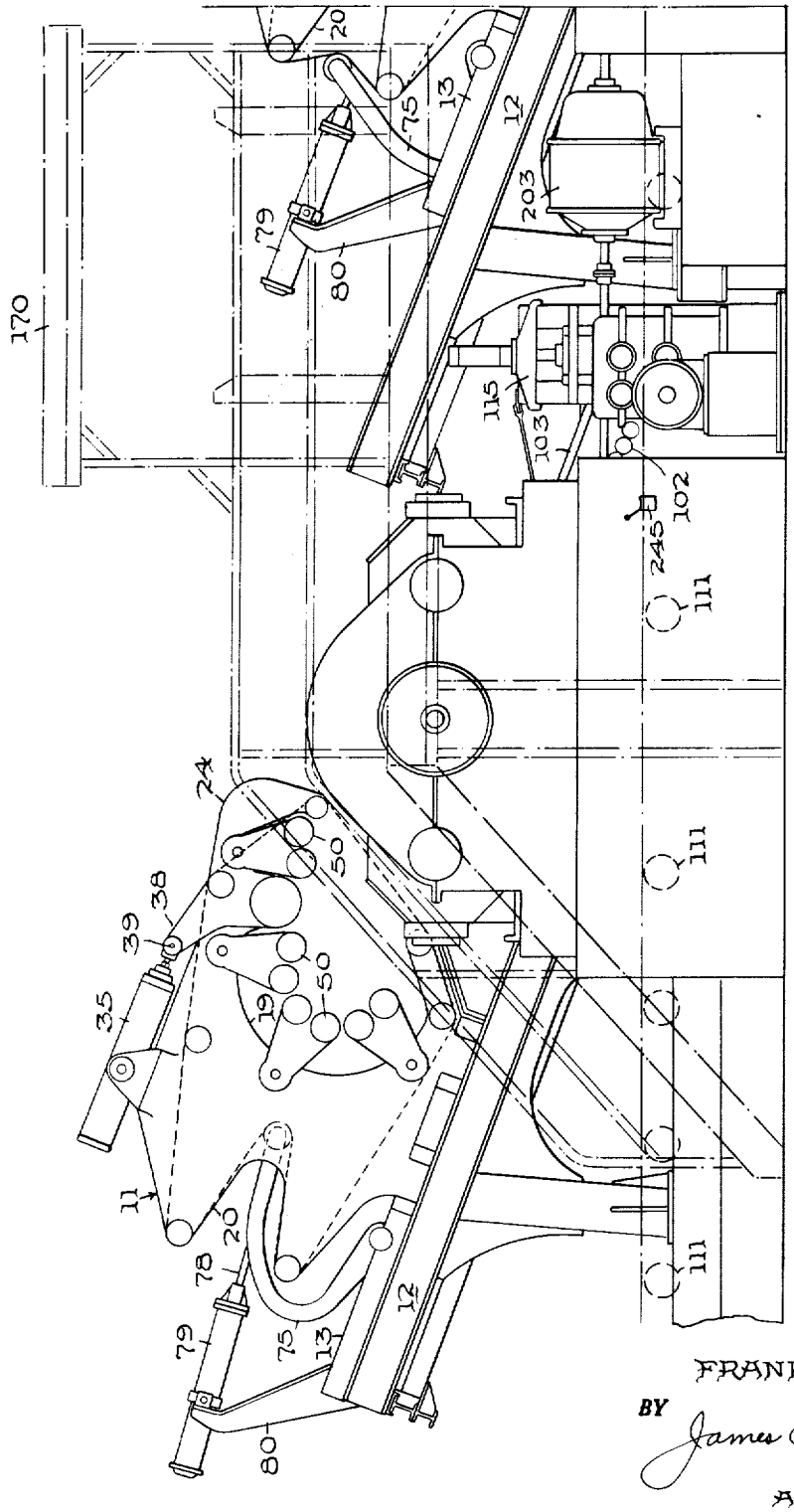


FIG. 3.

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COILING APPARATUS

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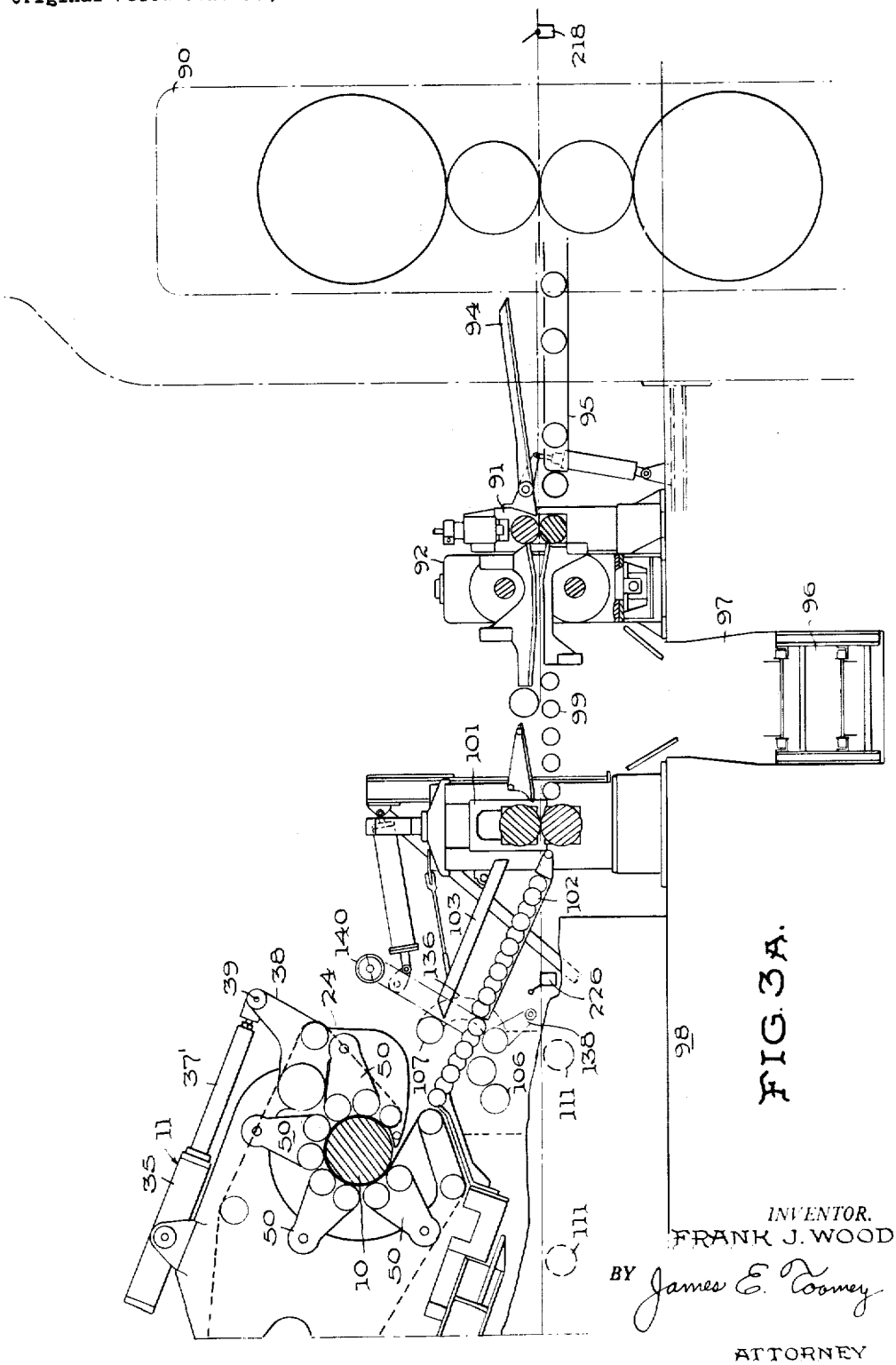


FIG. 3A.

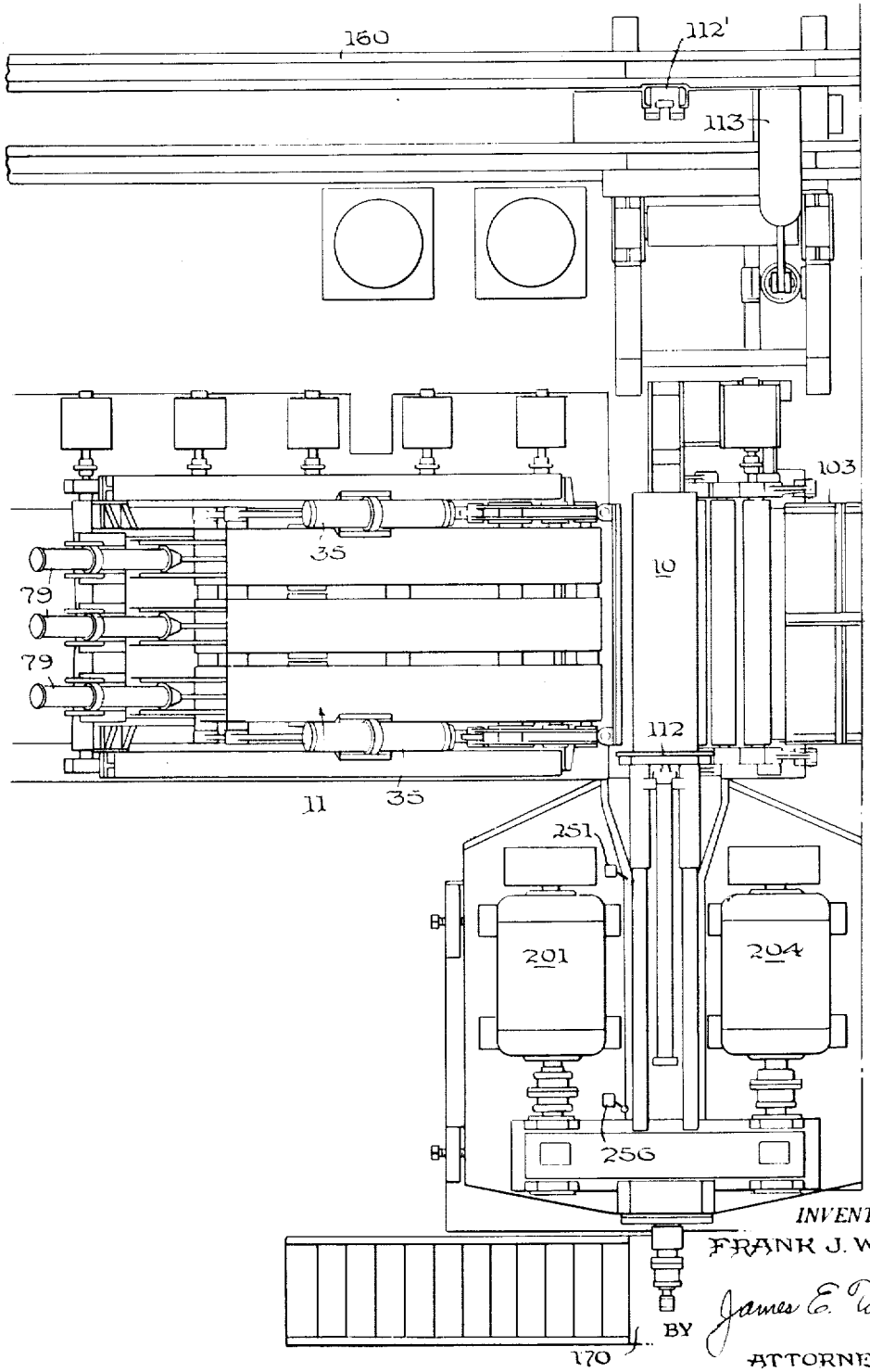
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Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

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FIG. 4.



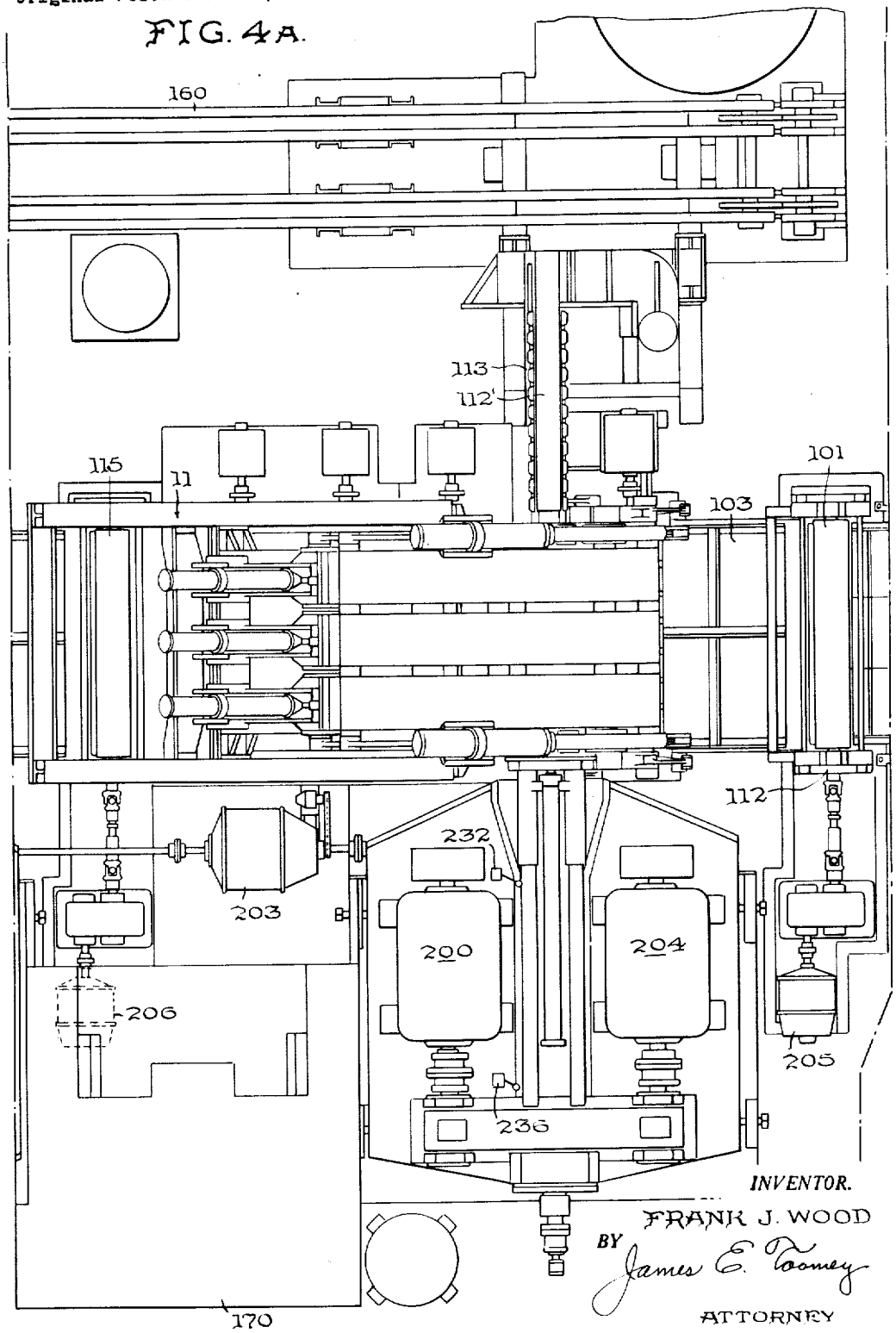
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Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

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FIG. 4A.



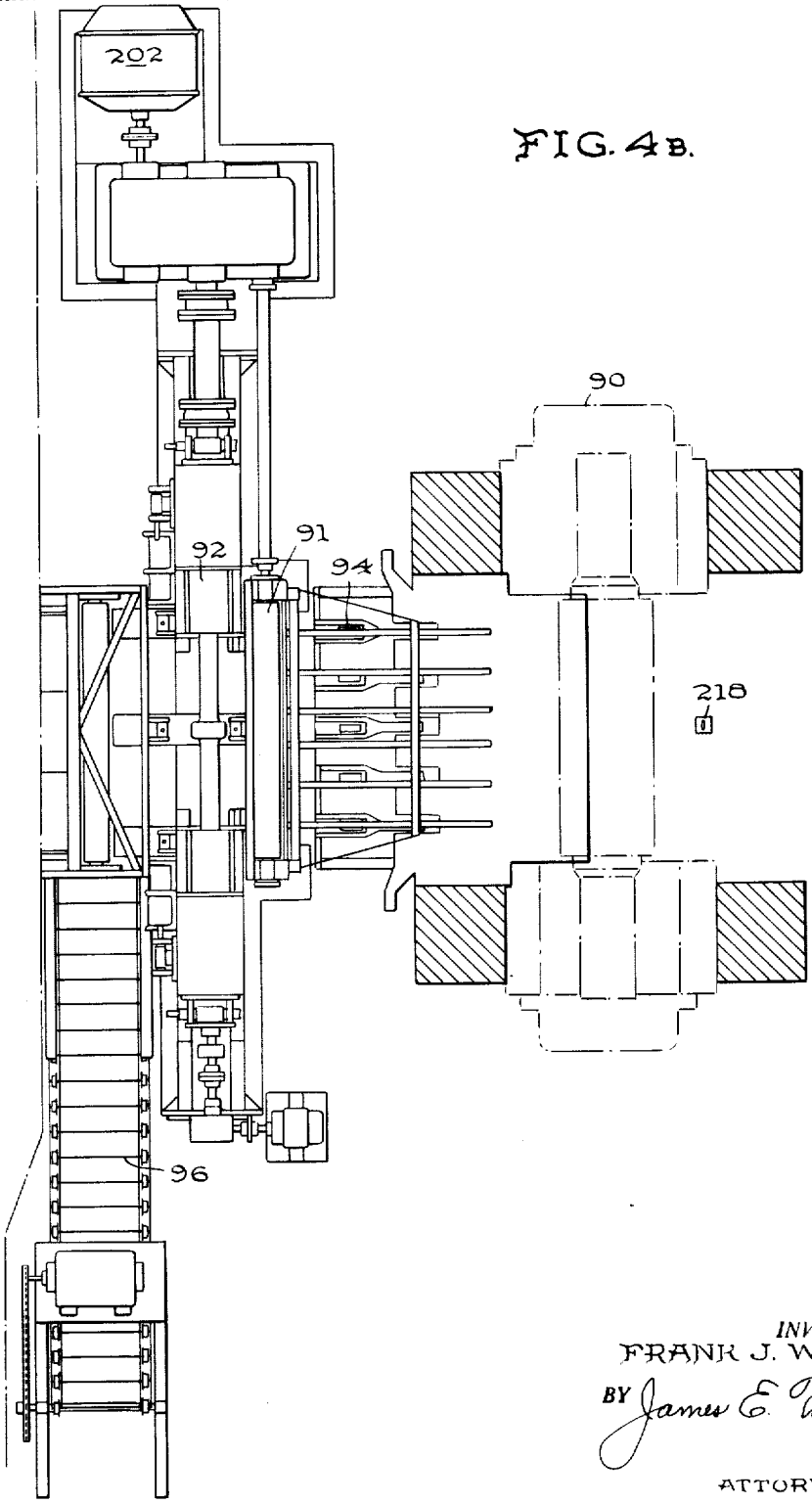
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COILING APPARATUS

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FIG. 4B.



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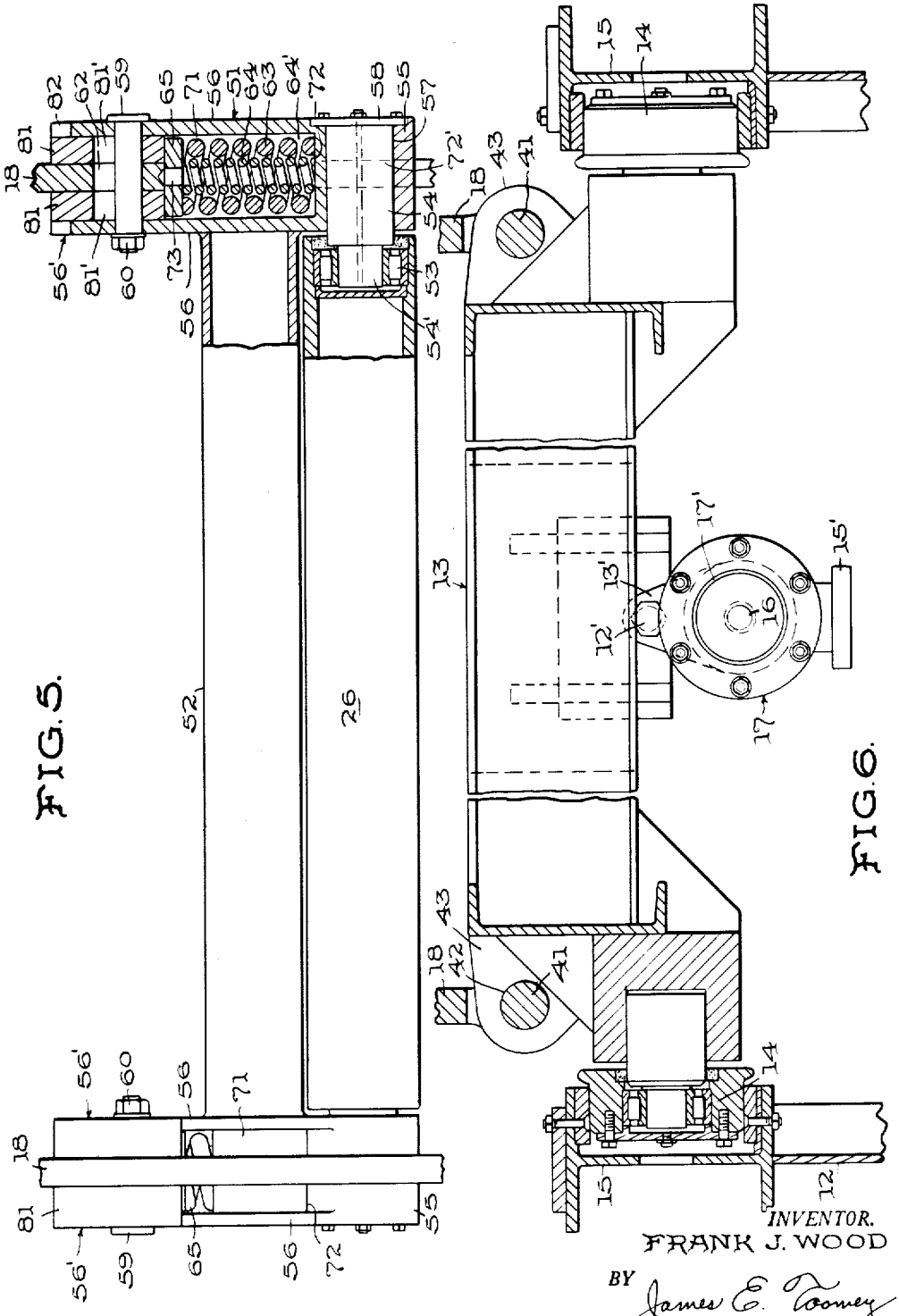


FIG. 5.

FIG. 6.

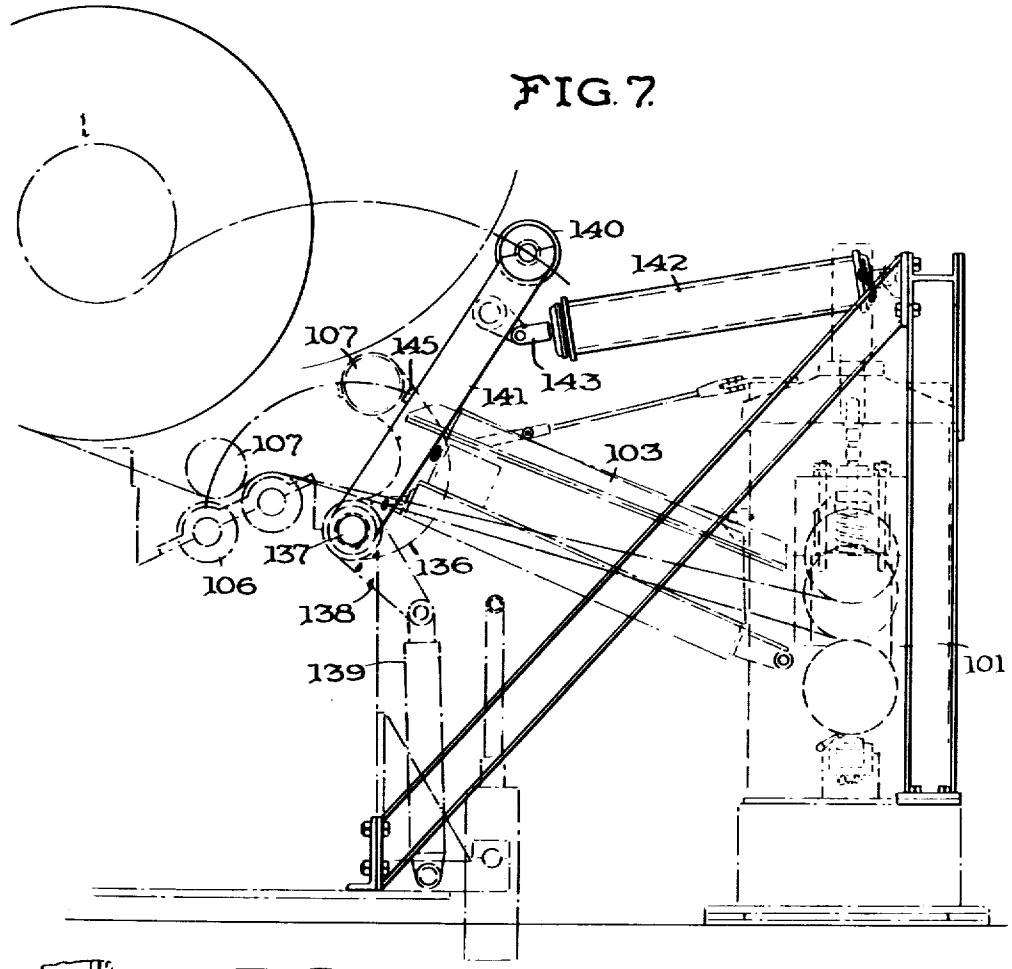
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Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

Original Filed June 15, 1951 14 Sheets-Sheet 9

FIG. 7.



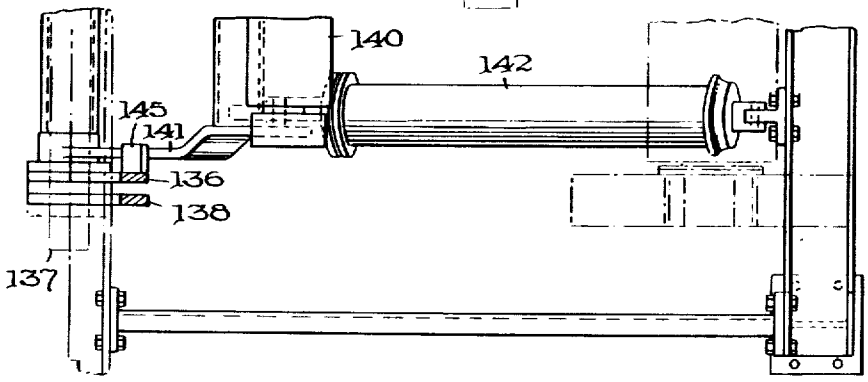


FIG. 8.

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Nov. 29, 1955 F. J. WOOD 2,725,104

COILING APPARATUS

Original Filed June 15, 1951 14 Sheets-Sheet 10

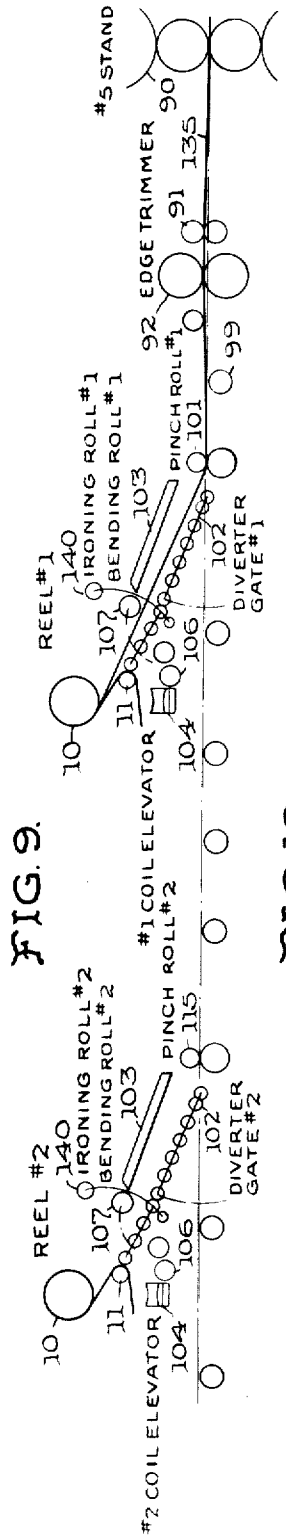


FIG. 9.

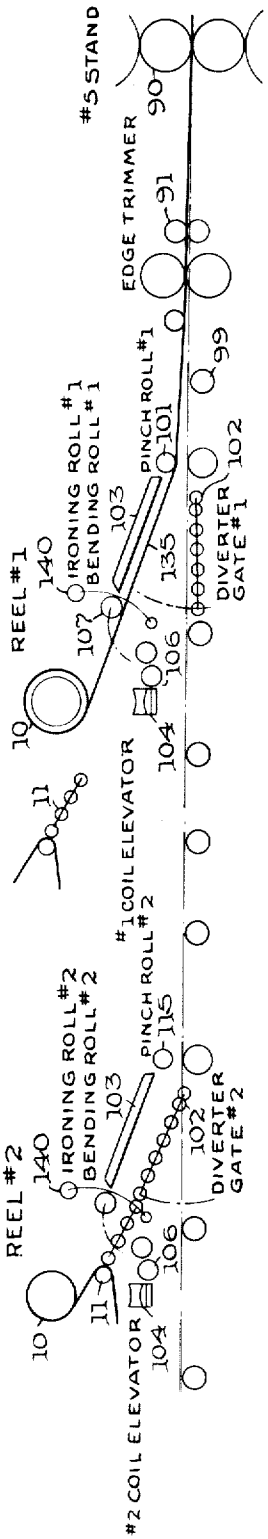


FIG. 10.

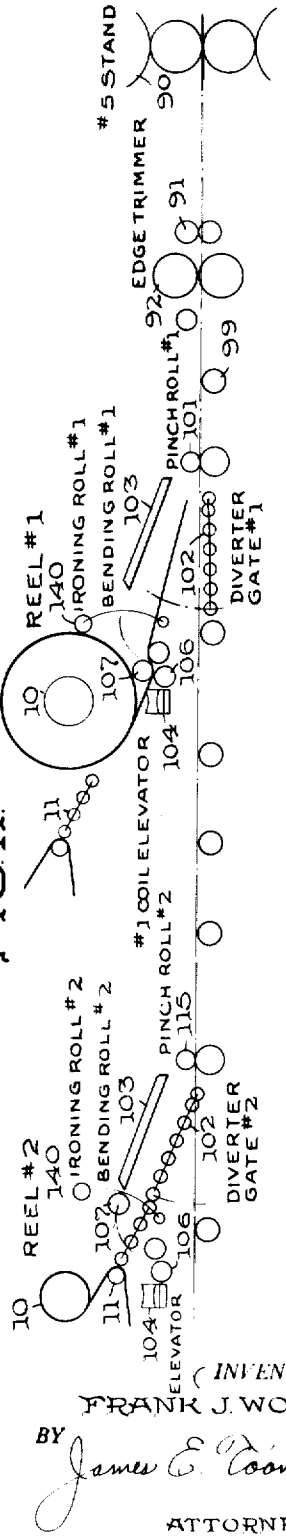


FIG. 11.

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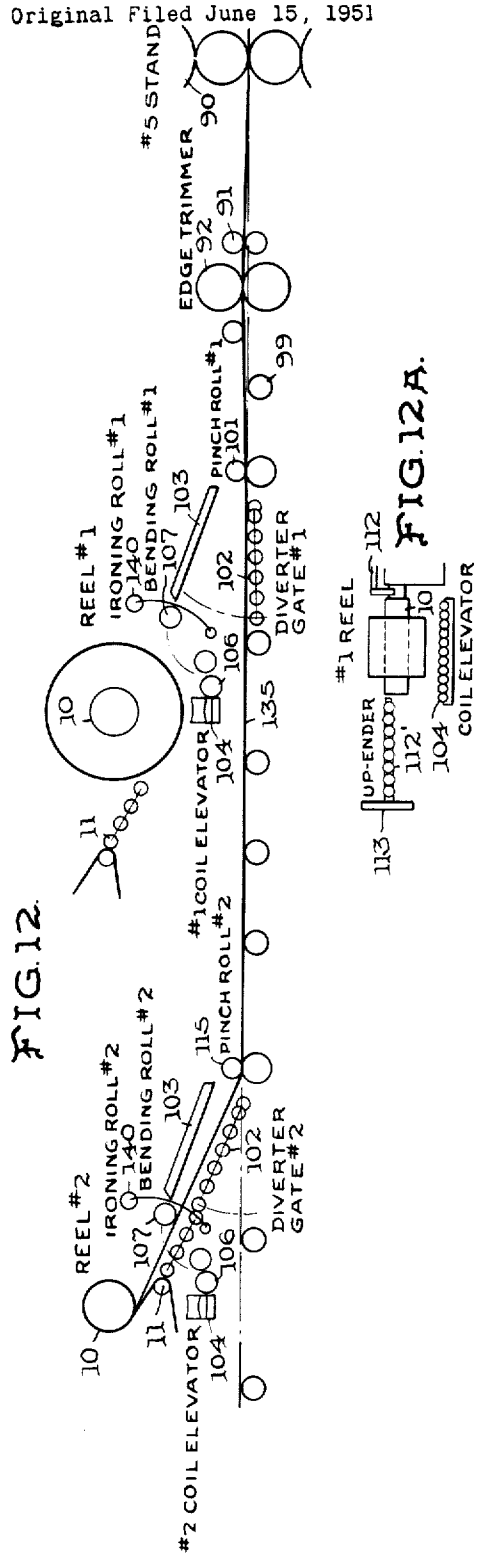


FIG. 12.

FIG. 12A.

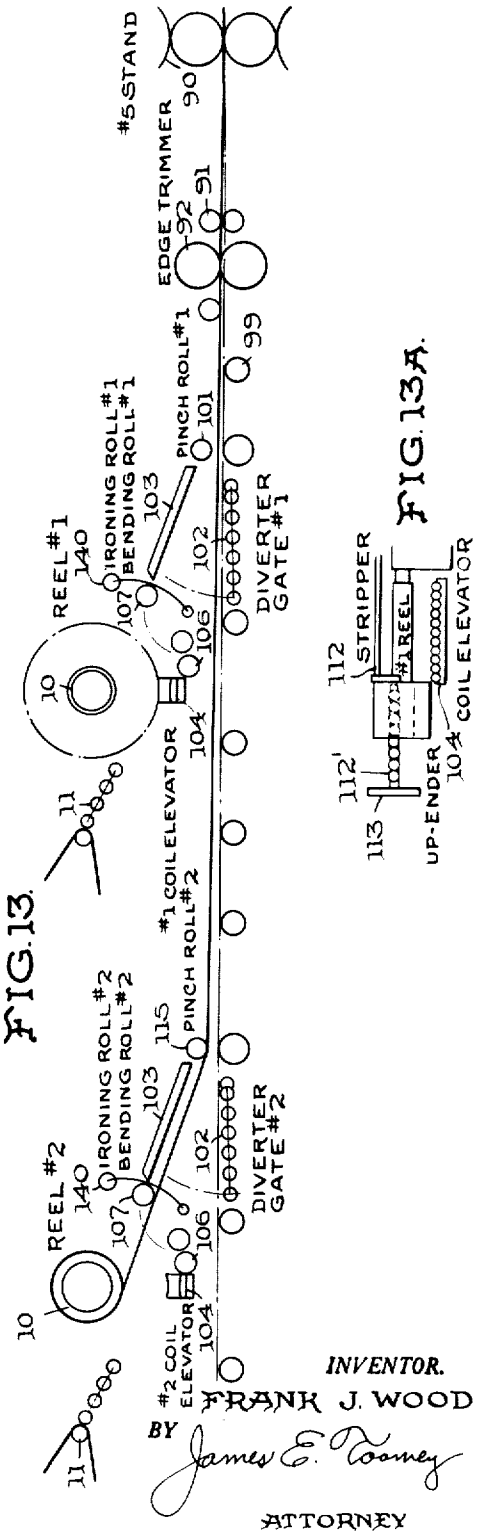


FIG. 13.

FIG. 13A.

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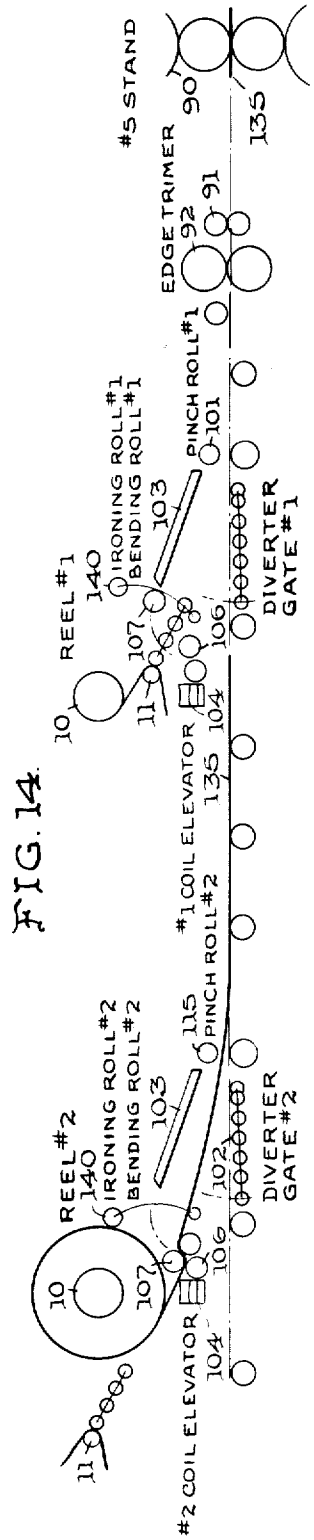


FIG. 14.

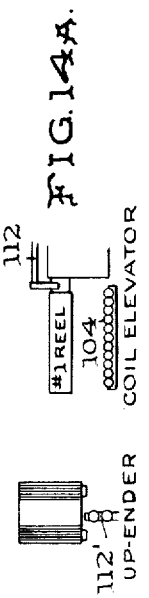


FIG. 14A.

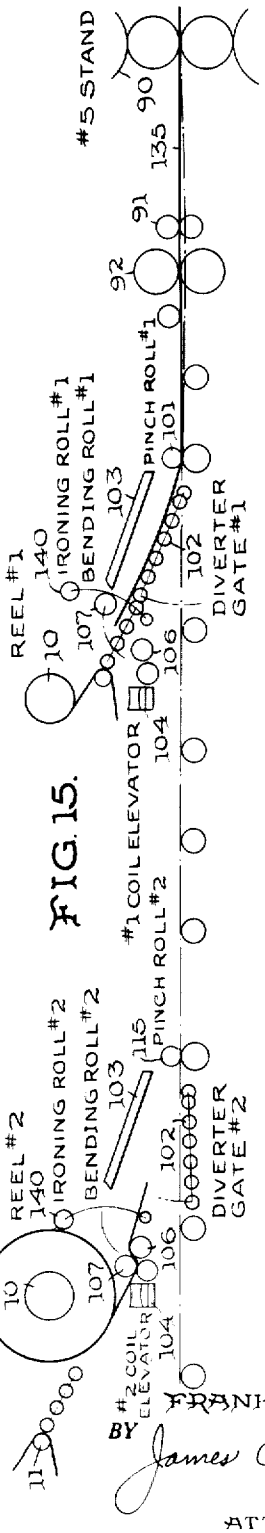


FIG. 15.

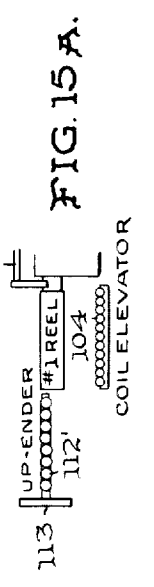


FIG. 15A.

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Nov. 29, 1955 F. J. WOOD 2,725,104

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Original Filed June 15, 1951 14 Sheets-Sheet 13

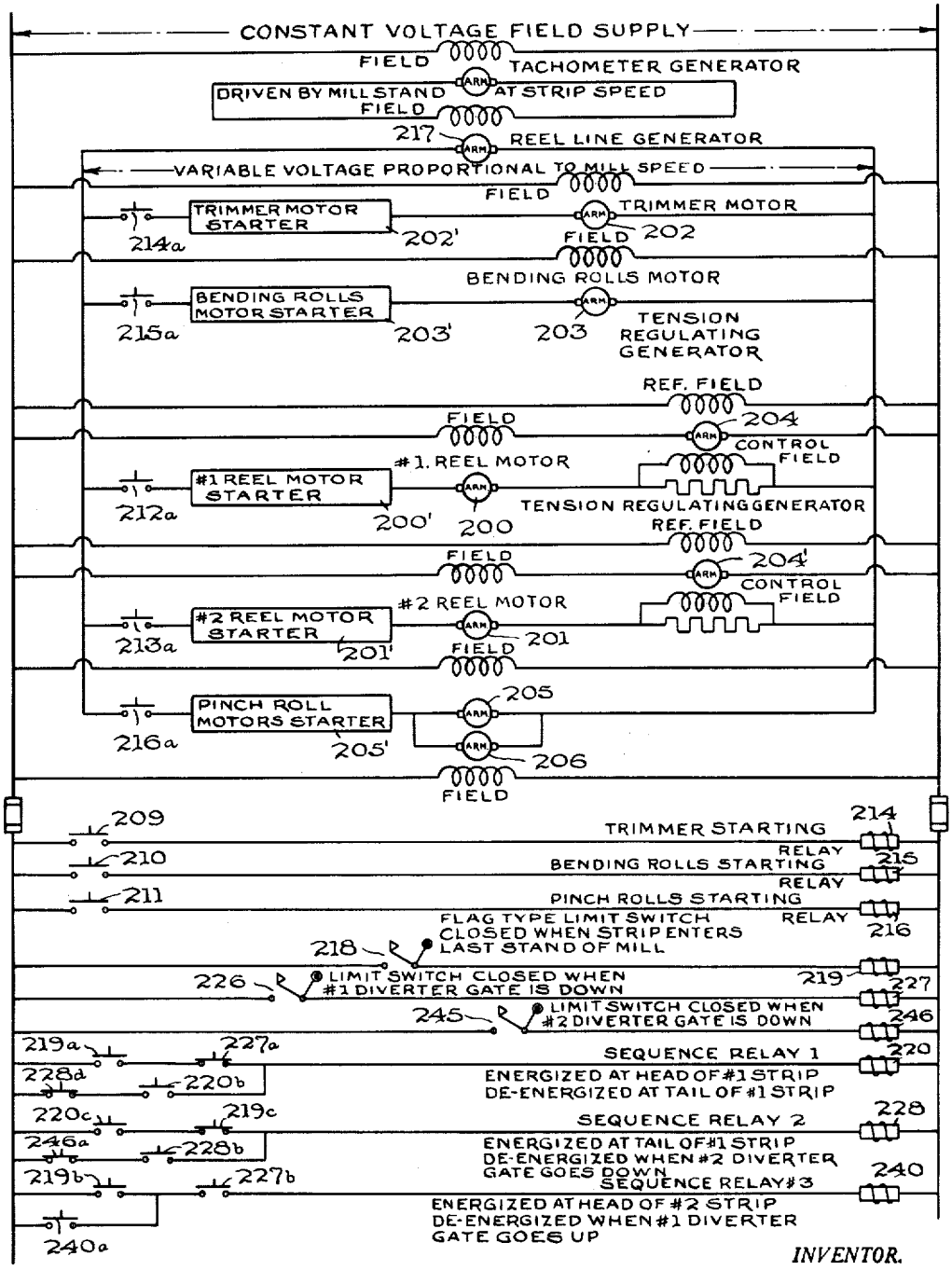


FIG. 16.

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COILING APPARATUS

Original Filed June 15, 1951 14 Sheets-Sheet 14

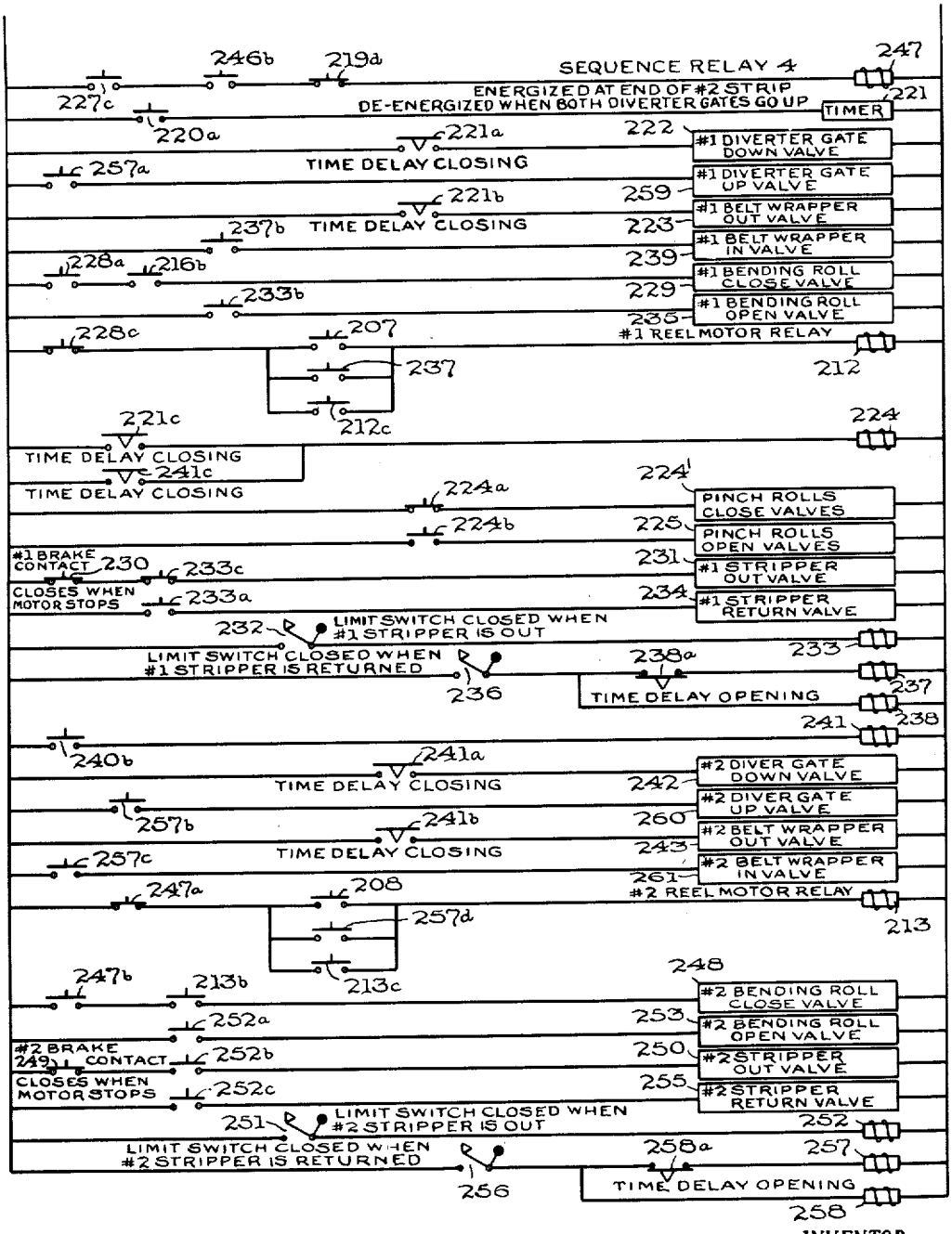


FIG. 16A.

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United States Patent Office 2,725,104 Patented Nov. 29, 1955

2,725,104

COILING APPARATUS

Frank J. Wood, Spokane, Wash., assignor to Kaiser Aluminum & Chemical Corporation, Oakland, Calif., a corporation of Delaware

Original application June 15, 1951, Serial No. 231,836, now Patent No. 2,699,904, dated January 18, 1955. Divided and this application May 28, 1953, Serial No. 363,837

13 Claims. (Cl. 164—65)

This invention relates to the coiling of continuous strips of metal as they issue forth from the exit end of a rolling mill. More particularly, it is concerned with providing a novel apparatus, including a novel belt wrapper assembly to be used in conjunction with a reel for performing the coiling operation.

In the rolling or processing of metal strip the disposition of the material as it leaves the mill presents a serious problem. It has been found that the most satisfactory solution to this problem is to coil the strip to facilitate further handling. Accordingly, it has been customary in the past to place a coiling block or reel adjacent the exit end of the mill for the purpose of soiling the sheet as soon as it leaves the mill. Various types of apparatus such as belt wrappers have also been employed in conjunction with these reels for performing the coiling operation, the principal functions of these belt wrappers being to assist in wrapping the leading edge and initial turns of the strip about the coiling block or reel.

The belt wrappers devised in the past for this purpose have not proven entirely satisfactory or efficient, since because of their design and construction they have not been able to insure a tight first wrap of strip material about the coiling block. As a result slippage of the coil sometimes occurred, and this gave rise among other things to scoring the surface of the strip, which makes it useless for many purposes. Furthermore, when this slippage occurs tension cannot be effectively applied to the strip and the resulting coils are frequently irregular in shape and difficult to handle.

In addition the belt wrappers that were devised in the past for use with reels or coilers were suitable only for use in coiling strips of thin gauge metal and were not readily adapted for use in coiling strips of heavy gauge metal since the rolls thereon which were brought substantially into engagement with the reel when the wrapper was moved into position against the reel served only as guiding rolls for the endless belts of the belt wrapper. Consequently, the strip was merely guided about the reel by the belts backed up by the aforementioned rolls. Since thin gauge strip is flexible and will readily bend of itself to assume the configuration of the reel, the use of belt wrappers in coiling thin gauge material was feasible. Heavy gauge strip, however, is not as flexible and must be bent by some external means prior to its being wrapped on the reel. The belt wrappers of the past because of their construction could not satisfactorily do this.

The complex design of these belt wrappers and the arrangement of the parts thereon has also given rise to a serious maintenance problem and considerable time has been required to repair them when a breakdown occurred, during which time the entire rolling and coiling operation had to be halted. This in turn resulted in a tremendous loss in production, and in the overall efficiency of a continuous rolling and coiling operation.

This question of maintenance and repair is most important with respect to the endless belts which are trained

about the vertically and horizontally spaced rollers on the belt wrapper. These belts are usually made of canvas or some other like material and tend to wear out in a relatively short period of time. To repair or replace these belts the belt wrapper assembly as a whole had to be dismantled almost completely, because there was no other simple or expeditious way of repairing or replacing the belts due to the complex design of the assembly. The production loss and time consumed because of this is obvious.

All of the above problems become magnified when it is realized that the strips of metal, as they move from the rolling mill, are traveling at relatively high speeds and many hundreds of feet of strip pass from the mill in a few minutes time. Thus, when production is halted for even a short period of time, the loss in the production of strip metal is tremendous and the advantages gained by a continuous rolling and coiling process are to a great extent minimized.

Another important factor in the coiling of strip material relates to the providing of some means for making the tail end of an individual length of strip conform with the configuration of the rest of the coil so that the last turns will fit snugly thereagainst. Otherwise, if the last turns are left loose and are not positively curved or bent to fit the coil, considerable difficulty is experienced in the further handling of the same.

Where a plurality of reels are employed to coil the individual lengths of strip material and the strips are rolled at relatively high speeds, it has always been difficult, after an individual length of strip material has been wound on one reel, to satisfactorily transfer the coiling operations from the first coiler or reel to another without momentarily halting the rolling operations thereby making exceptionally high rolling speeds impractical and defeating the other advantages gained by a continuous method of rolling and coiling individual lengths of sheet metal material. The use of belt wrappers with the coiling blocks or reels and the method of operation of the former greatly increases this problem and consequently their use in conjunction with a continuous method of rolling and coiling individual lengths of strip metal has not always been desirable.

The present invention provides a satisfactory solution for all of the aforesaid problems. In addition, by utilizing the present invention individual lengths of strip, as they emerge from the mill at a relatively high speed, can be efficiently coiled in a continuous manner and without the necessity of interrupting either the coiling or rolling operation.

It is an object of this invention, therefore, to provide a novel apparatus and method for continuously coiling individual lengths of strip metal.

It is a further object of the present invention to provide a novel means for continuously coiling individual strips of metal, of different thicknesses or gauge, wherein the use of belt wrappers is contemplated and whereby the coiling operations can be quickly and conveniently shifted from one reel to another without interfering with the otherwise continuous movement of the individual lengths of strip metal.

It is also one of the primary objects of this invention to provide a novel belt wrapper apparatus which is readily adaptable for use in coiling either thin or relatively thick gauge strips of metal.

A further object of this invention is to provide a novel belt wrapper apparatus to be used in conjunction with a reel, and having rolls so mounted thereon at the forward reel engaging portions of the belt wrapper that when the belt wrapper is in engagement with the reel, these rolls on the belt wrapper which back up the end-

less belts and encircle the reel will not only serve to guide the initial part of the strip about the reel but also to continuously and positively bend the strip metal so that it will take the curvature of the reel and fit snugly thereagainst, thereby allowing the belt wrapper to be used in the coiling of either thin or heavy gauge strip and still obtain a tight first wrap of strip metal about the reel.

Another object of this invention is to provide a novel means for bending the initial portions of strips of metal of different thicknesses about a reel, so that they will assume the configuration of the reel simultaneously with their being wrapped therearound.

It is another object of this invention to provide novel means for accurately and safely conveying a length of moving strip to the proper coiling means.

A further object of this invention is to provide in combination with a coiling block and the belt wrapper assembly associated therewith novel means for positively placing a proper curvature upon the last turn of a coiled strip so that the last turn will fit snugly against the remainder of the coil.

A further object of this invention is to provide a novel means of continuously coiling individual lengths of strip metal wherein the use of belt wrappers is contemplated and whereby the coiling of each length of strip can be automatically shifted from one reel to another.

It is another object of the invention to provide novel means for assembling and disassembling a belt wrapper in the event that the belts thereon have to be repaired or replaced.

Still another object of the invention is to provide a novel belt wrapper assembly, which will efficiently serve to wrap the initial turns of strip material about a reel, when the belt wrapper assembly has been brought into engagement therewith.

A further object of this invention is to provide a bending roll associated with each reel and belt wrapper whereby a positive and permanent curvature can be given to the trailing edge of each individual length of strip so that the last turns thereof will fit snugly against the remainder of the coil.

A further object of this invention is to provide an ironing roll along with a bending roll for each reel which ironing roll is adapted to engage the outer periphery of the coil at a predetermined time and keep the last turn of the coil folded and in contact with the rest of the coil until the reel is stopped.

Another object of the invention is to provide a novel belt wrapper assembly, wherein the rollers which are located in the forward portion of the apparatus that contacts the coiling block or reel, are arranged in groups or nests, this arrangement being conducive among other things to insuring a tight first wrap of the strip material about the reel.

A further object of this invention is to provide a wrapping arm for a belt wrapper assembly, wherein certain of the rollers mounted thereon are likewise arranged in groups or nests.

Another object of the invention is to provide novel means for resiliently mounting all of the aforesaid nests or groups of rollers.

A further object of the invention is to provide a plurality of reels which are mounted in tandem fashion at the exit end of a rolling mill, and with each one of which a separate belt wrapper assembly is adapted to cooperate together with means for directing individual lengths of strip metal alternately first to one of the reels and the belt wrapper assembly associated therewith and then to another reel and the belt wrapper assembly associated therewith.

Another object of this invention is to provide a novel means for continuously coiling strip material wherein the side edges of said strip material are trimmed immediately after leaving the mill and just prior to the coiling thereof.

A further object of this invention is to provide a novel pin and hinge arrangement for attaching the belt wrapper superstructure or frame to an undercarriage, whereby the frame may be easily disengaged from said undercarriage for the purposes of repair or for the removal and replacement of the belts thereon.

A further object of this invention is to provide a belt wrapper which because of its compact construction requires but a minimum amount of room in which to operate.

These and other objects are accomplished by providing an apparatus for continuously coiling moving lengths of strip material as they leave the exit end of a rolling mill comprised of a plurality of reels disposed in tandem fashion adjacent the exit end of the mill. A belt wrapper assembly is associated with each of the reels and is movable into or out of cooperative relationship with the reel so as to assist the reel in coiling the initial turns of an individual length of strip metal. Each belt wrapper assembly is comprised of a movable carriage and a plurality of normally upstanding plates are mounted upon the carriage. These plates form the superstructure or frame of the belt wrapper. A wrapping arm is pivotally affixed to the reel engaging forward crescent shaped portions of these plates. Pin and hinge means are used to attach the several plates to the carriage in such a fashion that each plate is capable of movement in an arcuate path about an axis which is substantially transverse to the pivotal axis of the wrapping arm. A plurality of rollers are mounted on the wrapping arm and a second plurality of vertically and horizontally spaced rollers are interposed between the plates at predetermined points and adjacent the crescent shaped forward portions. Certain of these rollers on the wrapping arm and certain of the rollers interposed between the plates adjacent the crescent shaped portions are arranged in groups or nests.

A plurality of endless belts are trained about the rollers on the frame and the rollers on the wrapping arm in such a fashion that they are normally out of contact with those rollers on the frame and wrapping arm that are mounted in groups or nests, except when the wrapping arm comes into engagement with the reel, at which time these groups or nests of rollers on the wrapping arm and frame cause the aforesaid endless belts to substantially completely encircle the reel. Means are also provided for maintaining a constant tension on the belts. Associated with each reel is a bending roll for bending the final convolutions of an individual length of strip metal so they will be tightly wrapped about the remainder of the coil on the reel or coiling block. An ironing roll acts in conjunction with the bending roll and serves to engage the outer periphery of the coil being reeled and keeps the last turn of the coil folded and in contact with the rest of the coil until the reel is stopped. Means such as automatically operated diverter gates are also provided for alternately directing individual lengths of strip metal first to one of the reels and the belt wrapper assembly associated therewith and then to another reel and the belt wrapper assembly associated therewith. Finally trimming rolls are provided for trimming the edges of the individual lengths of strip immediately after leaving the mill and just prior to the coiling thereof.

These and various other objects, novel features and advantages of the invention will become more apparent, when the following detailed description is read in conjunction with the accompanying drawings, wherein:

Figure 1 is a side elevational view partially broken of the belt wrapper assembly of the instant invention, showing the wrapping arm thereof in engagement with a coiling block and in position to wrap and bend the initial turns of an individual length of strip metal therearound;

Figure 2 is a plan view partially broken of the belt wrapper assembly shown in Figure 1;

Figures 3 and 3*a* constitute a schematic side elevational view of a mill system showing schematically the tandem arrangement of the coiling blocks or reels and the belt wrapper assemblies associated therewith adjacent the exit end of a rolling mill;

Figures 4, 4*a* and 4*b* constitute a plan view of the coiling apparatus and mill system disclosed in Figures 3 and 3*a*;

Figure 5 is a view partially in section of one nest of rollers mounted on the belt wrapper frame, when taken along lines 5—5 of Figure 1;

Figure 6 is a view partially in section of the belt wrapper carriage and frame when taken along the lines 6—6 of Figure 1;

Figure 7 is an enlarged side elevational view of one of the bending rolls and ironing roll assemblies shown in Figures 3 and 3*a*;

Figure 8 is a partial plan view of one side of the bending roll and ironing assemblies shown in Figure 7;

Figure 9 is a schematic view of one step in the continuous coiling operation, showing one reel as it begins to wrap an individual length of strip, the belt wrapper associated therewith being in the proper position, while a second reel is being held in readiness for coiling the next individual length of strip;

Figure 10 is another schematic view of a further step in the coiling operation, showing the buildup of the coil on the first reel and with the belt wrapper associated therewith retracted, while the second reel is still being held in readiness for coiling;

Figure 11 is a further schematic view of another step in the coiling operation, wherein the first reel is shown as completing the coiling of an individual length of strip with the tail end of the strip being formed into a coiled end by means of the bending roll associated with the reel, while the second reel is being held in readiness for coiling the next individual length of strip;

Figure 12 is a schematic view of a further step in the coiling operation, wherein a second individual length of strip is shown as being initially wrapped about the second reel, while as indicated in Figure 12*a* the first reel is now being placed in a position so that the coiled material on the reel may be discharged therefrom;

Figure 13 is a schematic view of another step in the coiling operation, showing the buildup of the coil on the second coiler while simultaneously therewith the coil elevator associated with the first reel as indicated in Figure 13*a* has been raised to receive the coil therefrom and a stripper plate is moving the coil off the reel and on to an upender;

Figure 14 is a schematic view of another step in the coiling cycle wherein the second reel is shown to be completing the coiling of an individual length of strip and the tail end of the strip is shown as being bent by the bending roll associated with the reel, while as indicated in Figure 14*a* the coil from the first reel has been removed therefrom and is now being upended and placed on the conveyor;

Figure 15 is a schematic view of still another step in the coiling operation showing a third individual length of strip as it moves from the mill immediately prior to its being coiled on the first reel, during which time the second reel is completing the coiling of the strip being wound therearound, and while as indicated in Figure 15*a* the upender for the first reel has returned to a horizontal position and is now in a position to receive the coil therefrom when this third length of strip has been coiled thereon and;

Figures 16 and 16*a* constitute a schematic diagram of one type of electrical control system that may be used in operating the two reels, belt wrappers, edge trimming rolls, bending rolls, and diverter gates, etc., so that their operation will be automatic and in proper timed sequence with each so that as they leave the mill the strips of metal can be alternately directed to and coiled first on one reel and then on the other without interruption.

With further reference to the drawings and particularly Figures 1 and 3 the apparatus used for continuously coiling individual lengths of strip material contemplates the use of at least two coiling blocks or reels **10** located in tandem fashion adjacent the exit end of a rolling mill, each reel being positively driven by suitable power means. These coiling blocks may be of the usual collapsible type and they are not shown or described in detail herein since they do not form part of the invention.

Associated with each coiling block **10** is a belt wrapper assembly **11**. This belt wrapper assembly guides and wraps the leading edge of the strip about the coiling block, until the frictional engagement between the drum and strip is such that the reel will coil the strip of itself at which time the belt wrapper may be removed from the reel. Since both belt wrappers are similarly constructed a description of one will suffice for both.

Each belt wrapper assembly is generally comprised of an inclined table A; a carriage B movable thereon; a pair of upstanding plates C mounted upon this carriage and forming the superstructure or frame for the belt wrapper; a wrapping arm D pivotally affixed to the upper forward end of the plates C together with positive means for raising and lowering the arm; a plurality of tension rollers arms E for maintaining a constant tension on the belts of the belt wrapper, and a plurality of rollers F for the endless belts mounted on the belt wrapper including groups or nests of rollers G located on the wrapping arm, and adjacent the crescent shaped forward end of the plates C.

More specifically each belt wrapper assembly **11** is movably mounted upon a table **12** which is inclined downwardly and toward a coiling block or reel **10**, by means of the movable carriage **13**. As best shown in Figure 6 carriage **13** has rollers **14** suitably attached to each side thereof and these rollers are adapted to ride along the guides or rails **15** located on each side of the top of table **12**.

Although any suitable means may be utilized for moving the carriage **13** and belt wrapper assembly into and out of engagement with the coiling block **10**, the preferred embodiment of the invention contemplates that hydraulic means, such as a piston rod **16**, working in a hydraulic cylinder **17**, be used, one end of the piston rod **16** being rigidly fixed by suitable means to one end of the table **12**, and the hydraulic cylinder barrel **17'** being flexibly attached to the underside of carriage **13** by means of the tie rod **12'** and lugs **13'**, one of lugs **13'** being attached to the cylinder barrel **17'** and the other being affixed to the carriage **13**. If desired suitable guide tracks **16'** or the like may also be installed on table **12** for engaging a guide member **15'** affixed to the bottom of cylinder barrel **17'**. It will be noted that the inclination of table **12** downwardly toward the reel **10** assists the piston **16** and cylinder **17** in moving the carriage **13** toward the reel **10**.

The superstructure or frame of the belt wrapper assembly is generally comprised of a pair of sidewalls or side plates **18**. These side plates have crescent shaped forward portions **19** and open mouthed back portions **20**. The aforementioned crescent shaped portions of plates **18** are adapted to partially encircle the coiling block **10** when the belt wrapper is in an extended or reel engaging position.

In the preferred embodiment of the invention and as best shown in Figures 1 and 6 pin and hinge means **40** are used to attach side plates **18** to carriage **13**. This pin and hinge means includes a locking pin **41**, which is adapted to be thrust through holes **42** in the upstanding lugs **43** on the carriage **13** and also through holes **44** in the tongues **45** of each side plate, which tongues interlock with lugs **43** on the carriage. Pin **41** is also

provided with an apertured tip 46 and a pulling hook or some other tool may be easily inserted therein when it is desirable to remove the pin.

When disengagement of any one of the side plates 18 from the carriage 13 is required, e. g., for the purposes of repairing or replacing the endless belts on the belt wrapper assembly the pin 41 is withdrawn from the holes in one of the upstanding side plates and the holes in the lugs 43 located on one side of the carriage. The belt wrapper frame is then swung upwardly as a whole, the pin and hinge arrangement on the other side of the assembly being used as the fulcrum point for the swinging movement of the remainder of the belt wrapper frame.

Pivotally attached to the upper horn 22 on the crescent portion of each plate by means of the transverse shaft 23 or the like is a wrapping arm 24 comprised of a pair of oppositely disposed roughly H-shaped plates 25 one for each side of the belt wrapper assembly.

A plurality of vertically and horizontally spaced rollers 26 and 26' are suitably journalled between the side plates 18 and the H-shaped wrapping arm plates 25 respectively. It will be noted by referring to Figures 1 and 5 that certain of these rollers on the wrapping arm as well as certain of the rollers interposed between side plates 18 at the crescent portions thereof are arranged in groups or nests. These groups or nests of rollers will be more fully discussed later.

It will also be observed by referring to the drawings that with the exception of the rollers which are arranged in nests or groups the various rollers of the wrapping arm as well as those disposed between side plates 18 are preferably divided into a plurality of segments 27 so that a plurality of endless belts 27' may be conveniently trained about each roller.

The lower parts or right legs of H-shaped plates 25 of the wrapping arm 24 are advantageously curved so as to form a substantial continuation of the curved outer margins on the crescent shaped portions of side plates 18, when the wrapping arm, as shown in Figure 1, is in a closed or reel engaging position.

Rigidly affixed to the lower portion of each curved plate 25 is a bracket 28 having a longitudinal bore 29 therein. One side edge of a deflecting and protecting lip plate 30 is anchored directly to each bracket piece 28 on each curved plate 25 through the medium of a locking pin 31 which is adapted to be inserted through bore 29 and eyes 31' in the upstanding members 32 and 32' which have been previously welded or otherwise secured to the upper marginal edges of lip plate 30.

This pin and hinge arrangement for each bottom edge of the wrapping arm 24 permits easy attachment of plate 30 to wrapping arm 24 as well as a quick way for removing the plate 30 in the event of repair or the like. Integrally formed with plate 30 is a solid nose portion 33 having a tucking roller 34 journalled in the hollowed out portion 34' of the nose plate. Deflecting plate 30, nose 33 and roller 34 efficiently direct the moving strip 135 in the proper path and about the reel 10 when the belt wrapper assembly has been brought into engagement therewith.

Suitably mounted upon the top of each of the side plates 18 which form the superstructure or frame for the belt wrapper is a hydraulic cylinder 35. Each hydraulic cylinder is preferably fastened to its respective side plate by means of the trunnion arms 36, which may be made integral with the cylinder casing and which are adapted to be inserted in the slots 34' located in the standards 35', which are secured to each side of the plate 18. A circular disk or cap plate 36' having a hole therein through which the trunnion arms may protrude is then bolted to the outside of one of the standards and thus secures the trunnion arms in slots 34'. A suitable clip fastener 37 may also be used if desired to further secure the cylinder casing to standards 35'. A piston rod 37' is pivotally connected at one end to the forked or bifurcated projection

38 on a wrapping arm plate 25 by means of the pin 39 and is adapted to reciprocate in the cylinder 35. Simultaneous reciprocation of each of the piston rods 37' in cylinders 35 in the proper direction causes pivotal movement of the wrapping arm plates 25 and the rollers interposed therebetween on shaft 23 in such a manner that the wrapping arm 24 as a whole may be brought downward into engagement with or upward and out of engagement from the reel 10. By using such positive means for bringing the wrapping arm into engagement with the reel instead of depending solely upon the thrusting action of the reel as it comes into contact with the belts, the operating space needed for the belt wrapper is reduced to a minimum.

It is obvious that with a slight modification the wrapping arm 24 could be attached to the lower part of the belt wrapper assembly without decreasing its own efficiency or that of the belt wrapper as a whole.

The rollers which are arranged in groups or nests on the wrapping arm and frame preferably do not contact the endless belts 27' until the wrapping arm has been brought into engagement with coiling block 10.

It will also be observed by referring to Figures 1 and 5 that each nest of rollers 50 on the belt wrapper proper is comprised of a pair of housings 51 one for each side frame 18. These housings in turn are joined together by an enlognated tubular bar 52 which spans the distance between the two side frames. A pair of rollers 26, each of which preferably constitutes a single unit and is not divided into sections may be suitably journalled one behind the other between the two housings and below the elongated bar 52, by means of the rollway bearings 53 and the concentrically arranged shafts 54 and 54'. Shaft 54 may be hollow and is adapted to be located in the bottom portion 55 of each housing 51.

This bottom portion 55 of each of the housings has projecting upwardly therefrom a pair of opposed arms 56 which are integral therewith. The shafts 54 for the rollers 26 are adapted to be inserted in bores 57 in the bottom portion 55 of the housings and are held in place therein by the flanges 58 thereon. The arms 56 are preferably tapered along their length and they are fulcrumed at their upper extremities by means of pin 59 and nut 60.

Pins 59 serve to hold the housing to one of the side plates 18 of the belt wrapper proper by being thrust through a suitable elongated opening 62 in each of the side plates 18, this opening in turn being located adjacent the crescent shaped opening or forward mouth portion of the side plate, the plates 18 in turn being insertable between the arms 56 of the housings.

A plurality of concentrically arranged compression springs 63 and 64 are also associated with each housing. They are mounted in the recess 64' located between the oppositely disposed arms 56, and plates 71 which may be formed integrally with arms 56 and bottom portion 55 of the housings, and below the pin 59. These springs serve to maintain each of the housings 51 and the rolls 26 associated therewith in an extended position and against the coiling block by bearing against the bottom surface 72 of the recessed portion 64' and also oppositely against the bearing plate 65 secured directly by welding to the side frame 18 with the pin 59 bridging plates 56 riding freely in the opening 62 and being forced downwardly towards the botttom of the said opening.

The arms 56 of housings 51 are also provided with shallow channel shaped ways 56' which are affixed directly to each side of the plates 18 and wrapping arm plates 25. Each way is comprised of a thick web portion 81 having an eye or opening 81' therein which is aligned with the opening 62 in the side plate 18 and outwardly projecting flanges 82. These ways serve to restrict the movement of the arms 56 of the housings and to keep them in proper yieldable position at all times with respect to the reel.

Springs 63 and 64 are adapted to be preloaded by means of a rod (not shown) having an externally threaded end, when the rod is inserted in the bore 72' located in

the bottom portion 55 of the housing intermediate the shafts 54 until the threaded end of the rod threadedly engages the internally threaded opening 73 in bearing plate 65 and is tightened therein.

By mounting the individual housings 51 to the side plates 18 in this manner, each nest of rolls is resiliently mounted and made retractable as the coil builds up on the coiling block or reel 10. Thus the first wraps of the coil about the block can be tightly made since the compressed springs 63 and 64 act upon rollers 26, which in turn act upon the strip thereby forcing it against the reel and to take the form of curvature of the reel even when heavy guage strip is coiled. The arrangement of the rollers on the plates 18 and wrapping arm 24 in nests which are located closely adjacent to one another comprises a substantially continuous line of rollers encircling the reel thereby giving additional assurance of a tight initial wrapping of the strip about the reel 10.

The construction and arrangement of the nest of rollers on and their attachment to the wrapping arm plates 25 is similar to those mounted on the side plates 18 adjacent the crescent portion thereof.

In utilizing a plurality of continuous resiliently mounted yieldable rollers for backing up the endless belts which engage the strip and wrap the same about a reel it has been found that the rollers apply a positive vending force to the strip as it is wrapped about the reel. In other words not only do the rollers serve to guide the strip about the reel but they also bend it and cause it to take the curvature of the reel.

In this way it is possible to wrap either heavy gauge or thin gauge strip material about a reel while utilizing the belt wrapper apparatus of the instant invention. Because of their construction the belt wrappers of the past have not been capable of wrapping heavy gauge material instead they have been limited to operations involving the wrapping of only thin or light gauged strip, since their sole function was to guide the strip about the reel instead of simultaneously guiding and bending the strip.

In order to provide tension on the endless belts 27' at all times there is mounted at the rearward portion of the belt wrapper assembly a plurality of elbow shaped tension arms 75. These arms which are arranged in pairs being joined together by a web 75' are pivotally connected at their lower extremities to the carriage 13 by means of the transverse shaft 76. Suitably journalled between the upper extremities of each pair of tension arms 75 is a roller 77 which is adapted to engage the outside surface of an endless belt 27'. Although three pairs of tension arms are shown, the number of pairs of tension arms is not limited thereto but instead is dependent upon the number of endless belts which are used and the results desired, provided, of course, there is one roller and a pair of tension arms for each endless belt utilized.

Each pair of tension arms 76 has the forward end of a piston rod 78 pivotally connected thereto by any suitable means such as by means of a pivotal pin 78'. These piston rods 78 in turn are adapted to reciprocate in hydraulic cylinders 79. Each cylinder 79 is mounted upon the carriage 13 through the medium of the brackets 80.

Although the rollers 77 are adapted to maintain tension on the endless belts at all times, through proper movement of the pistons 78 in cylinders 79, they are particularly adapted to maintain tension on the belts when the wrapping arm 24 has been retracted from the coiling block 10 and the belt wrapper assembly as a whole has been moved out of engagement therewith. At this time movement of piston rods 78 outward from cylinders 79 actuates arms 75 and rollers 77 causing them to move into the belt wrapper assembly. In this way any slack in the endless belts caused by the retraction of wrapping arm 24 is immediately taken up and compensated for as is clearly shown in Figure 3 by the position of tension arms 75 of the second belt wrapper assembly therein.

By using a separate roller 77 for each individual belt and by operating each roller by a separate piston a constant tension is maintained on each belt independently of the other belts.

The lower forward end of the belt wrapper is also provided with a guideway 85 comprised of a plurality of roughly L-shaped supporting brackets 86. Each bracket is independently secured to a transverse plate 86' which in turn is secured to carriage 13 and a plurality of guiding rollers 87 is suitably journalled therebetween. If desired a cover plate 88 having holes 89 for the rollers 87, may also be employed to span the gap between the brackets 86. This cover plate is secured to brackets 86 and serves to prevent the leading edge of the coil from becoming entangled in rollers 87.

This new and improved belt wrapper assembly may be advantageously employed with but one reel for the coiling of strip material. However, since in carrying out the method of continuous coiling individual lengths of strip material it is essential that two or more belt wrappers be located in tandem fashion at the exit end of the rolling mill, this arrangement will now be described, wherein the preferred embodiment of the invention contemplates the use of two reels and two belt wrapper assemblies one for each reel.

It will be obvious from the discussion that follows relative to a new and improved method and apparatus for continuously coiling sheet material that, although belt wrapper assemblies similar to the one which has previously been described are the preferred kind to be used with the reels, other belt wrapper assemblies may also be utilized in carrying out this method of continuously coiling sheet material. With further reference to the drawings, Figures 3, 3*a*, 4 and 4*a* show diagrammatically the tandem arrangement of the two reels and their associated belt wrapper assemblies in position near the last stand 90 of a rolling mill. Interposed between this last stand of rolls 90 and the first reel 10 is a set of pinch rolls 91 and a set of strip edge trimming knives 92 fed by pinch rolls 91. Pinch rolls 91 and knives 92 are positively driven by means of the motor 202. It will also be noted that these knives 92 are located as close as possible to the last stand 90 of the mill. A conventional guide 94 may be pivotally attached to the last stand 90 to insure the entry of the individual lengths of strip metal 135 into the pinch rolls 91, as they move along the first section of the run out table 95.

A scrap conveyor 96 located in the depression 97 of floor 98 continuously removes the pieces of scrap metal discharged thereon by the edge trimming knives 92 having scrap cutters associated therewith and carries it to a suitable discharge station. Bridging and supporting rolls 99 which also form part of the run out table 95 carry the moving lengths of strip across depression 97 to a second set of pinch rolls 101 from which the individual lengths of strip can then be alternately directed either to the first coiling reel 10 and the belt wrapper assembly associated therewith or to the second coiling reel and the second belt wrapper assembly associated therewith. These rolls are suitably driven by a motor 205. A similar set of pinch rolls 115 is located in front of the number 2 or second reel, being driven by a suitable motor 206.

The individual preferred belt wrapper assemblies associated with each reel have been previously described in detail. The various elements associated with each coiling block, which also assist in making the coiling of the individual strips a continuous operation, will now be described.

Associated with each reel 10 is a diverter gate 102 and a guide plate 103, which serve to direct the leading edge of an individual length of strip upward from the run off table 95 and to an individual reel 10 and its belt wrapper assembly. A coil elevator 104 as shown in Figures 9–13*a*

is suitably mounted directly below each reel **10** and this elevator moves upward and engages the outer surface of the coil, after it has been wound on the reel.

Also interposed betwen each diverter gate **102** and each coiling block **10** is a pair of lower bending rolls **106**. Both sets of lower bending rolls **106** are suitably driven by a motor **203**. Located above each of these pairs of rolls is a third upper bending roll **107**, which is adapted to move downward against the top surface of the sheet and to become seated in rolls **106** and coact therewith as the last turns of a length of strip moves toward the reel so as to cause these last turns to take a permanent set or bend. The trailing edge of the strip will thus be given the proper curvature which will insure its being tightly wrapped about the remainder of the coil. In addition to serving as a bending roll in its downward position roll **107** also acts as a billy roll for the moving strip in its elevated or retracted position, this retracted position being maintained during the main part of the reeling operations.

As indicated in Figures 3*a*, 7 and 8 this bending roll **107** is journalled between a pair of spaced arms **136** attached to a pivot rod **137**. Also attached to pivot rod **137** is an arm **138** which is suitably connected to a hydraulic cylinder (not shown) by means of the link **139**. Movement of the link **139** upward upon actuation of the hydraulic cylinder in turn causes counter-clockwise movement of pivot rod **137**, and corresponding movement of arms **136** and bending roll **107** downward until roll **107** becomes seated in rolls **106**.

Associated with each bending roll **107** is an ironing roll **140** suitably journalled between a pair of arms **141** which are each adapted to be actuated by an air cylinder and piston **142** and **143** suitably linked thereto. Arms **141** are located between arms **136**. These arms are also attached to one end to pivot rod **137**. It will be noted by referring to Figures 7 and 8 that the holding lugs **145** on the arms **136** for the bending roll **107** engage the ironing roll arms **141** and serve to prevent any downward movement of ironing roll arms **141**, until the bending roll arms move downward. Although the pressure in the air cylinders **142** is not sufficient to overcome the opposing thrust of the lugs **145** it will be kept constant at all times and the ironing roll will thus follow the movements of the bending roll and move forward when the bending roll is also moved forward, and retract when the bending roller **107** retracts.

This ironing roll as indicated in Figures 9, 10, 11, 14 and 15 is adapted to engage the outer periphery of the coil as the last turns thereof are made on the reel and serves to keep them folded and against the coil proper until the reel has stopped so that the trailing or tail end of the strip will not flap about or be uncontrolled as it is coiled.

After an individual length of strip has been coiled on the number one reel or the reel nearest to the last stand **90** of the mill, the belt wrapper assembly associated therewith having been previously disengaged therefrom after the first initial wraps of strip material have been made on the reel, the resultant coil is then removed from the reel by means of a conventional coil elevator **104**, stripper plate **112** and upender **113** all of which are well known in the art in the following manner.

The coil elevator **104** is moved in a well known manner upwardly for a predetermined distance and into supporting engagement with the bottom surface of the coil. At this time the coiling block is collapsed and the coil is allowed to rest upon the elevator. The stripper plate **112** is then actuated and moves forward to push the coil off of the reel and onto the horn **112'** of the upender **113**, which then transfers the coil to a suitable coil transfer conveyor apparatus **160**.

All during this time, a second individual length of strip material is being fed along the second section of the run out table **95** to the second reel and the second belt wrapper assembly, this second section of the run out table being provided with a plurality of positively driven rollers **111**.

At this time also the diverter gate for the number one reel is in a downward position and the diverter gate for the number two reel since it is in an upward position permitting this second individual length of strip to be fed to the number two reel, where it is coiled and removed therefrom in the same manner as the first strip was coiled on the first reel.

By referring particularly to Figures 9–16*a* the automatic operation of the entire apparatus in continuously coiling individual lengths of strip will be more apparent. In the starting position as shown in Figure 9 both reels **10** are empty; upenders **113** are in a position to receive the coils from both the reels; belt wrappers **11** are in engagement with the reels; both bending rolls **107** and ironing rolls **140** are retracted; pinch rolls **101** and **115** are closed; both diverter gates **102** are up, and both coil elevators **104** are in a lowered position.

The motors **200** and **201** for the numbers one and two reels, edge trimmer motor **202**, motor **203** for the numbers one and two sets of lower bending rolls **106**, motors **205** and **206** for the numbers one and two sets of pinch rolls are started through conventional-type D. C. motor resistance accelerating starters **200'**, **201'**, **202'**, **203'** and **205'** by means of pushbutton switches **207**, **208**, **209**, **210** and **211**. These switches can be actuated by an operator in the control station **170** located adjacent the mill:

The closing of pushbutton switch **207** causes the energization of reel one motor relay **212**, which in turn closes switches **212***a*, thereby closing the circuit to the number one reel motor starter **200'**. Relay **212** also acts to close switch **212***b* in the number one bending roll close valve circuit and switch **212***c* in the holding circuit for relay **212**. The closing of pushbutton switch **208** causes the energization of reel two motor relay **213**, which in turn acts to close switch **213***a*, thereby closing the circuit to the number two reel motor starter **201'**. Switch **213***b* is also closed in the number two bending roll close valve circuit as well as switch **213***c* in the auxiliary holding circuit for relay **213**. The closing of pushbutton switch **209** causes the energization of the edge trimmer starting relay **214**, which in turn operates to close switch **214***a*, thereby closing the circuit to the trimmer motor starter **202'** which then operates to start trimmer motor **202**.

The closing of pushbutton switch **210** causes the energization of the bending rolls starting relay **215**, which in turn operates to close switch **215***a*, thereby closing the circuit to the starter **203'** for the motor **203** which operates both sets of the lower bending rolls **106**.

The closing of pushbutton switch **211** causes the energization of the pinch rolls starting relay **216**, which in turn operates to close switch **216***a*, thereby closing the circuit to the starter **205'** for the motors **205** and **206** of the number one and two sets of pinch rolls **101** and **115**.

These motors for the reels, trimmer, bending rolls and pinch rolls will operate at such a speed as is necessary to match the mill speed, this matching being done with a variable voltage generator **217**, which receives its excitation from a tachometer on the fifth or last mill stand.

As the leading edge of the first individual length of strip **135** to be reeled leaves the fourth stand of the mill, it trips and closes a flag-type limit switch **218** suitably located between the fourth and fifth stands of the mill. The closing of limit switch **218** actuates relay **219**, which in turn then operates to close switches **219***a*, **219***b*, and to open switches **219***c* and **219***d*. The closing of switch **219***a* in turn causes the energization of the first sequence relay **220**. Energization of relay **220** causes the closing of switches **220***a*, **220***b*, **220***c*, and actuation of a suitable timer **221**. The contacts of timer **221** close after sufficient time has elapsed to allow the strip to be wrapped a few turns on the first reel with the assistance of the first belt wrapper. At this point the contacts of the timer **221** close causing the closing of switch **221***a* so that down

valve 222 for the number one diverter gate of the gate associated with the first reel is activated whereby this gate is lowered. Closing of the contacts of timer 221 also causes the closing of switches 221*b* and 221*c*. Switch 221*b* then causes the energization of out valve 223, which operates to move the number one belt wrapper out or away from the first reel and to a retracted position. Out valve 223 can also be used if desired to operate cylinder 35 for the belt wrapper wrapping arm 24 and to retract it away from the reel. Switch 221*c* causes the energization of relay 224 which operates to open switch 224*a* in the circuit for the pinch rolls close valves 224' as it closes and to close the switch 224*b* which then causes the actuation of the open valves 225 for both sets of pinch rolls whereby the pinch rolls of both sets 101 and 115 are opened. The moving strip is now reeled by reel one under tension controlled by a suitable tension regulating generator 204, which regulates the field of the reel motor 200 to maintain a predetermined current in the motor.

In the meantime the lowering of the number one diverter gate closes flag-type limit switch 226 and this in turn causes energization of relay 227 which operates to open switch 227*a* and to close switches 227*b* and 227*c*. Relay 220 still remains energized because switch 220*b* in the secondary or holding circuit for relay 220 still remains closed.

When the tail of the first strip clears the flag limit switch 218, this switch opens and causes relay 219 to drop out. As relay 219 drops out, switches 219*a* and 219*b* open and switches 219*c* and 219*d* return to their normally closed positions. Relay 220, however, still remains energized because of its holding circuit for a sufficient length of time to permit the second sequential relay 228 to be energized when relay 219 drops out.

As relay 219 drops out and the second sequence relay 228 is energized, it closes switch 228*a* in the circuit for the number one reel bending roll close valve 229. It also acts to close switch 228*b* in the secondary or holding circuit for the relay itself and to open switch 228*c* in the circuit for reel one motor relay 212 and switch 228*d* in the holding circuit for the number one sequence relay 220. When switch 228*c* is opened, the number one reel motor starting relay 212 is de-energized, and switches 212*a*, 212*b* and 212*c* are opened, switch 212*b* being opened after a sufficient time has elapsed for the bending roll 107 to have moved down. The motor 200 then comes to a stop. When number one bending roll close valve 229 was actuated, the close valve operated to move the bending roll into contact with the moving strip, and the ironing roll 140 associated therewith into engagement with the outer periphery of that part of the strip previously coiled on the reel in the manner previously described.

The bending rolls put a positive bend in the remainder of the strip and the tail end of the strip is carried onto the reel by its momentum. When the reel slows down, decelerating at a rate equal to the drag of the strip a suitable brake relay switch 230 in the number one reel motor starter closes setting the brake on the reel and closing the circuit to the out valve 231 for the stripper plate 112 on the number one reel. This valve may also be advantageously employed to collapse the reel and to permit the stripping of the coil therefrom. As the stripper plate 112 moves out it carries the coil onto the horn 112' of a conventional upender 113, and at the end of its stroke it trips a flag-type limit switch 232. The closing of switch 232 in turn causes the energization of actuating relay 233. This relay then acts to close the circuit to the return valve 234 for the stripper plate by closing switch 233*a* and opening switch 233*c* in the circuit for stripper out valve 231. Valve 234 may also be advantageously used to expand the reel. Relay 233 also operates to actuate the opening valve 235 for the bending roll 107 associated with the number one reel, thereby causing the bending roll and ironing associated therewith to move upward and away from the number one reel by closing the switch 223*b*.

As the stripper plate is returned it trips flag limit switch 236. When switch 236 closes it actuates the number one stripper return relay 237 and the timer relay 238. As relay 237 is energized it operates to close switch 237*a* in the circuit of the number one reel motor relay 212 so that the number one reel motor can be energized since relay 228 dropped out a short time before when, as will be described later, the second diverter went down returning switch 228*c* to a closed position. Energization of relay 237 also closes switch 237*b* located in the circuit for the number one reel belt wrapper in valve 239, which then operates to bring the belt wrapper and also the wrapper arm 24 into position on the reel. The purpose of timer relay 238 used to open the switch 238*a* in the circuit for relay 237 is to bring about the release of the contacts initially controlled by the relay 237 so that the belt wrapper for the number one reel can be taken off the reel and the reel stopped in the next sequence.

In the meantime the first sequence relay 220 has dropped out, being de-energized at the tail end of the first strip when relay 228 became energized since the energization of relay 228 opened switch 228*d* in holding circuit for relay 220.

As relay 220 dropped out it caused the opening of switch 220*a* located in the circuit for timer 221. The de-energization of timer 221 caused the opening of switch 221*c* and the de-energization of relay 224. As relay 224 became de-energized switch 224*a* in the circuit for pinch rolls closing valves 224' closed and switch 224*b* opened in the circuit for the pinch rolls open valves 225, thus causing the pinch rolls 101 and 115 to close.

In addition when the number one diverter gate 102 or the gate associated with the first reel was lowered, it will be remembered that it tripped limit switch 226, which energized relay 227, relay 227 in turn closing switch 227*b* in the circuit for the third sequence relay 240 and making this relay permissive. Thus while the number one diverter gate is lowered and as the leading edge of the second strip again trips flag switch 218, relay 219 is again energized and when again energized acts to close switch 219*b* in the circuit for the third sequential relay 240 thereby closing the relay circuit. As relay 240 is energized it in turn acts to close switch 240*a* in its holding circuit, and switch 240*b* in the circuit of a time delay relay 241. In a time long enough for the sheet to wrap a few times about reel two, the switches 241*a*, 241*b* and 241*c* are closed by relay 241. When switch 241*a* closes it operates to actuate the second diverter gate 102 down valve 242, while switch 241*b* operates to actuate the number two belt wrapper out valve 243, thereby causing the belt wrapper and its wrapping arm to become disengaged from the reel.

Also by closing switch 241*c* pinch roll relay 224 is again energized to open switch 224*a* and close switch 224*b*, thereby opening both sets of pinch rolls 101 and 115. Reel two then winds the strip under tension in the same manner as previously described with respect to reel one, the second moving strip being reeled under tension controlled by a suitable tension regulating generator 204', which regulates the field of the number two reel motor to maintain a predetermined current in the motor.

As the second diverter gate lowers it trips limit switch 245, which then causes the energization of relay 246. The energization of relay 246 operates to open switch 246*a*, thereby de-energizing number two sequence relay 228. When relay 228 becomes de-energized switch 228*c* in the circuit for number one motor relay 212 is closed and motor 200 again started since switch 237*a* has not yet opened. As the motor starts the brake thereon is released and the switch 230 opens. Relay 246 also acts to close switch 246*b*, thereby making the circuit to the fourth sequence relay 247 permissive, it being remembered, of course, that both diverter gates are now down and accordingly switches 227*c* and 246*b* are closed, thereby completing the circuit to this relay, when relay

219 drops out as the end of the second strip passes over limit switch 218 opening the same and closing switch 219*d*.

As relay 247 becomes energized it opens switch 247*a*, thereby taking the power off the number two reel motor 201 by de-energizing relay 213. Switch 213*b* controlled by relay 213 is a delayed opening switch.

Thus relay 247 when energized also closes switch 247*b* in the circuit of the number two bending roll close valve 248 switch 213*b* remaining closed for a sufficient amount of time for this to occur, and this valve then operates to bring the number two bending roll 107 and the ironing roll 140 associated therewith into contact with the strip being coiled on the number two reel. As the number two reel comes to a stop a brake relay in the starter 201' for the number two reel motor closes the switch 249. When switch 249 is closed the circuit to the number two stripper plate out valve 250 is closed, and this valve then operates to move the stripper plate out and against the coil on the number two reel. Valve 250 is also advantageously used to collapse the reel to permit stripping of the coil therefrom in a well known manner.

As the stripper plate for the number two reel moves out and reaches the end of its stroke, it trips limit switch 251 which then acts to cause the energization of relay 252. As relay 252 is energized it operates to close switch 252*a* in the circuit of the number two bending roll out valve 253. This valve then operates to move the bending roll and its associated ironing roll away from the number two reel and into an open or retracted position. In the meantime relay 252 also acts to cause the opening of switch 252*b*, which then opens the circuit to the number two stripper plate out valve 250, and the closing of switch 252*c* which closes the circuit to the number two stripper plate return valve 255. Valve 255 then acts to return the stripper plate to its return or retracted position.

As the number two stripper plate returns to its normally retracted position, it trips limit switch 256 closing it and causing the energization of relay 257 and the time delay relay 258. The energization of relay 257 causes the closing of switch 257*a* in the circuit of the number one diverter gate up valve 259. Valve 259 then operates to raise this diverter gate. Relay 257 also causes the closing of switch 257*b*, which then closes the circuit of the number two diverter gate up valve 260. Valve 260 then operates to raise the second diverter gate.

Finally relay 257 also acts to close switches 257*c* and 257*d*. When switch 257*c* is closed the circuit of the number two belt wrapper in valve 261 is closed, and the valve 261 then operates to bring the number two belt wrapper and the arm thereon back onto the reel.

When the numbers one and two diverter gates were raised relays 227 and 246 dropped out, thereby de-energizing relay 247 and thus returning switch 247*a* to its normally closed position. When switch 247*a* closes the circuit to the number two motor relay 213 is closed and the motor 201 for reel two started.

In the meantime it will be remembered that the closing of switch 257 acted to energize the timer relay 258. This relay 258 acts to open switch 258*a* in the circuit for relay 257 allowing relay 257 to drop out after the numbers one and two diverter gates have been raised, the number two belt wrapper brought into engagement with the reel and the motor 201 for the second reel actuated. Relay 213 will still remain energized even when switch 257*d* opens, because relay 213 when it becomes energized, also energizes switch 213*c* in the holding circuit for relay 213. As the motor starts the brake thereon is released and the switch 249 opens.

In the meantime also the third sequential relay 240 has dropped out, because of the de-energization of relay 227 which occurred when the number one diverter gate was raised, and switch 227*b* in the circuit for the third sequence relay 240 was opened.

As relay 240 becomes de-energized it allows switch 240*b* to open, de-energizing relay 241. The de-energization of relay 241 opens switch 241*c*. As switch 241*c* is opened, relay 224 is de-energized, and the de-energization of relay 224 causes switch 224*a* to return to a normally closed position and 224*b* to return to a normally open position. When switch 224*a* is closed pinch roll close valves 225 are actuated and cause both pinch rolls to close.

Reels one and two are now ready to receive another strip and the sequence will be repeated on the third and fourth strip, etc. It will also be understood that a suitable master switch can also be employed if desired to control the operation of the pushbutton switches 207, 208, 209, 210 and 211.

Thus through the use of the novel belt wrapper apparatus herein disclosed strips of metal of different thicknesses or gauge can be conveniently and tightly coiled on the same reel.

By utilization of such belt wrapper apparatus it is also possible to efficiently and completely control the movements of each strip during the time it is initially formed into a coil on the reel.

The construction of the belt wrapper apparatus proposed is such that it lends itself to easy maintenance and repair.

Finally the use of such a belt wrapper apparatus with a plurality of reels located adjacent the exit end of the rolling mill, together with other strip handling apparatus herein described, makes possible a continuous, efficient coiling of the various strips of metal as they issue forth from the exit end of a rolling mill, and thus in turn also makes the continuous rolling of individual lengths of sheet metal at relatively high speeds not only possible but also commercially feasible.

This application is a divisional application of my application Serial No. 231,836 filed June 15, 1951, now Patent No. 2,699,904.

An advantageous embodiment of the invention has been herein illustrated and described. It will be understood, however, that various changes may be made therein without departing from the true spirit or scope thereof as defined by the appended claims.

I claim:

1. In an apparatus for use in connection with a rolling mill system of the type described comprising a reel on which the rolled strip material may be wound, a belt wrapper assembly movable into and out of cooperative relationship with the reel to assist said reel in wrapping the material around the same during the initial stages of said reeling operation and to insure an initial tight wrap of the rolled material on said reel and a bending roll located adjacent said reel on the side opposite said belt wrapper for bending the end portion of the strip material immediately prior to its being wrapped on the reel whereby the end portion of the strip will be positively curved so as to be tightly wrapped about the length of strip previously coiled, and common means for moving said belt wrapper and said bending roll into and out of engagement with the strip material being coiled in a predetermined sequence of operations.

2. Apparatus for use in connection with a rolling mill system comprising a reel on which the strip of rolled material may be wound, a belt wrapper assembly movable into and out of cooperative relationship with the reel to thereby assist said reel in wrapping the material around the same during the initial stages of said reeling operation to thereby obtain a tight initial wrap of metal about the reel, said belt wrapper assembly including a movable carriage, a plurality of normally upstanding plates each one of which is independently pivotally attached to said carriage and said plates having crescent shaped forward portions, a wrapping arm pivotally secured to the forward portions of said plates, said arm having a plurality of rollers mounted thereon, certain of said rollers being arranged close together, a plurality

of vertically and horizontally spaced rollers disposed between said plates at predetermined points thereon and adjacent said crescent portions, said rollers disposed between said plates adjacent said crescent portions likewise being arranged close together whereby a continuous line of reel encircling and engaging rollers is formed about said reel when said belt wrapper and the wrapping arm thereon are brought into engagement with the reel, a belt trained about the rollers on said wrapping arm and about the rollers disposed between said plates and adapted to contact the closely arranged rollers disposed between the said plates and on the said wrapping arm only when said wrapping arm has been moved into engagement with said reel, positive means for moving said wrapping arm into and out of engagement with said reel, a bending roll located adjacent said reel on the side opposite to said belt wrapper for placing a positive bend in the final convolutions of the strip immediately prior to their being wrapped on said reel whereby the final convolutions of said strip will be positively curved so as to fit tightly about the length of strip previously coiled about said reel, means including a diverter gate for directing said strip alternately toward and then away from said reel and belt wrapper assembly and common means for operating said belt wrapper assembly, diverter gate and bending roll in a predetermined sequence of operations.

3. Apparatus for use in connection with a rolling mill system of the type described comprising a reel adapted to coil strips of metal of various thicknesses thereon, a belt wrapper assembly movable into and out of engagement with the reel for aiding said reel in wrapping said strips of metal around the reel during the initial stages of said coiling operation, said belt wrapper assembly including a movable carriage, a plurality of normally upstanding plates mounted upon said carriage, said plates having crescent shaped forward portions, pin and hinge means for independently mounting each of said plates on said carriage, a wrapping arm pivotally secured to the forward portions of said plates, said arm having a plurality of rollers mounted thereon, certain of said rollers being arranged in groups, a second plurality of vertically and horizontally spaced rollers disposed between said plates at predetermined points and adjacent the crescent shaped forward portions thereof, certain of said rollers disposed between said plates adjacent the crescent shaped portions likewise being arranged in groups, a plurality of belts trained about the rollers on said wrapping arm and about rollers disposed between said plates and adapted to contact the groups of rollers on said wrapping arm and the groups of rollers disposed between said plates only when said wrapping arm has been moved into engagement with said reel, positive means for moving said wrapping arm into and out of engagement with said reel, bending and ironing rolls located adjacent said reel on the side opposite to said belt wrapper said bending roll being adapted to place a positive bend in the end portions of the strips to be coiled immediately prior to their being wrapped about the reel whereby the end portions may be tightly wrapped about the other portions of the strip previously coiled and said ironing roll being adapted to engage the outer periphery of strip metal on the reel so as to restrain the last wrap of strip on the reel from outward movement and common means for actuating said belt wrapper and said bending and ironing rolls in a predetermined sequence of operations.

4. Apparatus for use in continuously coiling individual lengths of strip metal as they continuously issue from the exit end of a rolling mill, comprising the combination of a plurality of reels disposed in tandem fashion at the exit end of said mill, a belt wrapper assembly associated with each of said reels and movable into and out of cooperative relationship with a reel so as to assist said reel during the initial stages of coiling individual lengths of strip metal thereon, each of said belt wrapper assemblies including a movable carriage, a plurality of normally upstanding plates mounted upon said carriage and having crescent shaped forward portions, a wrapping arm pivotally affixed to the forward portions of said plates, means for pivotally mounting each of said plates to said carriage, whereby each plate may be capable of movement in an arcuate path about an axis which is substantially transverse to the pivotal axis of said wrapping arm, a plurality of rollers mounted upon said arm, a plurality of vertically and horizontally spaced rollers interposed between said plates at predetermined points and adjacent the forward portions of said plates, certain of the rollers on the wrapping arm and certain of the rollers located adjacent the forward portions of said plates being arranged close together so as to form a continuous line of rollers when the belt wrapper and the arm thereon are brought into engagement with the reel, a plurality of belts trained about the rollers on said wrapping arm and the rollers interposed between the said plates in such a manner as to substantially completely encircle the reel when said wrapping arm has been moved into engagement therewith, means for moving said wrapping arm into engagement with said reel, a bending roll associated with each reel for bending the final convolutions of the strip material being wound therearound, means including diverter gates for alternately directing said individual lengths of strip metal first to one of said reels and the belt wrapper assembly associated therewith and then to another of said reels and the belt wrapper assembly associated therewith, a trimmer located adjacent the first of said reels for trimming the edges of each individual strip metal prior to the coiling thereof, and common means for actuating said reels, said belt wrapper assemblies, said bending rolls, said diverter gates, and said trimmer in a predetermined timed sequence of operation.

5. An apparatus of the type defined in claim 4 including an ironing roll associated with each bending roll and adapted to engage the outer periphery of that part of the strip which has been previously coiled, when the bending roll moves downward to engage the trailing end portions of the said strip.

6. Apparatus for use in continuously coiling individual strips of metal as they continuously issue forth from the exit end of a rolling mill, comprising the combination of a plurality of reels disposed in tandem fashion at the exit end of said mill, a belt wrapper assembly associated with each of said reels and movable into and out of cooperative relationship with a reel so as to assist said reel during the initial stages of coiling individual strips of metal thereon, each of said belt wrapper assemblies including a movable carriage, a plurality of normally upstanding plates mounted upon said carriage and having crescent shaped forward portions, a wrapping arm pivotally affixed to the forward portions of said plates, a plurality of rollers mounted upon said arm, a plurality of vertically and horizontally spaced rollers interposed between said plates, certain of the rollers disposed between the plates adjacent the crescent forward portions thereof and on said wrapping arm being mounted in closely arranged groups, a plurality of belts trained about the rollers on said wrapping arm and the rollers interposed between the said plates in such a manner as to be normally out of contact with groups of rollers disposed between the plates adjacent the crescent forward portions thereof and on the wrapping arm except when said wrapping arm has been moved into engagement with the reel, means for maintaining a constant tension on said belts, means including a bending roll associated with each reel for positively bending the trailing end portions of each individual strip of metal during the coiling thereof, means including diverter gates for alternately directing the said individual strips of metal first to one of said reels and then to another of said reels, trimming rolls located adjacent the first of said reels for trimming the edges of each of said strips of metal prior to the coiling thereof, and common means for actuating said reels, said belt wrapper assemblies, said bending rolls, said diverter gates and said trimmer in a predetermined timed sequence of operation.

7. In a coiling apparatus of the type described including a reel and a belt wrapper apparatus adapted to cooperate therewith, a bending roll located adjacent said reel on the side thereof opposite to said belt wrapper apparatus, and arranged for pivotal movement toward and away from a length of strip metal being fed to the said reel, said bending roll being adapted to move forward at a predetermined time and seat itself upon the trailing edge portions of said strip so as to place a positive bend in the trailing edge portions of the strip, whereby the said edge portions can be tightly wrapped about the remainder of the strip previously coiled on the reel, and an ironing roll associated with the said bending roll and adapted to move forward simultaneously with said bending roll and to engage the outer periphery of the strip previously wrapped about the reel and common means for actuating said bending roll and said ironing roll in a predetermined sequence of operations.

8. In combination with a reel for coiling strips of metal of different thicknesses, a belt wrapper apparatus adapted to cooperate with the said reel during the initial stages of coiling a strip of metal thereon so as to cause the initial wraps of strip metal to be tightly coiled about the reel, said belt wrapper comprising a movable carriage, a plurality of upstanding plates mounted upon the said carriage, each of said plates having a crescent shaped forward portion, a wrapping arm pivotally affixed to the crescent shaped forward portion of said plates, pressure applying rollers mounted between the said plates adjacent the crescent shaped forward portions thereof, a nest of pressure applying rollers mounted on the wrapping arm whereby when the said belt wrapper has been moved forward and the said crescent shaped portion and wrapping arm are brought into peripheral engagement with the said reel, a continuous line of substantially contiguous rollers capable of applying substantial amounts of pressure will be formed about the outer periphery of the said reel, a belt trained about the rollers mounted on the wrapping arm and between the said upstanding plates, means separate from said belt wrapper for bending the terminal portions of the strip material immediately prior to the wrapping thereof on the reel, whereby the final convolutions of the said strip will be positively curved to conform to the curvature of the outer periphery of the previously coiled strip, and common means for operating said belt wrapper and said last mentioned means in timed relationship to one another, whereby all portions of the strip metal being coiled will be tightly wrapped on the reel and a completely tight coil formed.

9. In a coiling system of the type described including a real and a belt wrapper apparatus adapted to cooperate therewith, an ironing roll also located adjacent said reel on the side opposite to said belt wrapper apparatus and arranged for pivotal movement toward and away from said reel and the material coiled thereon, said ironing roll being adapted to engage the last wrap of strip material coiled on the said reel so as to restrain said last wrap of material on the reel from outward movement, and common means for actuating said belt wrapper and said ironing roll.

10. In a coiling system of the type described including a reel, a bending roll located adjacent said reel and arranged for pivotal movement toward and away from a length of metal strip being fed to the reel, said bending roll being adapted to move forward at a predetermined time and seat itself upon the trailing edge portions of the strip so as to place a positive bend in the trailing edge portions of the strip, whereby the said edge portions of the strip will readily assume the contour of the remainder of the strip previously coiled on the reel, and an ironing roll associated with said bending roll and adapted to move forward simultaneously with said bending roll to engage the last wrap of strip material on the reel, pivotal arm means for mounting said bending roll, and holding lug means on said arm means for preventing a downward movement of the ironing roll until said bending roll has been moved forward.

11. Apparatus for use in connection with a rolling mill system of the type described comprising in combination with a plurality of reels and a belt wrapper assembly associated with each reel, a separate bending roll located adjacent each of said reels, each of said bending rolls being arranged for pivotal movement toward and away from a length of strip metal being fed to a reel, said bending roll being adapted to move forward at a predetermined time and seat itself upon the trailing edge portions of the strip metal so as to place a positive bend in the trailing edge portions of the strip metal, whereby the said edge portions can be tightly wrapped about the remainder of the strip metal previously coiled on the reel, and common means for actuating the bending roll and belt wrapper assembly associated with a reel in a predetermined sequence of operations.

12. Apparatus for use in a rolling mill system of the type described comprising in combination with a plurality of reels and a belt wrapper assembly associated with each of said reels, a separate ironing roll located adjacent each of said reels on the side opposite to the belt wrapper assembly, said ironing roll being adapted to move forward and to engage the last convolution of the strip material wrapped about the reel so as to restrain the last convolution of strip material wound on the reel from outward movement, and common means for actuating the belt wrapper and the ironing roll associated with a reel in a predetermined sequence of operations.

13. Apparatus for use in a rolling mill system of the type described comprising in combination with a plurality of reels and a belt wrapper assembly associated with each of said reels, a separate bending roll located adjacent each reel and arranged for pivotal movement toward and away from a length of metal strip being fed to the reel, said bending roll being adapted to move forward at a predetermined time and seat itself upon the trailing edge portions of the strip so as to place a positive bend in the said trailing edge portions of the strip, whereby said edge portions of the strip will conform to the contour of the remainder of the strip wrapped on the reel, and a separate ironing roll also located adjacent each reel, said ironing roll being adapted to move forward simultaneously with a bending roll to engage the last wrap of the strip on the reel from outward movement, and common means for actuating the bending roll and the ironing roll and belt wrapper apparatus located adjacent a reel.

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