Oct. 16, 1934. J. F. WARREN 1,977,503

METHOD OF AND APPARATUS FOR PREPARING, HANDLING, AND SHIPPING SHEET METAL

Filed: April 2, 1931 2 Sheets-Sheet 1

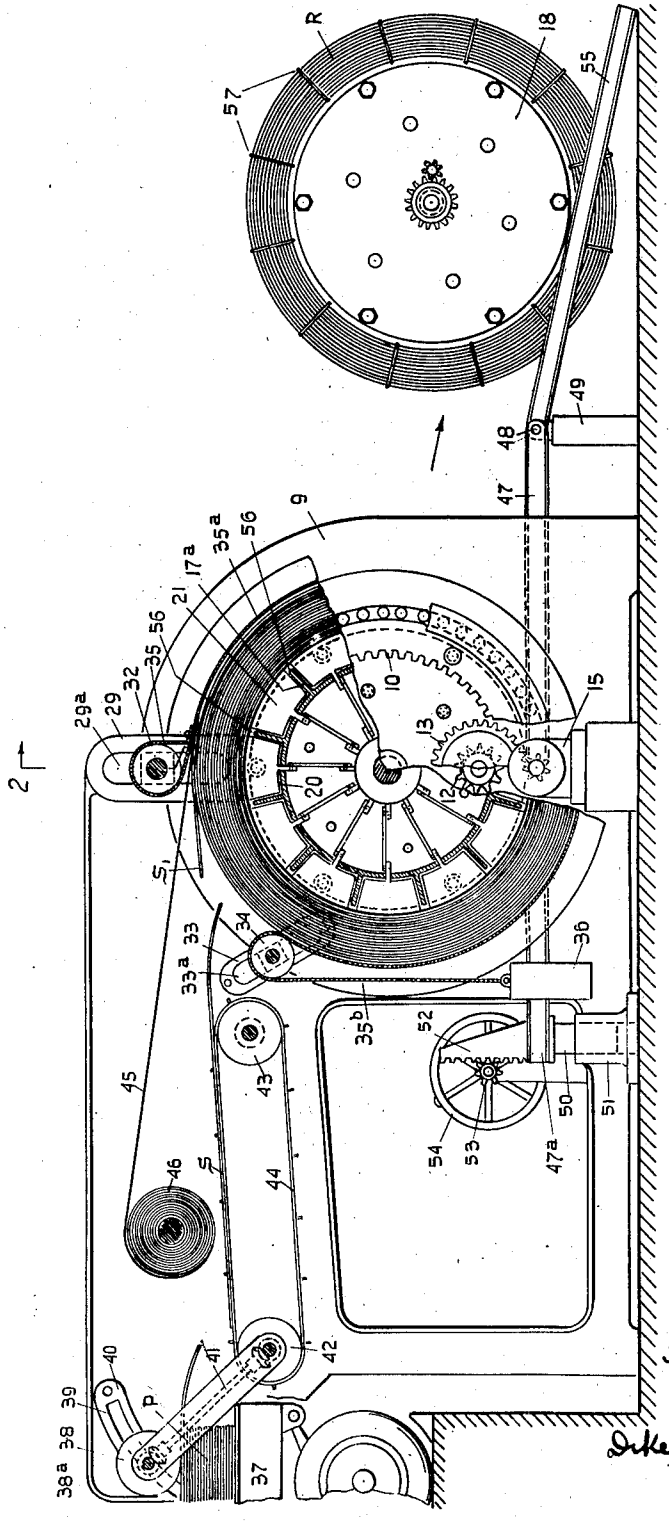


FIG. 1

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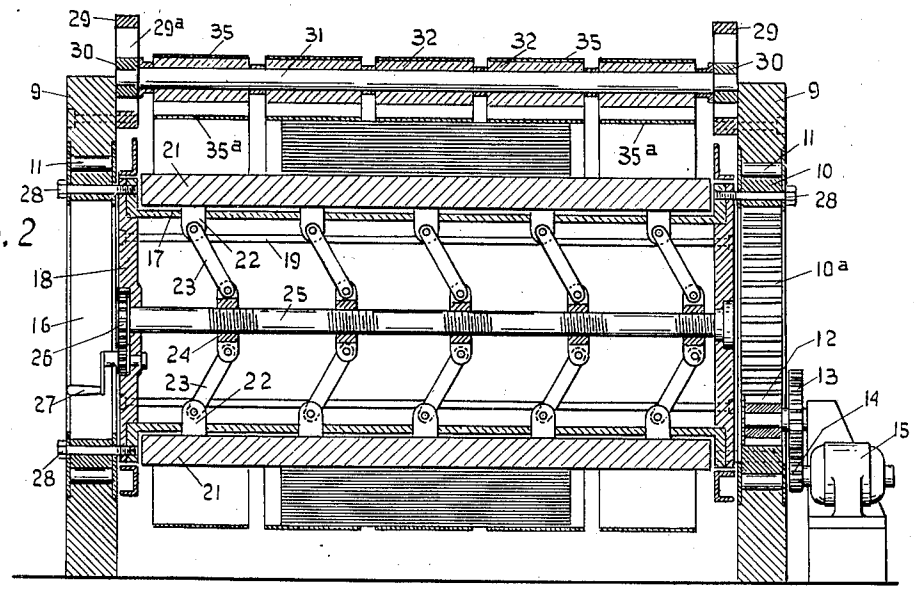
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Filed April 2, 1931 2 Sheets-Sheet 2

FIG. 2



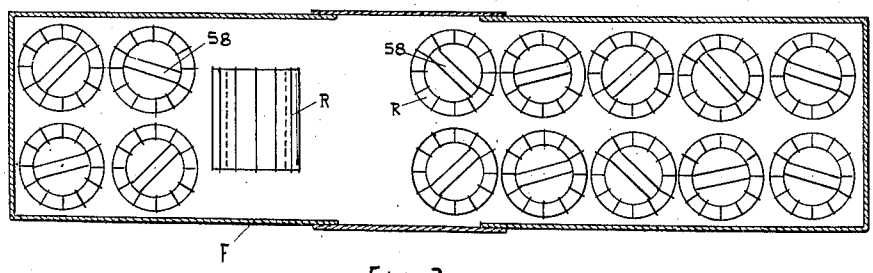


FIG. 3

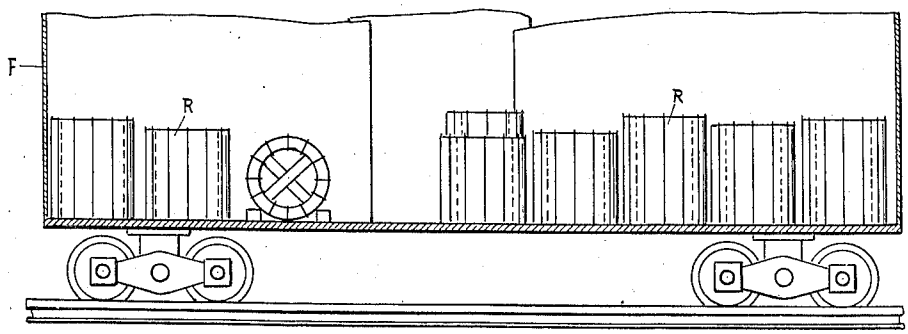


FIG. 4

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UNITED STATES PATENT OFFICE

1,977,503

METHOD OF AND APPARATUS FOR PREPARING, HANDLING, AND SHIPPING SHEET METAL

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Application April 2, 1931, Serial No. 527,228

9 Claims. (Cl. 242—59)

This invention relates to the preparation and handling of sheet metal, particularly sheet steel, for the purpose of loading and transporting the same in freight cars or carriers from rolling mills to consumers, such for example as automobile or automobile body manufacturers.

It is the customary practice, for instance in the production of sheet steel for shipment, to cut the metal after the rolling process into sheets of sizes required by the consumer for the purpose of producing stampings, such as body panels, fenders, hoods, etc. Heretofore these steel sheets have been arranged and loaded in packs or stacks suitably bound or braced on the freight car floor and transported to destination. Each pack or stack of sheets, weighing frequently as much as ten tons, has been supported either directly or through the medium of wood members on the car floor with the individual sheets piled or arranged flatwise or on their edges and held in the stacks by means of binding elements, such as steel bands. The loading and transportation of sheet metal from rolling mills to consumers has thus been predicted upon the essential idea of arranging the individual sheets in stacks or packs, and so far as I am aware, this method of shipping sheet metal or steel, i. e., in packs or stacks, has been considered necessary in any system heretofore devised.

The loading and transportation of sheet metal, especially finished sheet steel having the surfaces of the sheets oiled for protective purposes, has always presented serious difficulties and given rise to many disadvantages as well as problems. The repeated handling and rehandling of the individual sheets alone results in heavy labor costs. The frequent damage to the sheets in transit resulting from such well known causes as the shifting of the sheets on each other and their breaking loose in the car, causing scratches, blemishes, edge crimps and necessitating either refinishing operations by the consumer or the return of the damaged sheets to the rolling mill, has been a further source of expense necessarily increasing the price of the product. The lumber and other materials, commonly called dunnage, used for bracing and binding the packs in the car result in substantial expense not only due to their cost but particularly to the necessity of paying freight on this dunnage.

The foregoing are some of the factors which vitally affect the present costs of handling and shipping sheet steel in packs or stacks, and although efforts have been made in the industry to effect economies, to cut down the amount of dunnage and labor expenses, and to reduce the extent of sheet damage in transit, such efforts have only been along the single thought of improving and refining standard and conventional practice of pack or stack shipment without presenting any effective solution.

An object of the present invention is to provide a method and apparatus for preparing, handling and shipping metal or steel sheets whereby certain inherent disadvantages in conventional or standard practices may be eliminated and substantial savings incident to labor, freight and damage costs may be effected, all of which are accomplished by the present invention while at the same time discarding the established practice of shipping metal sheets in packs or stacks. In accordance with the present invention the individual sheets are rolled in succession and preferably in uniform continuity substantially as a continuous strip into cylindrical form, providing a unit roll in which the individual sheets are held intact against any relative movement by the convolutions in the roll and which may be readily handled by truck or crane and transported in the freight car without any substantial liability of damage either to the sheets or the freight car during transit.

This application is a continuation in part of my co-pending application, Serial No. 525,342, filed March 25, 1931.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is an assembly view illustrating an apparatus for preparing the metal sheets into roll or cylindrical form.

Fig. 2 is a section substantially on lines 2—2 of Fig. 1.

Fig. 3 is a diagrammatic plan view of a loaded freight car.

Fig. 4 is a longitudinal section of the loaded car.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not

intended to limit the invention beyond the terms of the several claims hereto appended as considered in view of the prior art and the requirements thereof.

In the drawings I have illustrated an apparatus by which the method of the present invention may be practiced. In general it comprises a cylindrical winding mandrel constructed to be expanded or contracted, and removably mounted between supports carrying driving mechanism by means of which the mandrel may be rotated to coil or wrap the metal sheets thereon. The sheets are fed automatically and in succession to a conveyor which in turn delivers the sheets one after the other to the revolving mandrel. A sheet retainer is provided for pressing each sheet and holding it to the curvature of the mandrel until the sheet is automatically held in coiled condition by a succeeding wrapping of sheet. This sheet retainer may comprise a flexible apron of suitable material, such as sheet steel, snugly embracing the mandrel under tension and supported to conform automatically to varying diameters. With the illustrated apparatus, therefore, the metal sheets may be fed or pulled off automatically from a stack, carried by an endless conveyor and delivered successively to the mouth or opening between the end of the compressing apron or retainer and the mandrel. Rotation of the mandrel draws the sheet between the apron and mandrel, bending or coiling it to the curvature of the latter and thus winding or rolling the sheet on the mandrel. The sheets follow in succession, preferably in abutting relation, or end to end, without overlapping, so that in appearance the completed reel of sheets presents substantially a roll formed of a single continuous strip. A separating medium is preferably introduced between the convolutions while the sheets are coiled on the mandrel, which may be a strip, or series of spaced narrow strips, of paper or other suitable material. Such strips act as a binder for assisting in holding the coiled sheets of the roll and a protective medium for the sheet surfaces.

In the drawings the machine or apparatus has been illustrated in simplified form for the purpose of bringing out the more salient features. The driving and supporting means for the mandrel may comprise suitable frame uprights 9, one thereof at the driven end carrying through roller bearings 11 a revolving ring gear 10 provided with internal gear teeth 10*a*. This ring gear is driven through a series of reduction gears 12, 13 and 14 from a motor 15. The frame 9 at the opposite end of the mandrel carries through similar roller bearings 11 a driven ring 16.

Detachably mounted between the frame members 9 is an expansible and contractible mandrel comprising a reel or drum 17 having disk like ends 18 secured together by through bolts 19. The peripheral face of the reel or drum is provided with a series of equally spaced radially projecting blades 17*a* forming segmental ways 20 within each of which is mounted a segmental block 21. Each block at its base has a series of projecting tongues or members 22 extending through guide slots in the drum, and the adjacent sets of these tongues are connected by means of sets of toggle links 23 to a series of nuts 24 carried by a screw threaded adjusting rod 25 extending axially through the drum and mounted in suitable bearings in the ends 18. The rod 25 may be turned through reduction gearing 26 by a detachable crank 27, or by any suitable power means if desired. By turning the crank handle 27 to rotate the adjusting rod 25 in either direction it will be seen that the nuts 24 will travel longitudinally on the rod, thereby collapsing or extending the toggle links 23 and forcing the segmental blocks 21 inwardly or outwardly. The outer arcuate faces of the blocks will, however, maintain substantially a continuous cylindrical face of varying diameter depending upon the position of adjustment of the blocks, it being noted that all of the blocks, which form the winding core of the mandrel, move simultaneously and equally when the adjusting screw is operated. It will be understood that the required diameter of this core will depend ordinarily upon the diameter required to prevent permanent deformation of the metal sheets when coiled therearound, since a sheet of greater flexibility may be coiled on a core of less diameter without exceeding the elastic limit of the metal.

The mandrel is designed to be readily connected or disconnected from the supports 9. In the present instance, by way of example, the coupling means is in the simple form of bolts 28 connecting the rings 10 and 16 with the annular flange like ends of the drum. As later described, by unscrewing the bolts to uncouple the parts, the mandrel may be rolled out from between the supports for the purpose of removing the roll of sheets preparatory for placing in storage or loading on a freight car.

Secured to the upper ends of the frame supports 9 are a pair of guide brackets 29 provided with vertical guide slots or ways 29*a* within which guide blocks 30 freely slide, these blocks being connected by a shaft 31 carrying a spaced series of idler rollers 32 which may be of any suitable lengths and spaced as required. A tension band 35, such as a strip of sheet steel, is looped around each roller 32 and anchored, this band extending around the mandrel core at 35*a* and traveling upwardly and around an idler roller 34 and then dropping vertically at 35*b* with a weight 36 secured to the lower end. The roller 34 comprises one of a set, substantially the same as rollers 32, similarly mounted on a shaft carrying guide blocks at its ends slidable freely in guideways 33*a* of brackets 33.

Mechanism is provided for automatically feeding the metal sheets in succession to the mandrel. For example the sheets may be delivered in a pack or stack P to the machine on a truck 37. A weighted friction roll 38 is carried on a shaft 38*a*, this roll resting on the top of the pack of sheets. The shaft 38*a* carries at opposite ends guide rollers traveling freely in arcuate guideways 39 of brackets 40. The pull-off roll 38 is driven through the medium of bevel gearing and shaft 41 from the shaft of a roller 42 which together with a roller 43 carries an endless belt or apron 44 for feeding and delivering the sheets to the mandrel. It will be understood that the peripheral speed of rotation of pull-off roll 38 will be the same as the conveyor rollers 42 and 43 so that the feed of the sheets from the pack S will correspond to their rate of feed by the conveyor 44. Moreover, the rate of travel of the conveyor will be governed by the varying peripheral speed of the mandrel core and sheets coiled thereon, suitable mechanism (not shown) for varying the speed of travel of the conveyor to correspond with the varying peripheral speed of the roll of sheets being provided.

From the foregoing it will be readily understood that upon revolving the mandrel the sheets will

be fed in succession from the stack P onto the conveyor 44, fed and guided by suitable edge guides to the rotating mandrel core. As indicated in Fig. 1, the sheet S is carried to a point somewhat below the opening between the roller 32 and the face of the mandrel or roll, and is thence carried around beneath the tension bands 35 which bend or coil the sheet to the curvature of the mandrel as shown in the drawing by the preceding sheet S^1. The tension bands are at all times held snugly to the mandrel by the pull exerted from the weight 36, and will conform to the varying diameter of the roll by virtue of the automatic adjustment of the rolls 32 and 34 supported through the guideways 29*a* and 33*a*. The sheets are thus delivered to the revolving mandrel and coiled thereon in succession, the gaps between adjacent ends of the sheets being as narrow as possible and preferably with the sheets substantially abutting end to end, without overlapping, so as to approximate a continuous sheet wound or coiled in convolutions.

A liner or separating strip or strips of paper or other material softer than the metal of the sheets is preferably introduced between the convolutions. For this purpose a strip 45 may be fed continuously from a roll 46, during the winding or coiling operation, over the top face of the sheet as it enters the machine, and continuously wound around the successive coils. After the final sheet has been coiled the mandrel may be rotated to provide several additional windings of the strip 45 around the roll to protect the exposed faces of the sheets and act as a binding to assist in holding the outer sheets in position. It will be noted that the coiled sheets within the roll or reel will be maintained in position by the overlapping sheets of the next succeeding wrappings, especially since the gaps between successive sheets will ordinarily be staggered throughout the convolutions. Consequently no problem of binding the roll after removal from the mandrel core is presented.

Upon completion of the coiling operation the weight of the mandrel and sheets is released from the supports 9 and the coupling bolts 28 removed to free the mandrel and permit removal thereof. Beneath the disk ends 18 of the drum are a pair of guide rails 47 pivoted at 48 at their forward ends to supporting members 49. The rear ends of the rails are joined together and have depending guides 50 movable in guide supports 51. By means of a rack 52 and pinion 53 operated by a wheel 54 the rails may be elevated slightly from the positions shown in Fig. 2, in which they are free of contact with the mandrel, so as to take the weight thereof. Upon uncoupling the mandrel it may then be rolled on the rails 47 and inclined rails 55 to the floor of the plant. Thereupon the crank handle 27 is attached and the adjusting rod 25 rotated to collapse the toggle links, shifting the blocks 21 inwardly to contract the mandrel core. Prior to this the roll of sheets may, if desired, be bound as by means of wires 57 which can be threaded through the spaces 56 longitudinally of the drum and bound at various points. Separator strips of wood 58 (Fig. 3) may be inserted crosswise within the rolls where necessary to provide additional rigidity during shipment. After the mandrel core is collapsed it may be readily withdrawn from the coil of sheets and rolled back on the guide rails to the machine for a succeeding operation.

The bound roll or reel of sheets R may be picked up by a crane and transferred to a truck, and thence transported to storage prior to shipment or direct to the freight car. In Figs. 3 and 4 the sheet rolls are shown loaded on the floor of a freight car for transportation to the consumer. If necessary retainer strips may be nailed to the car floor to prevent undue shifting of the reels transversely of the car. Also, metal strips may be bent around the lower edges of the sheets for the purpose of additional protection.

As shown in Fig. 2 the mandrel is preferably constructed to accommodate sheets of different widths, relatively narrow sheets being shown coiled in this instance by way of example. Moreover, according to the invention, sheets of different widths may be formed into a single roll, such as by first rolling a succession of wide sheets and then a succession of narrower sheets. The method is thus susceptible of considerable flexibility, permitting a customer to receive in a single package sheets of different lengths and widths. Moreover, in transit the danger of damage to the sheets, as heretofore, is eliminated since the sheets cannot slide or shift in the roll and thus mar or scratch the surfaces. Also, the amount of dunnage is greatly reduced, permitting substantial savings in freight costs. Labor costs are reduced since the handling of individual sheets in stacking, re-stacking, loading and unloading is brought to a minimum. Finished steel sheets prepared and shipped according to the invention, when unrolled at the automobile or other factory, will be in their original flat condition and may be fed direct to the presses, since in coiling the sheets they are not permanently deformed nor stretched beyond the elastic limit of the metal. It will also be seen that the apparatus may be utilized for rolling relatively long continuous sheets or strips which are later cut to sizes for stampings and which are of a length incapable of being stacked in a freight car for shipment.

I claim:

1. The herein described method of preparing metal sheets for shipment, which consists in rolling a succession of individual sheets into a cylindrical body with the metal of the sheets free from permanent deformation, and retaining the successive sheets during the rolling operation end to end to form substantially uniform convolutions.

2. The herein described method of preparing metal sheets for shipment, which consists in rolling a succession of individual sheets into a cylindrical body with the metal of the sheets free from permanent deformation, and retaining the successive sheets during the rolling operation end to end to form substantially uniform convolutions with the adjacent faces of the sheets separated.

3. The herein described method of preparing metal sheets, such as sheet steel, for shipment, which consists in bending a succession of sheets below the elastic limit thereof to form the sheets into a cylindrical body with the sheets in substantially continuous convolutions.

4. The herein described method of preparing metal sheets, such as sheet steel, for shipment, which consists in bending a succession of sheets below the elastic limit thereof to form the sheets into a cylindrical body with the sheets in substantially continuous convolutions, and introducing a separating medium of relatively softer material than the sheets between convolutions of the body.

5. In an apparatus of the class described, the combination of means for bending a succession of unconnected individual metal sheets below the

elastic limit thereof into a cylindrical body, means for maintaining said sheets in uniform continuity to form substantially continuous convolutions, and means for introducing a separator medium of relatively softer and more frangible material than the sheets between the convolutions.

6. In an apparatus of the class described, the combination of a cylindrical mandrel, means for expanding and contracting the same, means for rotating the mandrel, means for feeding a succession of metal sheets to be bent below the elastic limit thereof into a cylindrical body on the mandrel, means for maintaining the sheets in uniform continuity to form substantially continuous convolutions, and means for supporting said last means to conform automatically to the varying diameter of the roll.

7. In an apparatus of the class described, the combination of a cylindrical support, means for rotating the same, means for feeding a succession of unconnected metal sheets to said support to be bent below their elastic limit into a cylindrical body, and a retainer including pressure means for maintaining the successive sheets in positions to form convolutions.

8. In an apparatus of the class described, the combination of a cylindrical support, means for rotating the same, means for feeding a succession of metal sheets to said support to be bent below their elastic limit into a cylindrical body, a non-rotatable automatic radially adjustable retainer embracing said support and including pressure means for maintaining the adjacent ends of the successive sheets in non-overlapping positions to form convolutions, and means for contracting said support to remove the roll of bent sheets.

9. In an apparatus of the class described, the combination of a cylindrical support, means for rotating the same, means for feeding a succession of metal sheets to said support to be bent below their elastic limit into a cylindrical body, and an adjustable retainer embracing said support and including pressure means for maintaining the adjacent ends of the successive sheets in non-overlapping positions to form substantially continuous convolutions.

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