April 25, 1967 R. E. GEESON 3,315,958

APPARATUS FOR DELIVERING FERROUS METAL SHEETS

Filed Dec. 4, 1964 9 Sheets-Sheet 1

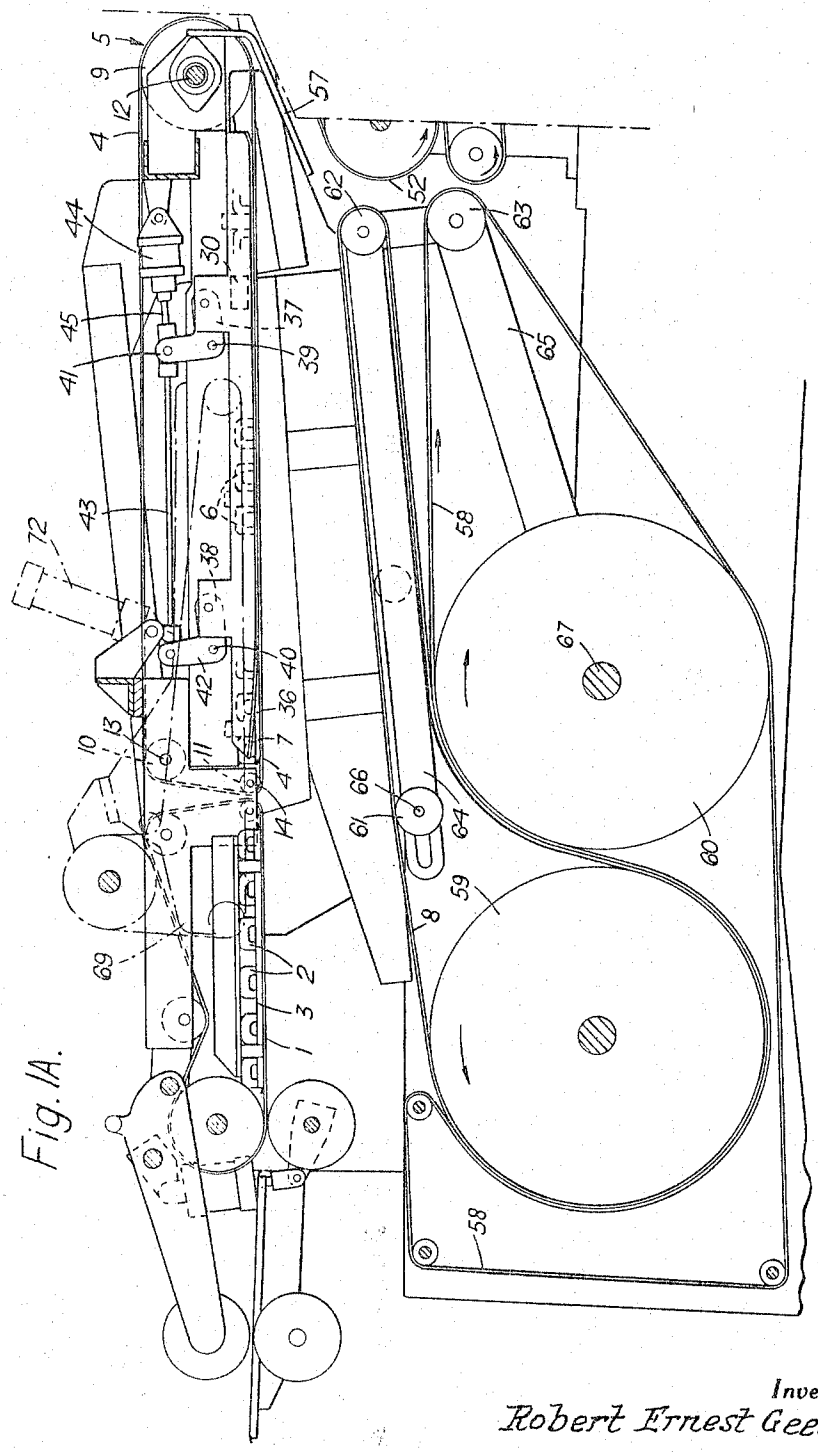


Fig. 1A.

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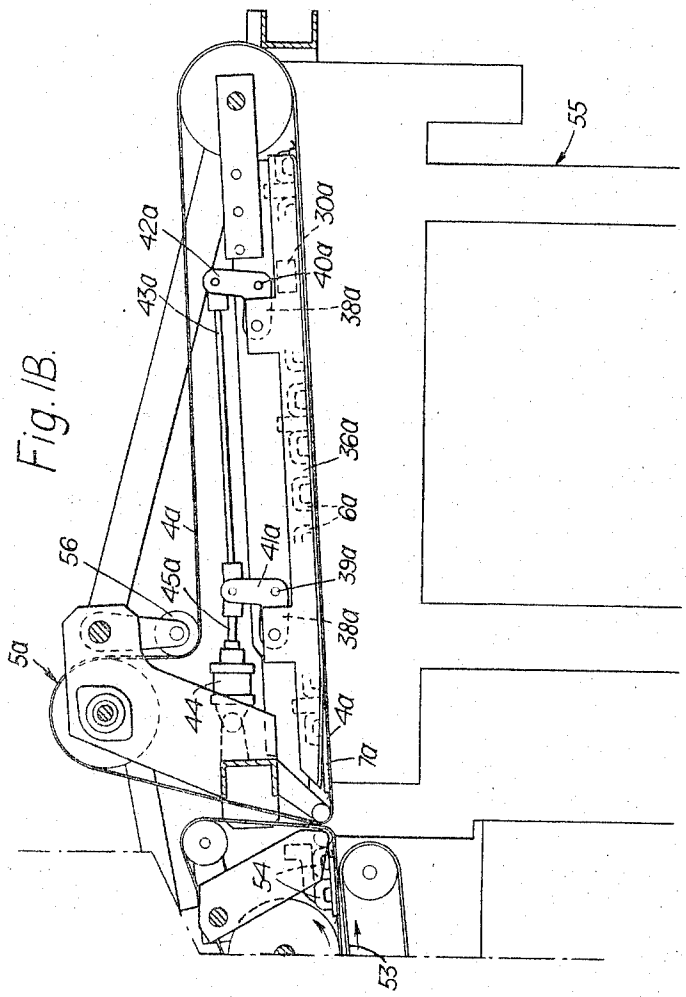
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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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Fig. 1B.



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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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9 Sheets-Sheet 3

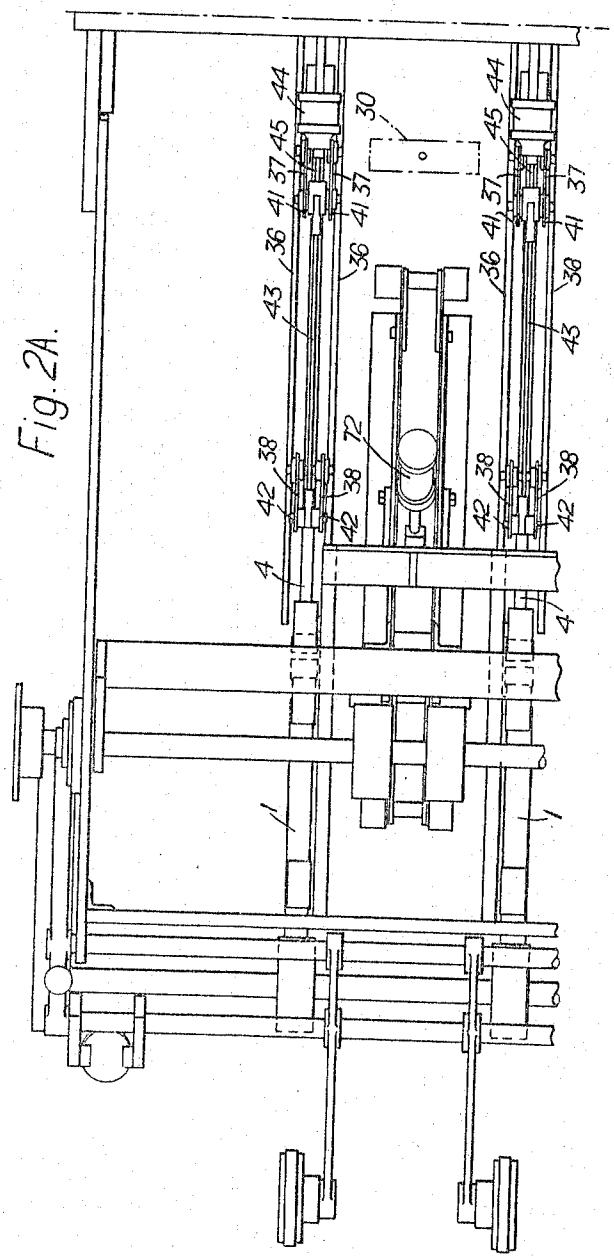


Fig. 2A.

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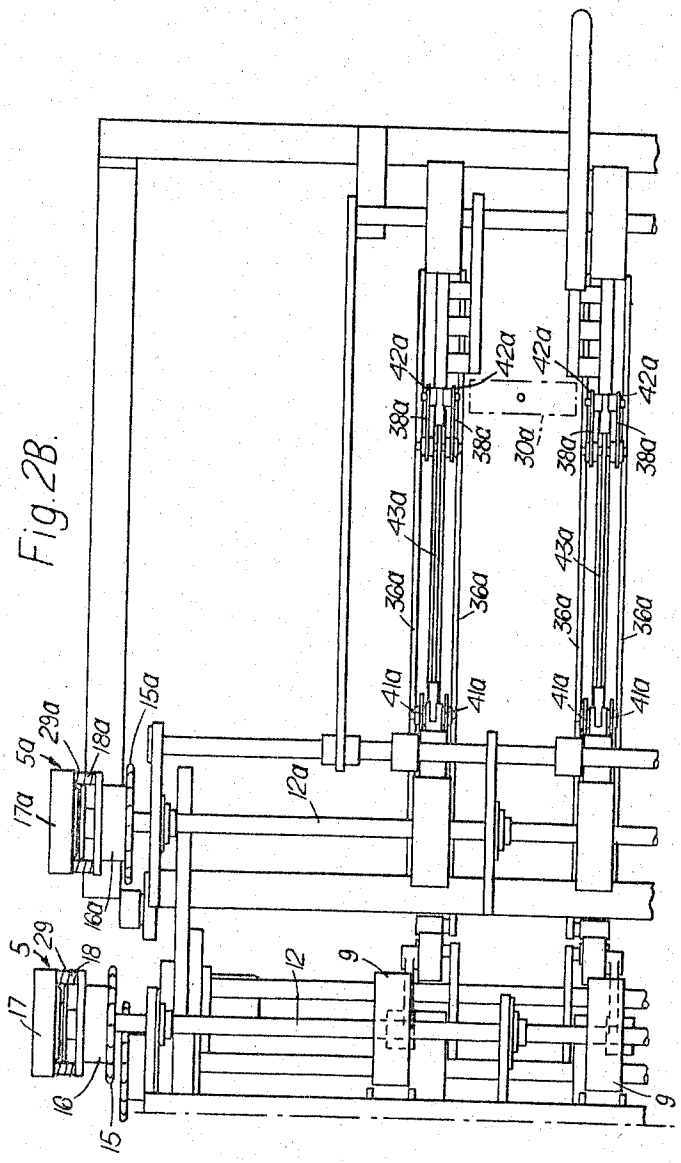
April 25, 1967 R. E. GEESON 3,315,958

APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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9 Sheets-Sheet 4

Fig. 2B.



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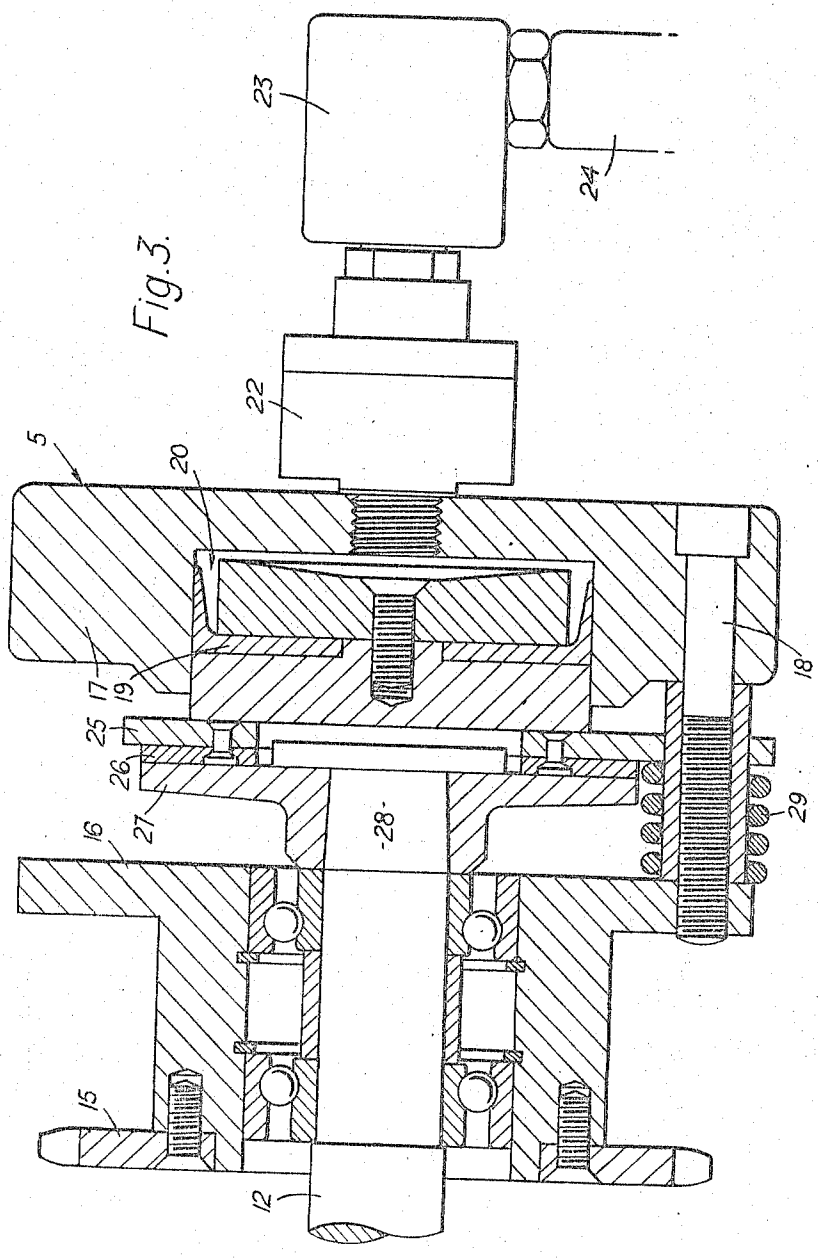
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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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Fig. 3.



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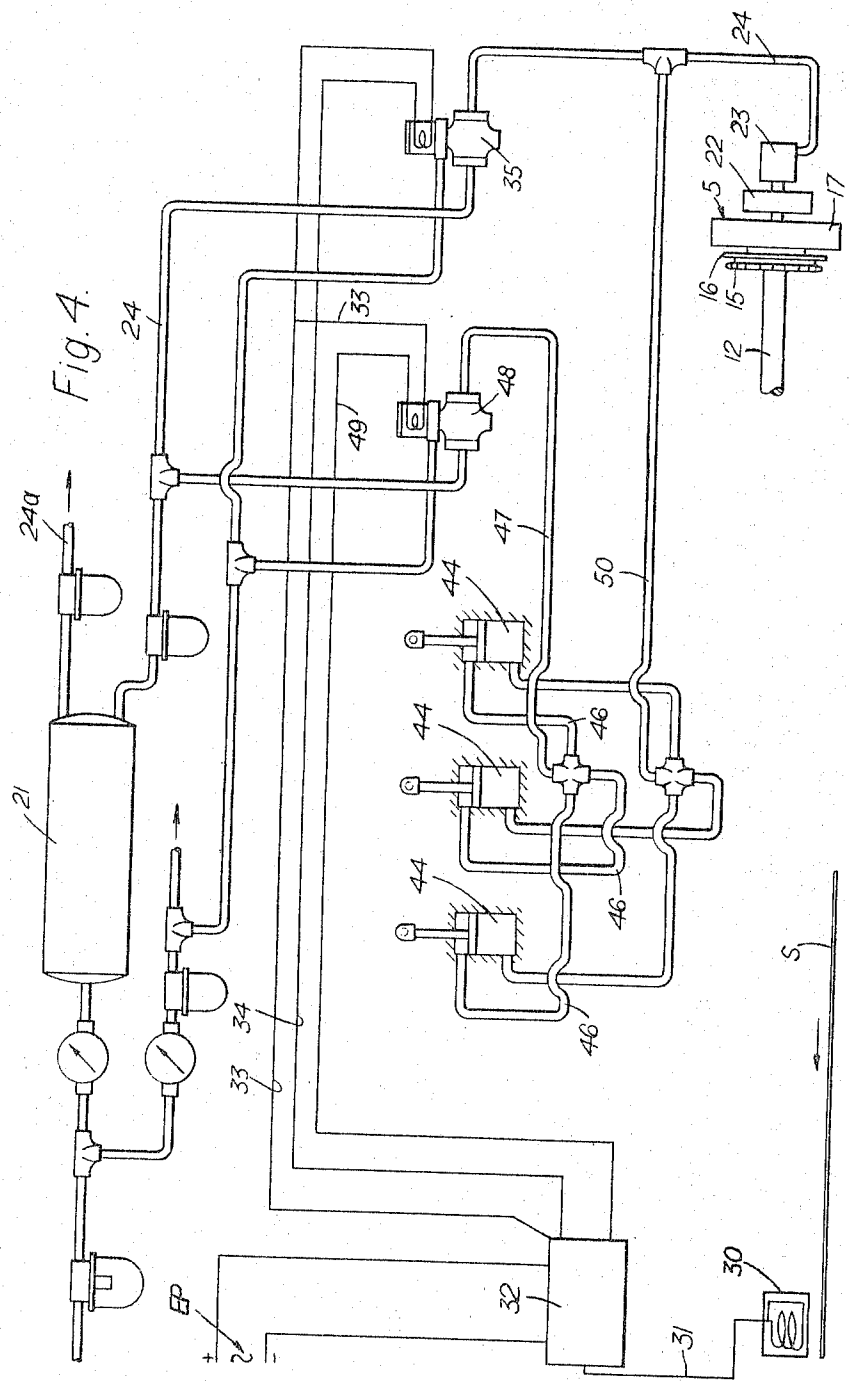
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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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Fig. 4.



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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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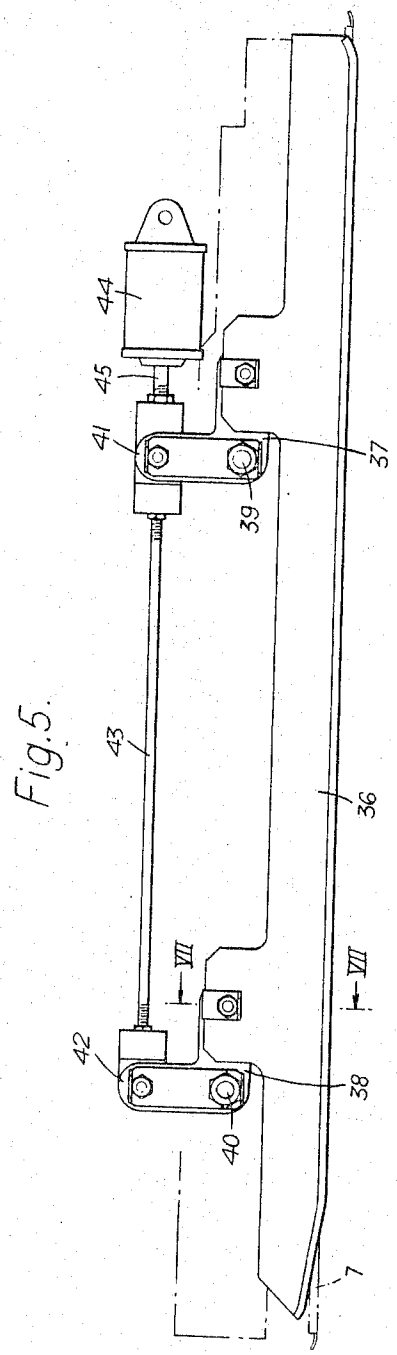


Fig. 5.

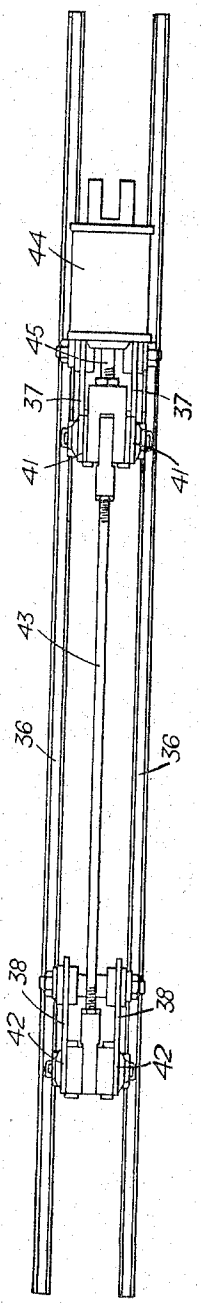


Fig. 6.

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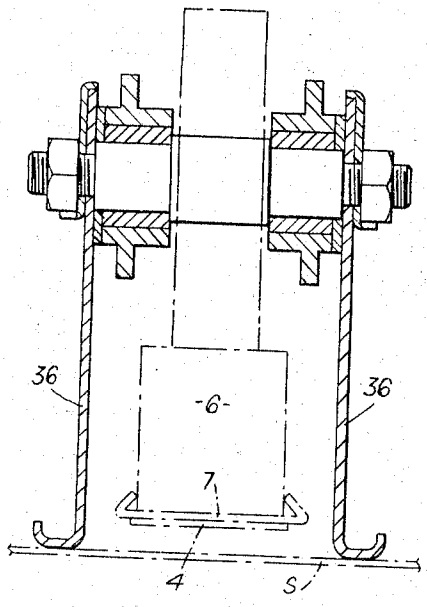
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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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Fig. 7.



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APPARATUS FOR DELIVERING FERROUS METAL SHEETS

Filed Dec. 4, 1964 9 Sheets-Sheet 9

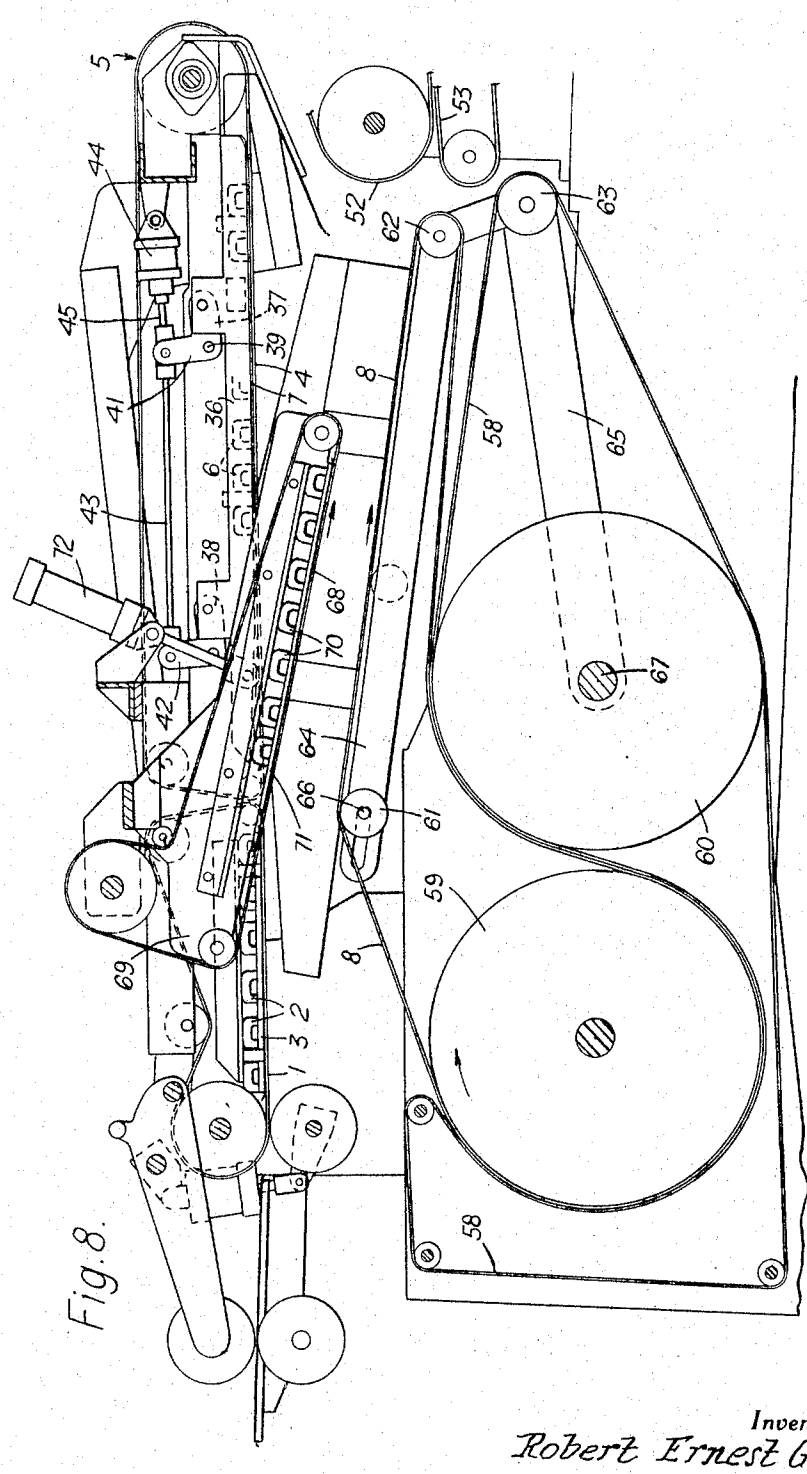


Fig. 8.

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3,315,958

APPARATUS FOR DELIVERING FERROUS METAL SHEETS

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Filed Dec. 4, 1964, Ser. No. 416,040
Claims priority, application Great Britain, Dec. 4, 1963, 47,967/63
9 Claims. (Cl. 271—68)

This invention relates to apparatus for delivering sheets of ferrous metal.

When removing ferrous metal sheets from drying ovens, or other sources, it is desirable that the sheets are handled smoothly with a minimum of shock in order to reduce to a minimum the risk of scratching or smudging decoration applied to the sheets, or of causing creases in the sheets. As will be well understood creases can be easily caused anywhere across a sheet, particularly across very thin sheets, when the sheet is subjected to vibration such as may be caused when the edge of a moving sheet strikes a buffer disposed to arrest the sheet. Such buffer can also cause buckling of the leading edge of the sheet.

When sheets are moved to predetermined positions to which they are to be delivered, for example to a position at which they are to be stacked one on another, it is usual to employ a buffer which arrests the sheets at the position of delivery. Some known kinds of delivery apparatus also employ means such as rollers or rails to bow the sheets in order to give them sufficient stiffness to permit feeding of the sheets and to prevent the leading edges of the sheets scraping across the uppermost sheet of a stack. For reasons of economy it is now the tendency for the size of sheets to be increased and for the thickness thereof to be reduced and with this kind of sheet the known kinds of feeding apparatus tend to become unreliable due to collapsing of the sheets before the delivery position is reached. With the known kinds of delivery apparatus the leading edges of the sheets tend to follow a trajectory such that the height at which they strike the buffers varies, thus rendering precise control difficult.

It is an object of the present invention to provide a sheet delivery apparatus which avoids the use of buffers and of sheet-bowing means.

According to the invention there is provided apparatus for deliverying sheets of ferrous metal, comprising endless delivery belts linear movement of which is controlled by a clutch, said delivery belts being supported above a sheet-receiving position to which sheets transported by the belts are to be delivered, magnets co-operating with the delivery belts to cause sheets to adhere thereto for transport thereby, stripper elements co-operating with the delivery belts to disengage a sheet therefrom and move it out of the field of the magnets for gravitational movement to the sheet-receiving position, clutch and stripper element control means arranged to control operation of the clutch and stripper elements, and sensing means operatively connected with said control means and operable when a sheet is in position for release from the delivery belts to cause the clutch temporarily to permit arresting of the movement of the delivery belts and the stripper elements to release the sheet from the belts.

Further according to the invention there is provided apparatus for delivering sheets of ferrous metal, including a first and a second transporter unit each comprising endless delivery belts linear movement of which is controlled by a clutch, said delivery belts being supported above a sheet-receiving position to which sheets transported by the belts are to be delivered, magnets co-operating with the delivery belts to cause sheets to adhere thereto for transport thereby, stripper elements co-operating with the delivery belts to disengage a sheet therefrom and move it out of the field of the magnets for gravitational movement to the sheet-receiving position, clutch and stripper element control means arranged to control operation of the clutch and stripper elements, and sensing means operatively connected with said control means and operable when a sheet is in position for release from the delivery belts to cause the clutch temporarily to permit arresting the movement of the delivery belts and the stripper elements to release the sheet from the delivery belts, said second unit being supported over a sheet-receiving position at which sheets delivered by the second unit are superimposed one on another, and said first unit being disposed over an intermediate endless belt conveyor arranged to move sheets deposited thereon from the first unit towards the second unit for transportation by the second unit.

In order that the invention may be clearly understood an embodiment thereof will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

FIGURES 1A and 1B illustrate, in sectional side elevation, apparatus according to the invention,

FIGURES 2A and 2B are top plan views of part of the apparatus of FIGURES 1A and 1B,

FIGURE 3 is a section through a clutch embodied in the apparatus,

FIGURE 4 is a schematic diagram illustrating control mechanism embodied in the apparatus,

FIGURE 5 is a side elevation of a stripper device embodied in the apparatus,

FIGURE 6 is a top plan of FIGURE 5,

FIGURE 7 is a section on line VII—VII, FIGURE 5, and

FIGURE 8 illustrates a modification to the apparatus.

Referring to the drawings, a thin ferrous metal sheet S, FIGURES 4 and 7, is transported from the wickets, not shown, of an oven, also not shown, by any suitable means such as conveyor belts or rollers and is delivered to a position at which it passes beneath an input conveyor arranged to deliver the sheet to a first transporter unit to be described below. The input conveyor comprises a plurality of endless input belts **1**, FIGURES 1A and 2A, supported in spaced side-by-side relation and magnets **2** which co-operate with the input belts **1** to cause the sheet to adhere to the belts for transport thereby. The belts **1** have a constant linear velocity which is the same as that of the sheet as it is moved into position for transport by the belts **1**. Stationary skids **3** are interposed between the belts **1** and magnets **2** and are made of non-magnetic metal.

As the sheet leaves the input conveyor it is moved thereby to a position at which it is engaged by the first transporter unit. This unit comprises a plurality of endless delivery belts **4** the linear movement of which is controlled by a clutch indicated generally by the reference numeral **5**. When in motion the belts **4** are moved with the same constant linear velocity as that of the input belts **1** and magnets **6** co-operate with the delivery belts **4** to cause the sheets to adhere thereto for transport thereby. Stationary skids **7** are interposed between the belts **4** and magnets **6** and are made of non-magnetic material. The unit is disposed over a sheet-receiving position consisting of an intermediate endless conveyor **8**, FIGURE 1A, formed by a plurality of endless belts disposed in side-by-side relation, and the sheet is released from the belts **4** to fall gravitationally on to the conveyor **8**.

The belts **4** pass round rollers **9** rotatable with a shaft **12** and rollers **10** and **11** are rotatable about fixed shafts **13**, **14**. The shaft **12** is driven by a sprocket **15**, FIG-

URES 2B, 3 and 4, through the clutch 5 which may, for example, be a pneumatic or a magnetic clutch. The sprocket 15 is rotated by a chain from the main drive, not shown, of the machine.

In the embodiment of the invention shown in the drawings the clutch is a pneumatic clutch as illustrated in FIGURES 3 and 4 and comprises a driving part 16 to which the sprocket 15 is secured and which is freely rotatable about the shaft 12. The part 16 is coupled to a driven part 17 by three equi-spaced bolts 18 and the driven part 17 includes a piston 19 slidable axially in a chamber 20 formed in part 17 and connected with a source of air supply 21, FIGURE 4, through an exhaust valve 22, a rotary air seal 23, and connection pipe line 24. A clutch plate 25 is movable with the piston 19 and has a facing friction ring 26 secured thereto for engagement with a clutch plate 27 mounted on the tapered end 28 of the shaft 12. The clutch, which ensures that the shaft 12 has a low rotational moment of inertia to assist in rapid deceleration, is engaged, as shown in FIGURE 3, by the application of air pressure to the rear of the piston, that is the end thereof at the righthand side of FIGURE 3, and on exhausting of the air from the chamber 20 springs 29 surrounding the bolts 18 effect disengagement of the friction rings 26 from the clutch plate 27. The upthrust of the sheets against the belts 4 causes the belts to be upthrust against the skids 7 and when the clutch is disengaged this combined upthrust effect causes retardation of the belts and of the sheet adhered thereto by the magnets 6. It will be understood that the retardation effect is increased in proportion to the length of the sheet because the longer a sheet is the greater is the number of magnets which are covered thereby. Further, the retardation effect is increased in proportion to the thickness of the sheets because as the sheet thickness is increased greater use is made of the available strength of magnetic flux as saturation conditions prevail in all cases. Thus as the mass of the sheets is increased due to increase of length and thickness, but not of width, the retarding effort is increased giving a degree of automatic compensation. If desired, in order further to increase the retarding effort, and primarily to assist in stabilisation of the position at which a sheet is brought to rest, some convenient form of braking device, not shown, may be associated with the shaft 12 to become operative when the clutch is disengaged.

The clutch is disengaged automatically as a sheet carried by the belts 4 approaches the position at which it is to be released from the belts and this is controlled by a sensing device 30, FIGURES 1A, 2A, and 4, which may consist of a microswitch or a pneumatic pilot valve, either of which can be magnetically actuated to avoid marking decoration on the sheet. Preferably, however, the sensing device consists of a proximity device connected, as by a co-axial cable 31, FIGURE 4, with a static switching unit 32 which includes electronic means, not shown, of suitable known kind and which is connected with a source EP of electrical energy. The switching unit 32 is connected by lines 33, 34 with a solenoid-operated pneumatic valve 35 included in the connection pipe line 24.

When the sheet is arrested above the intermediate conveyor 8 it is released from the belts 4 by stripper elements 36 each of which extends lengthwise of the direction of movement of a sheet S by the delivery belts 4. The stripper elements 36 are arranged in pairs, FIGURES 6 and 7, and are connected to the arms 37, 38 of bell-cranks which are respectively pivoted at 39, 40 to fixed frame elements. The arms 41, 42 of the bell-cranks have a link 43 connected thereto to be parallel with the stripper elements 36 so that the stripper elements, the link, and the bell-cranks form a parallel linkage. The bell-cranks 37, 41 and 38, 42 are spaced apart in the direction of movement of a sheet S by the delivery belts 4 and the link 43 is connected with actuating means

operable to effect rocking of the bell-cranks about the pivots 39, 40 therefor. As shown in the drawings, the actuating means comprises a pneumatic cylinder 44 and the link 43 is connected with the piston rod 45 associated with the cylinder 44. Each of the cylinders 44, FIGURE 4, is connected by branch pipe lines 46, 47 with the pipe line 24. A solenoid-operated valve 48 is included in the branch line 47 and the branch line 47 is connected with the line 24 at a position between the source 21 of air supply and the valve 35. Valve 48 is connected with the switching unit 32 by lines 33 and 49. the cylinders are also connected by a branch line 50 with the line 24 at a position between the clutch 5 and valve 35.

When the sensing device 30 senses the leading end of a sheet S carried by the delivery belts 4 it passes a signal to the switching unit 32 which then actuates the solenoid-operated valves 35, 48 to cut off the air supply to the clutch 5 and so effect disengagement of the clutch and arresting of the movement of the delivery belts 4, and also supplies air through lines 46 to the cylinders 44 so that the bell-cranks 37, 41 and 38, 42 are rocked, clockwise as viewed in FIGURE 5, so that the stripper elements 36 are moved downwards to disengage the sheet S from the belts 4 and to move it out of the field of the magnets 6 so that it falls by gravity on to the intermediate endless conveyor 8. The switching unit 32 operates valves 35, 48 in a manner such that the stripper elements operate only after the sheet has been brought to rest thus avoiding scratching of the upper surface of the sheet, this being particularly important if the upper surface of the sheet has been decorated. Immediately after the sheet has been removed out of the magnetic field the sensing device no longer senses the presence of a sheet and the switching unit reverses the action of the valves 35, 48 so that the stripper elements are returned to the starting positions thereof and the clutch is re-engaged to effect movement of the belts 4.

When the sheet is received by the intermediate conveyor 8 it is moved to a transfer device consisting of upper and lower endless belts 52, 53 and further magnets 54 which co-operate with the upper belts 52 to feed the sheet towards a second transporter unit disposed over a a sheet-receiving position consisting of a stacking device 55, of known form, by which the sheets are superimposed and stacked one on another. The construction and mode of operation of the second transporter unit will not be described in detail because it is generally the same as that of the first transporter unit. Accordingly, the parts of the second unit are indicated by the same references as those used to describe the first unit but are suffixed by the letter *a*. The belts 4*a* are tensioned by a tensioning roller 56 and the clutch 5*a* and stripper elements 36*a* are controlled by a circuit the same as that shown in FIGURE 4 but the valves therefor are connected in an air line 24*a* connected with the source 21 of air supply and the sensing device 30*a* is connected with a switching unit appropriate to the second unit so that the second unit is independent of the first unit.

By delivering the sheets to the stacking device 55 in the manner herein described the sheets remain substantially horizontal while falling from the belts 4*a* on to the stack thereby minimising vibration which might cause fouling of the next incoming sheet or delay in the sheet settling on the stack.

Before the sheet is delivered to the transfer device 52, 53 it is turned over so that the side of the sheet which is engaged by the belts 4*a* is the opposite side from that which was engaged by the belts 4. As the sheet falls towards the belts 8 the end thereof which was the leading end while the sheet was conveyed by the belts 4 slides down a fixed guide 57 as the sheet is taken up by the belts 8. The sheet is then moved by the belts 8 towards belts 58 which co-operate with the belts 8. The belts 8 and 58 are each partly wrapped around rollers

59, 60, see FIGURE 1A, and the sheet is engaged between the belts 8, 58 until the belts separate above roller 60 when the sheet is supported by the belts 58 and, having been reversed, is delivered by the belts 58 to the transfer device 52, 53, 54.

If desired, instead of the belts 58 being wrapped around roller 59 as shown in FIGURE 1A they may be wrapped around only the roller 60 in which case the roller 59 will be magnetic to cause the sheet to adhere to the belts 8 until it is transferred to the belts 58.

In some instances it may be desired not to reverse the sheets before delivering them to the stacking device 55 and to permit the apparatus to be used in these circumstances the roller 59 is driven by a reversible drive, not shown, and the guide rollers 61, 62 for the belts 8, and the guide rollers 63 for the belts 58, are mounted on frame elements 64, 65 pivoted respectively at 66, 67. When the sheets are not to be reversed the frame elements 64, 65 are moved to the positons thereof shown in FIGURE 8 and the direction of rotation of roller 59 is reversed to be as shown in FIGURE 8. The sheets received by belts 8 are now delivered by the belts 8 to the transfer belts 52, 53.

Further, when the sheets are not to be reversed it is not necessary to arrest the movement of the transporting belts and the sheets as they leave the belts 1 are received by deflector belts 68 which are driven continuously at a constant linear speed . The belts 68 are mounted on pivoted frames 69 and are located between the belts 1 and 4. To this end there are three belts 1 and 4 and four belts 68. When the sheets are not to be reversed the belts 68 occupy the positions shown in FIGURE 8 but when the sheets are to be reversed the belts 68 are raised to a position at which they are about one-inch above the belts 1, 4 as shown in FIGURE 1A.

Magnets 70 co-operate with the belts 68 and stationary skids 71 are located between the magnets 70 and belts 68. No stripper elements are employed with the belts 68 and the sheets run off the ends of the belts 68 and fall on to the belts 8 for movement thereby to the transfer belts 52, 53.

The deflector belt frames 69 are movable into and out of the operative position of the belts 68 by air cylinders 72.

I claim:

1. Apparatus for delivering sheets of ferrous metal, comprising endless delivery belts linear movement of which is controlled by a clutch, said delivery belts being supported above a sheet-receiving position to which sheets transported by the belts are to be delivered, magnets co-operating with the delivery belts to cause sheets to adhere thereto for transport thereby, stripper elements co-operating with the delivery belts to disengage a sheet therefrom and move it out of the field of the magnets for gravitational movement to the sheet-receiving position, clutch and stripper element control means arranged to control operation of the clutch and stripper elements, and sensing means operatively connected with said control means and operable when a sheet is in position for release from the delivery belts to cause the clutch temporarily to permit arresting of the movement of the delivery belts and the stripper elements to release the sheet from the belts; said control means for said stripper elements including parallel motion linkage means for moving said stripper elements transversely of said delivery belts with sheet-engaging surfaces of said stripper elements being parallel to said delivery belts.

2. Apparatus according to claim 1, wherein each stripper element extends lengthwise of the direction of movement of a sheet by the delivery belts and the control means includes a link parallel with its stripper element, a pair of pivoted bell-cranks spaced apart in the direction of movement of a sheet by the delivery belts and

connected with the stripper element and said link to maintain the parallel relation thereof, said link being connected with actuating means operable to effect rocking of the bell-cranks about the pivots therefor.

3. Apparatus according to claim 2, wherein the actuating means comprises a pneumatic cylinder and said link is connected with the piston rod associated with the cylinder.

4. Apparatus according to claim 1, wherein the clutch is a pneumatic clutch.

5. Apparatus for delivering sheets of ferrous metal, including a first and a second transporter unit each comprising endless delivery belts linear movement of which is controlled by a clutch, said delivery belts being supported above a sheet-receiving position to which sheets transported by the belts are to be delivered, magnets co-operating with the delivery belts to cause sheets to adhere thereto for transport thereby, stripper elements co-operating with the delivery belts to disengage a sheet therefrom and move it out of the field of the magnets for gravitational movement to the sheet-receiving position, clutch and stripper element control means arranged to control operation of the clutch and stripper elements, and sensing means operatively connected with said control means and operable when a sheet is in position for release from the delivery belts to cause the clutch temporarily to permit arresting of the movement of the delivery belts and the stripper elements to release the sheet from the delivery belts, said second unit being supported over a sheet-receiving position at which sheets delivered by the second unit are superimposed one on another, and said first unit being disposed over an intermediate endless belt conveyor arranged to move sheets deposited thereon from the first unit towards the second unit for transportation by the second unit.

6. Apparatus according to claim 5, wherein the intermediate endless belt conveyor comprises two endless belt conveyor means co-operating one with the other for effecting reversal of the upwardly facing side of a sheet delivered by the first unit.

7. Apparatus according to claim 5, including transfer means operable to feed a sheet from the intermediate endless belt conveyor to said second unit.

8. Apparatus according to claim 5, including an input conveyor arranged to deliver sheets to said first unit and comprising endless input belts movable continuously with a constant linear velocity, and magnets co-operating with the endless input belts to cause sheets to adhere thereto for transport thereby.

9. Apparatus according to claim 8, including a deflector conveyor comprising endless deflector belts located between said input belts and the delivery belts of said first unit, and magnets co-operating with the deflector belts to cause sheets to adhere thereto for transport thereby towards the intermediate endless belt conveyor, said deflector conveyor and the magnets associated therewith being movable between an operative and an inoperative position thereof in relation to the input belts and the delivery belts of the first unit.

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