

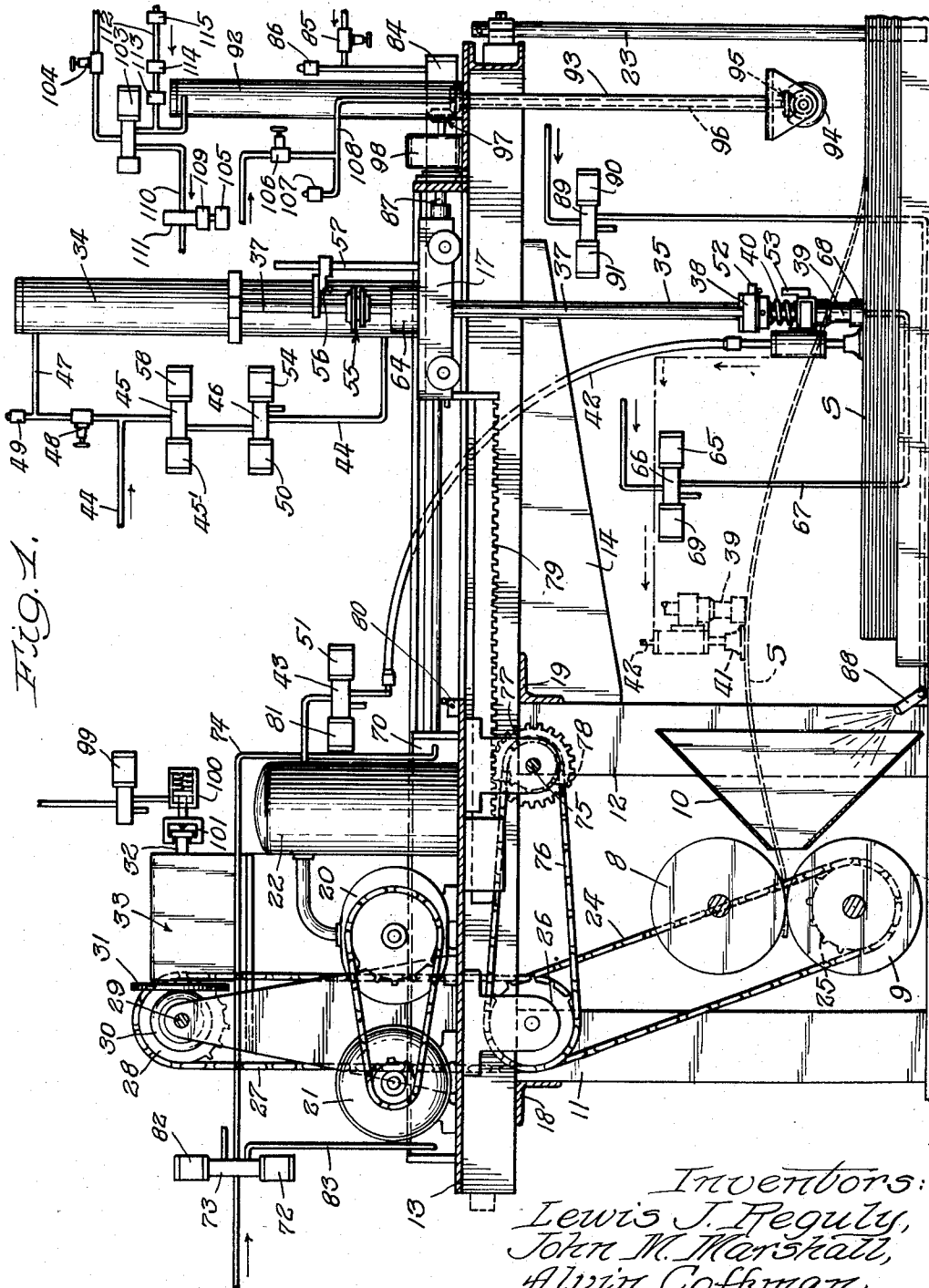
Aug. 26, 1958

L. J. REGULY ET AL
METAL SHEET FEEDER

2,849,231

Filed March 11, 1954

4 Sheets-Sheet 1



Inventors:
Lewis J. Reguly,
John M. Marshall,
Alvin Coffman,
Walter Lysek.
By Charles J. Merriam, attorney.

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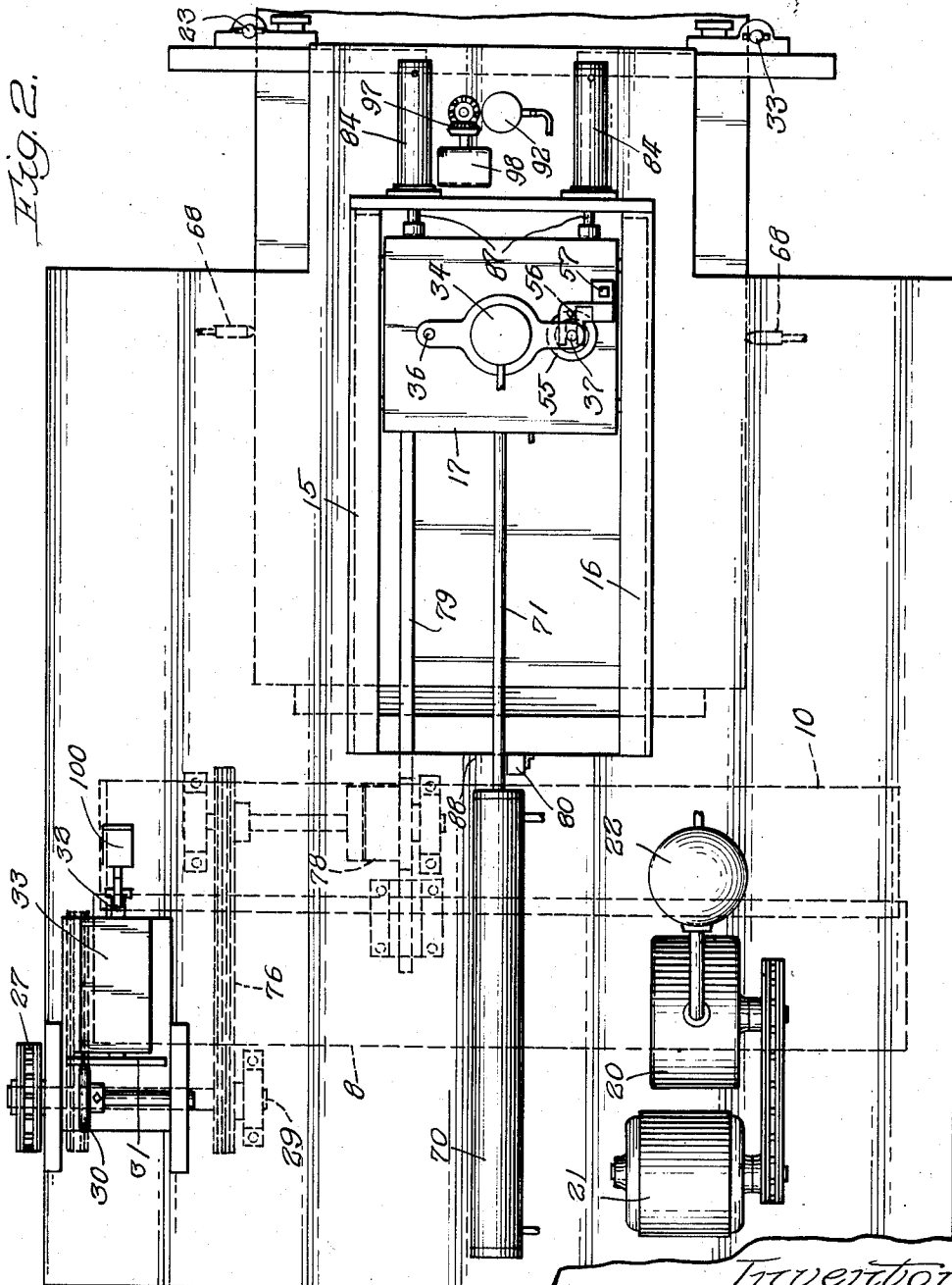
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4 Sheets-Sheet 2

Fig. 2.



Inventors:
Lewis J. Reguly,
John M. Marshall,
Alvin Coffman,
Walter Lysek,
By Charles J. Merriam, Atty.

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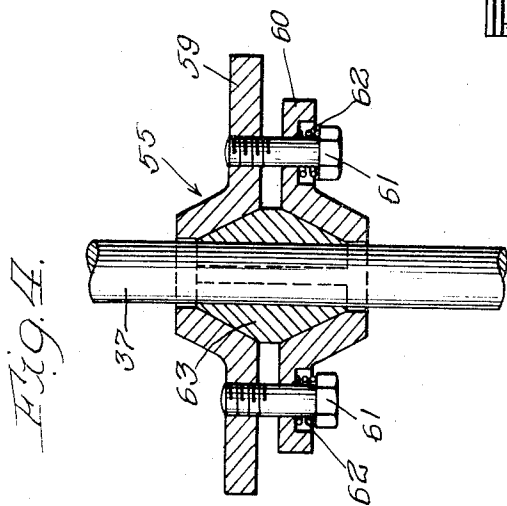
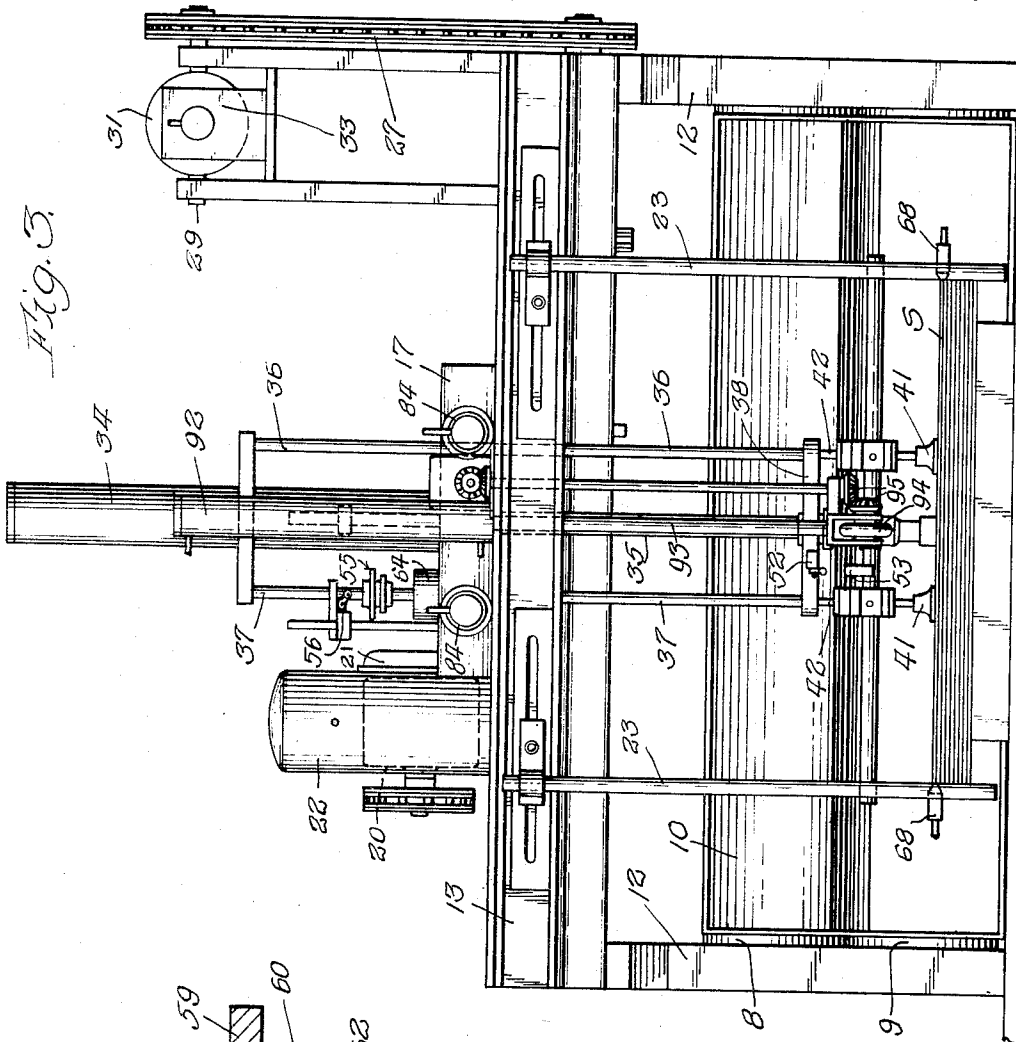
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METAL SHEET FEEDER

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4 Sheets-Sheet 3



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 John M. Marshall,
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 Walter Lysek,
 By Charles J. Merriam, Atty.

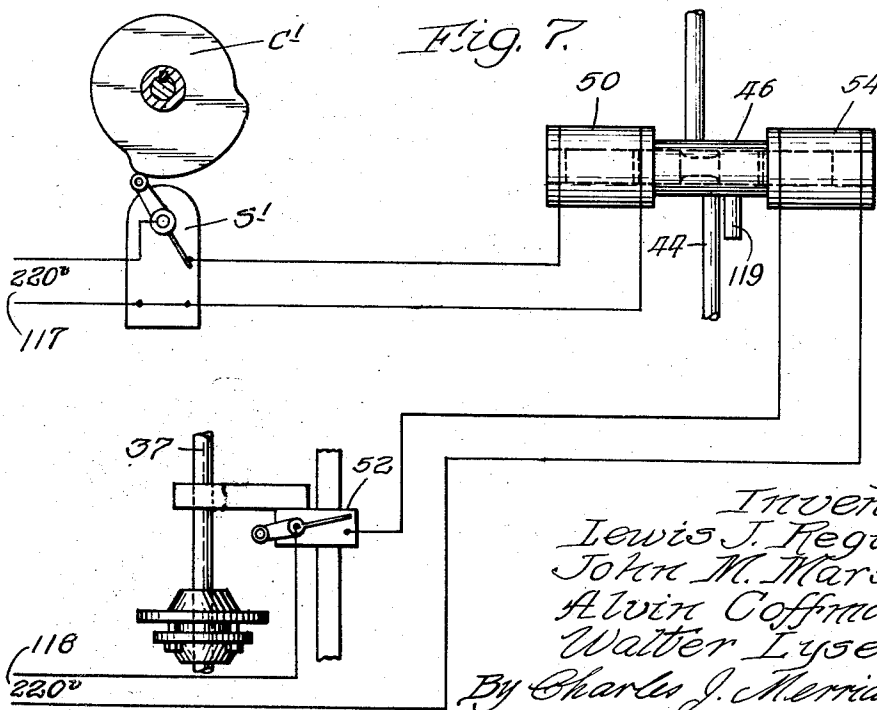
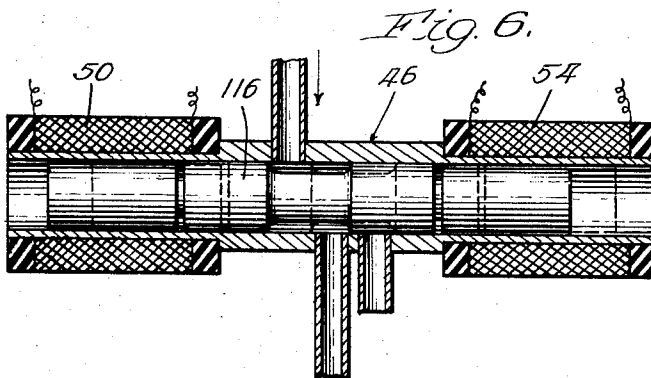
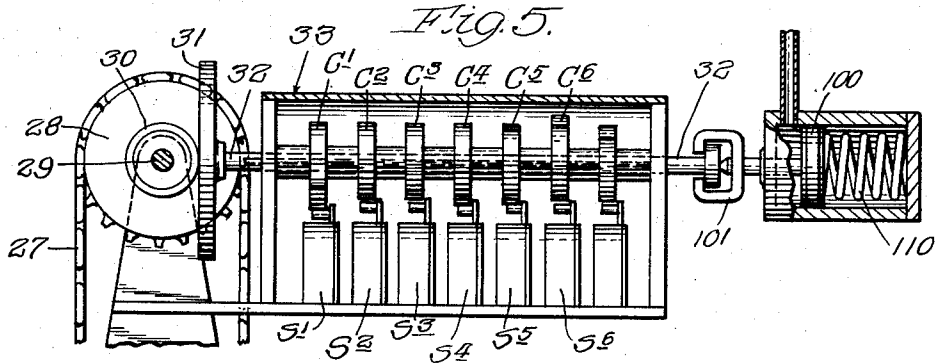
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4 Sheets-Sheet 4



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2,849,231

METAL SHEET FEEDER

Lewis J. Reguly, Gary, Ind., John M. Marshall, Chicago, Ill., Alvin Coffman, Indiana Harbor, Ind., and Walter Lysek, Palos Heights, Ill., assignors to Inland Steel Company, a corporation of Delaware

Application March 11, 1954, Serial No. 415,504

9 Claims. (Cl. 271—11)

This invention relates to a mechanism for feeding sheet material into rolls and more particularly to a mechanism for successively feeding metal sheets forming a stack into the bight of pinch rolls.

Many major producers of steel have strip mills producing wide metal strips in small gauges. These strips are sometimes processed further in sheet form for sale to consumers. The present invention is a mechanism for feeding sheets one after another into rolls which may coat the sheets or be part of a galvanizing or tinplating operation.

The feeding mechanism is operated by air and vacuum cylinder devices controlled by valves operated in turn by solenoids and switches. The feeder has several advantages over other mechanisms previously used for this operation in that it can be produced for only a small fraction of the cost of other devices of this nature. It requires no expensive power lifting hoists nor does it employ complicated mechanical devices. The maintenance cost of the equipment is quite low, particularly since it consists of air cylinders and solenoid operated valves. The mechanism is sufficiently heavy to feed sheets at a rapid pace but is so constructed that it may be made portable for use in different parts of a plant if desired. The apparatus also has built in a very effective means for separating one sheet in a stack from the other sheets.

A particular embodiment of the present invention is illustrated in the accompanying drawings in which:

Figure 1 is a fragmentary side elevational view diagrammatically illustrating the apparatus of this invention;

Figure 2 is a fragmentary plan view diagrammatically illustrating the apparatus shown in Figure 1;

Figure 3 is an end elevational view showing at least a part of the apparatus diagrammatically;

Figure 4 is a fragmentary sectional view through the slip nut on the guide rod of the sheet pick-up cylinder;

Figure 5 is a fragmentary vertical sectional view through the timer apparatus;

Figure 6 is a fragmentary sectional view through a typical valve member and the associated solenoids; and

Figure 7 is a schematic diagram of a typical circuit associated with one of the valves.

The present sheet feeder was made specifically for the purpose of feeding metal sheets into pinch rolls one at a time from the stacks of sheets positioned in front of the rolls. The particular sheets may be 15 to 18 feet long and from 12 to 36 inches wide with very little change required in the apparatus to handle sheets up to widths of 48 inches. The pinch rolls which receive the sheets may be running at a surface speed of some 15 to 200 feet per minute. Under these circumstances, the sheets may be fed into the rolls fairly rapidly, sometimes requiring only a matter of seconds for a sheet to be gripped and fed through the pinch rolls. The apparatus feeds the sheets one directly behind the other.

The sheet feeder is operated almost entirely with air cylinders and vacuum connections with appropriate electrical controls on the valves controlling the air pressure

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and vacuum. Compressed air is provided either by a source in the mill or by a separate compressor at approximately 100 lbs. per square inch. Air regulator valves are used to supply air pressure at proper level to the various parts of the apparatus as will be explained. A blower is mounted on the apparatus for evacuating a tank to provide vacuum connections to certain parts of the apparatus.

The basic operation of the apparatus to first pick up a sheet and then place it into the bight of the pinch rolls is accomplished by a combination of cooperating air cylinders. One cylinder raises the top sheet from the stack and thereafter another cylinder causes the sheet to be moved horizontally to place the forward edge into the pinch rolls. Thereafter, the sheet is released by the apparatus permitting the air cylinders to return the apparatus to its starting position. Mechanism is employed to insure that a second sheet is not fed into the pinch rolls until the preceding sheet has cleared the rolls.

The structure

The structure is illustrated diagrammatically in part in Figures 1 through 3. A pair of pinch rolls 8 and 9 are driven by a source of power, not shown, and in the usual manner. A sheet metal funnel-like guide 10 is positioned in front of the rolls and has an opening adjacent the bight between the rolls so as to deflect the leading end of a sheet into the bight should it be misaligned when carried toward the rolls.

The sheet feeder apparatus is mounted astraddle of the pinch rolls and so as to extend forwardly from the rolls. Cooperating supporting pairs of posts 11 and 12 support an upper framework 13 with the forward end of the framework being in effect cantilevered and held in position by bracing gusset plates 14. This framework 13 is generally horizontal and has a track formed of spaced channel irons 15 and 16 in which a carriage 17 is reciprocally mounted. Suitable cross bracing members in the form of angle irons 18 and 19 are provided so that the supporting structure is rigid against movement under influence of the moving parts of the apparatus and the load of a sheet which might be picked up for feeding into the pinch rolls.

The source of air pressure has not been shown as such may be drawn from available lines in a mill. In the diagrammatical showing of the figures, lines are indicated for a source of air pressure with an arrow indicating the flow. The vacuum needed is supplied by a blower 20 belt-driven by an electrical motor 21 to evacuate a tank 22. This apparatus is supported directly on the framework of the feeder as described above. A stack of sheets S are shown as positioned in front of the pinch rolls and may be partially aligned by removable guide rods 23 suspended from the front end of the horizontal framework 13 of the apparatus. The present structure is shown as mounted in position on the floor of the mill, however, it may be mounted upon a plate provided with skids or wheels for moving the feeder from one location to another. In some instances, the feeder might simply be bolted in place and moved from one mill to another by cranes.

The timer

The electrical control of the cylinders which do the work of the present sheet feeder is accomplished by a timer mechanism driven from the pinch rolls themselves. A chain drive 24 is connected to a sprocket 25 on the lower pinch roll and drives an intermediate sprocket 26 on a jack shaft which, in turn, is connected by chain 27 to a sprocket 28 on shaft 29. This shaft carries a friction drive wheel 30 which runs in contact with a disk 31 connected to the shaft 32 of a timer 33. The

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speed at which the timer shaft is caused to rotate is thus directly correlated to the surface speed of the pinch rolls 8 and 9. The timer is illustrated more particularly in Figure 5 and is provided with a number of cams which operate electrical switches by contact with operating arms of the switches. The function of each of the switches and the parts of the apparatus which it controls will be described in connection with the description of the operating parts of the sheet feeder.

Sheet pick-up

The carriage which runs in the track formed by the channels 15 and 16 carries an upright cylinder 34 with a downwardly extending piston rod 35. The cylinder is stationary in the carriage and the piston rod travels vertically relative to the cylinder. Guide rods 36 and 37 are positioned on either side of the cylinder and serve to guide a cross member 38 near the bottom end of the piston rod. This cross member supports a bumper member 39 pressed downwardly by a spring 40 which may yield under the pressure of the bumper hitting the stack of sheets S. Also carried by the cross member 38 and guide rods are a pair of suction cups 41. Vacuum lines 42 connect each of the suction cups to the tank 22 through an intervening three-way valve 43. This valve is controlled by a solenoid at each end, either of which, when energized will pull the valve to its limited position toward the solenoid.

Air pressure to operate the upright cylinder 34 is provided at 30 lbs. through an inlet line 44. This air pressure is applied through two-way valve 45 and three-way valve 46 to the lower end of the cylinder as will be hereafter described. Air pressure is supplied to the upper end of the cylinder through line 47 and a pressure regulator 48 set at 20 lbs. A pop-off valve 49 is set at 22 lbs. When the cylinder 34 is at rest, air pressure on the lower end of the cylinder will be at 30 lbs. and at the upper end of the cylinder at 20 so that the piston will be raised to its upper position.

The beginning of the cycle first initiates movement of the cylinder and piston device 34 to lower the suction cups to a sheet on top of the stack. This operation is initiated by cam C1 in the timer which closes a switch S1, energizing solenoid 50 of valve 46 exhausting the lower end of the cylinder 34. At the same time, switch S1 also energizes solenoid 51 of valve 43 connecting vacuum line 42 with the tank 22 so that the suction cups are evacuated.

The piston rod 35 descends until the bumper 39 rests upon the stack of sheets compressing the spring 40. A switch 52, carried on the cross member 38 at the lower end of the piston rod, is contacted by a detent 53 to stop the lowering of the piston rod. Switch 52 energizes solenoid 54 of valve 46, shifting the valve to admit air pressure to the lower end of the cylinder 34. Switch 52 also energizes solenoid 45' to open valve 45 so that the air pressure can get into the lower end of the cylinder. In the meantime, the suction cups have made contact with the sheet and since they are open to the vacuum tank 22, the cups grip the sheet.

The introduction at this point of 30 lb. pressure into the lower end of the cylinder 34 starts to raise the piston rod as well as the sheet which is now attached to the suction cups. The pressure above the piston in cylinder 34 thus increases with all excess over 22 lbs. being exhausted through the pop-off valve 49. The raising continues until a slip nut 55 mounted on guide rod 37 contacts switch 56 mounted on a standard 57. Switch 56 energizes solenoid 58 of valve 45 in the supply line to the lower end of the cylinder cutting off further supply of compressed air to the lower end. At this point, the piston will stop its travel and be suspended at the proper elevation under the balance of air pressure above and below the piston, taking into account the weight of the

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sheet, piston rod, and apparatus connected to the piston rod.

The slip nut 55 mounted on the guide rod 37 is caused by its structure to move upwardly on the rod with each down stroke of the piston an amount equal to the thickness of the sheet removed from the stack. The structure of the nut is illustrated in Figure 4 and comprises a top flange 59 and a spaced bottom flange 60 connected by bolts 61 having compression springs 62 yieldably holding the flanges together upon a friction material 63 in contact with the rod 37. The upper flange 59 is of larger diameter than the lower flange so that it may come in contact with the upper end of a tubular member 64 mounted on the carriage 17. This contact stops downward travel of the slip nut even though the guide rod 37 may continue after the contact between the nut and sleeve is made. Since the raising of the sheet is stopped by contact between the upper flange of the slip nut and the switch 56, each sheet will be raised a like amount and there will be no excessive drooping of the leading edge as would occur if the sheets were picked up in constantly increasing amounts.

In order that the top sheet S may be separated from the stack of sheets, cam C3 operates switch S3 in the timer to energize a solenoid 65 operating a valve 66 to supply air through a line 67 to a jet 68 directed at the stack of sheets to aid in separating the top sheet from the stack. After passage of the cam C3 over the switch, the opposite solenoid 69 is energized to return the valve 66 to a position exhausting the supply line 67 to the jet.

Movement of sheet into pinch rolls

The operation described above is that of the apparatus in raising the sheet from the stack to a position elevated over the stack. The sheet may now be advanced into the bight of the pinch rolls 8 and 9. This advance is accomplished by a piston and cylinder device connected to the carriage 17 to move it and the supply cylinder 34 forwardly to the pinch rolls. The cylinder 70 is mounted on the framework of the sheet feeder and the piston rod 71 is connected to the carriage 17. Cam C2 in the timer operates switch S2 energizing solenoid 72 admitting compressed air through the four-way valve 73 and line 74 to the forward end of the cylinder 70. The piston in cylinder 70 is set to travel at a surface speed in excess of the surface speed of the pinch rolls 8 and 9. However, the surface speed is maintained the same as the surface speed of the pinch rolls so that the sheet may be gripped by the rolls without any change in the speed of movement of the sheet. An overrunning clutch is used to limit the speed of travel of the carriage to the surface speed of the pinch rolls. A jack shaft 75 is supported below the framework of the apparatus and is driven by a chain 76. The shaft has a connection with a sprocket 77 through an overrunning clutch 78. The sprocket 77 is in mesh with a gear tooth rack 79 secured to the carriage 17 for movement therewith. The sprocket 77 cannot be driven any faster than will be permitted by the overrunning clutch 78 so that the speed of movement of the carriage toward the pinch rolls is limited to the surface speed of the pinch rolls through the driving mechanism just described.

At the forward end of the travel of the carriage 17, a limit switch 80 is contacted by the carriage and energizes solenoid 81 on the vacuum lines to the cups releasing the vacuum and exhausting the supply line 42, dropping the sheet from contact with the cups. Switch 80 also energizes solenoid 82 of valve 73 controlling the admission of air to the horizontal cylinder 70. The valve is moved to a position connecting the rearward end of the cylinder through line 83 with the supply of air pressure and exhausts the forward end of the cylinder permitting the cylinder to return the carriage to the forward position of its stroke.

Air cylinders are provided to cushion the stopping of the carriage upon its return to its starting position. A

pair of cylinders 84 are provided with air pressure at approximately 18 lbs. through a regulator 85 set at a maximum of 22 lbs. A pop-off valve 86 is also connected to the supply line to the cushioning cylinders 84. The piston rods 87 of the cylinders are so positioned as to contact the carriage upon its return to initial position.

It will be noted that the suction cups grip the sheet S a short distance from the leading edge of the sheet and in some gauges of materials, the sheet handled may droop downwardly at the leading edge from the supporting suction cups. In order to raise the leading edge to the proper elevation to enter the pinch rolls, an air blast is provided by nozzles 88 controlled by a three-way valve 89 operated by solenoids 90 and 91. These solenoids are controlled by a switch S4 in the timer actuated by a cam C4. It should be understood that the cams are properly shaped to contact the switches with which they are associated in the proper time sequence and for the proper length of time.

The governor

At the forward end of the apparatus frame, an upright cylinder 92 is provided having a downwardly extending piston rod 93 carrying a rubber tired disk 94 at its lower end. This disk, when in contact with a moving sheet, will turn a set of bevelled gears 95 on a splined shaft 96 which through an upper pair of gears 97 rotates a normally open electric governor 98. When the governor is rotated, a solenoid 99 (Fig. 1) is energized to open air supply to a small piston and cylinder device 100 (Figs. 1 and 5) opposite the shaft 32 in the timer. The air pressure moves the piston and through a yoke 101 pulls the shaft of the timer and the steel disk 31 away from the rubber drive disk 30 against the action of a compression spring 102. Thus, while the electric governor is rotated, the timer is disconnected from its drive and will remain stationary, the yoke 101 acting as brake against any rotation of the timer shaft 32 during this period.

Once a sheet passes the rubber disk 94 on the governor wheel so that it ceases to rotate, the electrical generator will be stopped, de-energizing solenoid 99 and exhausting the associated cylinder of the piston and cylinder device 100. This permits the timer shaft 32 to move to the left in Figure 1, again engaging the steel disk 31 with the rubber drive wheel 30 causing the timer to rotate and cam C5 to move off of switch S5.

The cam C5 and switch S5 control the lowering of the governor wheel to the sheet at the end of a forward stroke of the carriage 17. Switch S5 energizes solenoid 103 (Fig. 1) controlling the supply to the upper end of the cylinder 92. This admits air regulated at 12 lbs. by regulator 104 into the upper end of the cylinder. A time relay 105 on the exhaust of the upper end of the cylinder 92 is also energized by switch S5. The lower end of the cylinder 92 is provided with air pressure through a line 108 and a pressure regulator 106 set at 8 lbs. A pop-off valve 107 limits the pressure in the line and lower end of cylinder 92 to 10 lbs. When the air is admitted at 12 lbs. into the upper end of the cylinder, the piston is caused to travel downwardly, lowering the drive wheel 94 against the moving sheet which has previously been picked up by the pick-up cylinder 34. Since the governor 98 disengages, in effect, the timer from its drive during the forward motion of the sheet into the pinch rolls, the apparatus is thus automatically suited to operation with sheets of varying length as the feeding into the pinch rolls can continue so long as any sheet is passing the governor drive wheel 94.

When cam C5 moves off of switch S5 after the governor 98 has stopped, solenoid 103 is de-energized, connecting the upper end of the cylinder with the exhaust line 110, thus causing the cylinder 92 to raise the rubber wheel and the piston rod. The time relay 105 is also de-energized by switch S5 and after a set time, a normally open electrical interlock energizes solenoid 109 of valve 111 closing the exhaust from the upper end of the cylinder

and limiting the up stroke of the piston rod, maintaining the same distance on each stroke.

For the purposes of initiating the cycles of operation of the apparatus, a supply line 112 provides a means for an initial blast of air at high pressure to the cylinder 92 to properly position the drive wheel 94 for the governor 98. A valve 113 is controlled by a solenoid 114 and an electrical interlock on the time relay 115 illustrated diagrammatically on line 112.

Starting and stopping

Through the use of electrical interlocks, the apparatus will be returned to an initial starting position even though the proper controls are manually operated to stop the feeding apparatus. Cam C6 actuates switch S6 to properly position the mechanism when either stopping or starting. A time relay is built into the electrical circuits to permit the timer to rotate to a position with the cam C6 holding the switch S6 open.

The valves are solenoid operated and except where specified, the valves are of the type that will be moved to a given position that will be retained until moved away from that position by another solenoid. The solenoids 50 and 54 are arranged at opposite ends of the valve body 46 and operate on the core connected to the valve body 116 to move the valve between its full line and dotted line positions. This valve is shown in the typical electrical diagram of Figure 7 as associated with cam C1 and switch S1 which have a suitable source of power 117. The switch S2 has been previously described and when supplied with a source of power 118 can be closed to energize solenoid 54 moving the valve to a position to exhaust line 44 through an exhaust port 119.

With the apparatus herein described, a very effective sheet feeding device is provided with relatively inexpensive piston and cylinder devices and solenoid operated valves on the lines controlling these devices. Very little maintenance of such apparatus is required, yet the apparatus is quite effective to furnish a rapid successive feeding of sheets from a stack into pinch rolls. The apparatus is foolproof from the standpoint that while one sheet is fed into the pinch rolls, the timer is disconnected until a sheet has passed the governor drive. At this point, the timer is re-engaged and the cycle of operation is repeated.

Air pressure may be provided by a separate source on the apparatus itself if it is so desired.

While we have shown and described a particular embodiment of our invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

We claim:

1. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets to a pair of driven sheet gripping rolls comprising, a frame adapted to be positioned adjacent and above said gripping rolls, a horizontal track supported by said frame with one end of the track above and adjacent said rolls, said track extending away therefrom and adapted to extend over a horizontal stack of sheets, a carriage mounted on said track for horizontal reciprocal movement generally toward and away from said gripping rolls, a sheet lifting pneumatic piston and cylinder means mounted upright on said carriage and extending above said carriage and having sheet lifting means extending below said carriage for raising a sheet vertically from said stack positioned below the carriage, and additional pneumatic piston and cylinder means operatively connected to said carriage for moving said carriage and sheet lifting means horizontally to feed a sheet to said sheet gripping rolls.

2. Apparatus for sequentially feeding the top sheet of

a vertically stacked horizontal pile of metal sheets to a pair of driven sheet gripping rolls, comprising, a frame having a straight track supported generally horizontally and extending forwardly toward said pair of sheet gripping rolls, a carriage reciprocally mounted on the track, an air cylinder and piston device mounted upright on the carriage and having sheet lifting means for raising a top sheet vertically upward from the stack, an air motor for moving said carriage horizontally over the track to advance a raised sheet into the bight between said pair of gripping rolls, valve means for admitting air to and exhausting air from said air cylinder and said air motor, and means separated from said gripping rolls for controlling said valve means in timed sequence to first raise a sheet and then advance the raised sheet horizontally into the bight between said gripping rolls in repeated cycles.

3. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets as defined in claim 2 wherein the carriage is provided with a rack in mesh with a gear and an overrunning clutch is mounted to rotate with the gear, said clutch being driven in timed relation with the sheet gripping rolls to limit advancing travel of the carriage to the surface speed of the gripping rolls.

4. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets comprising, a pair of driven sheet gripping rolls, a frame adjacent said rolls and having portions extending over said pile of sheets, a track supported by said frame and extending forwardly from above said stack to a point overlying and adjacent the rolls, a rolling carriage mounted on the track, pneumatic carriage moving means secured to the frame and carriage for moving the carriage over the track from a starting position above said stack toward the rolls and back to starting position, a piston and cylinder means mounted upright on the carriage and having sheet gripping means for raising the top sheet of the stack of the pile, and means operable from said rolls and timed thereby for controlling actuation of the sheet raising means and carriage moving means sequentially for first raising and then advancing each top sheet from the pile of sheets to the gripping rolls.

5. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets as defined in claim 4 wherein the control means includes a timer having switch contacting members initiating the movements of the sheet raising means and carriage moving means in predetermined timed sequence.

6. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets as defined in claim 4 wherein a reset means is provided on the frame and has a wheel rotatable against a raised sheet when moving into the gripping rolls, said reset member during said wheel rotation returning said timer to

a starting position for control of the feeding of the succeeding sheet from the stack.

7. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets as defined in claim 4 wherein said upright air cylinder and piston is provided with suction means for contacting the exposed surface of a top sheet and lifting the sheet with a constant upward travel of the piston in the cylinder.

8. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets to a pair of driven sheet gripping rolls comprising a frame adapted to be positioned adjacent and above said gripping rolls, a horizontal track supported by said frame with one end of the track above and adjacent said rolls, said track extending away therefrom and adapted to extend over a horizontal stack of sheets, a carriage mounted on said track for reciprocal movement generally toward and away from said gripping rolls, a sheet lifting pneumatic piston and cylinder means mounted upright on said carriage and having sheet lifting means for raising a sheet vertically from said stack positioned below the carriage, additional pneumatic piston and cylinder means for moving said carriage and sheet lifting means horizontally to feed a sheet to said sheet gripping rolls, and means for causing the vertical sheet lifting means to raise the top sheet a constant distance regardless of the height of the stack.

9. Apparatus for sequentially feeding the top sheet of a vertically stacked horizontal pile of metal sheets to a pair of driven sheet gripping rolls comprising a frame adapted to be positioned adjacent and above said gripping rolls, a horizontal track supported by said frame with one end of the track above and adjacent said rolls, said track extending away therefrom and adapted to extend over a horizontal stack of sheets, a carriage mounted on said track for reciprocal movement generally toward and away from said gripping rolls, a sheet lifting pneumatic piston and cylinder means mounted upright on said carriage and having sheet lifting means for raising a sheet vertically from said stack positioned below the carriage, additional pneumatic piston and cylinder means for moving said carriage and sheet lifting means horizontally to feed a sheet to said sheet gripping rolls, and speed correlating means automatically maintaining the advance rate of the carriage toward the gripping rolls equal to the surface speed of the gripping rolls.

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 2,849,231

August 26, 1958

Lewis J. Reguly et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 59, for "stacks" read -- stack --; column 4, line 69, for "connecting" read -- connecting --; column 7, line 53, for the claim reference numeral "4" read -- 5 --.

Signed and sealed this 25th day of November 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents