

Aug. 12, 1952

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2,606,669

SHEET CONVEYING, STACKING, AND DELIVERING APPARATUS

Filed April 14, 1950

3 Sheets-Sheet 1

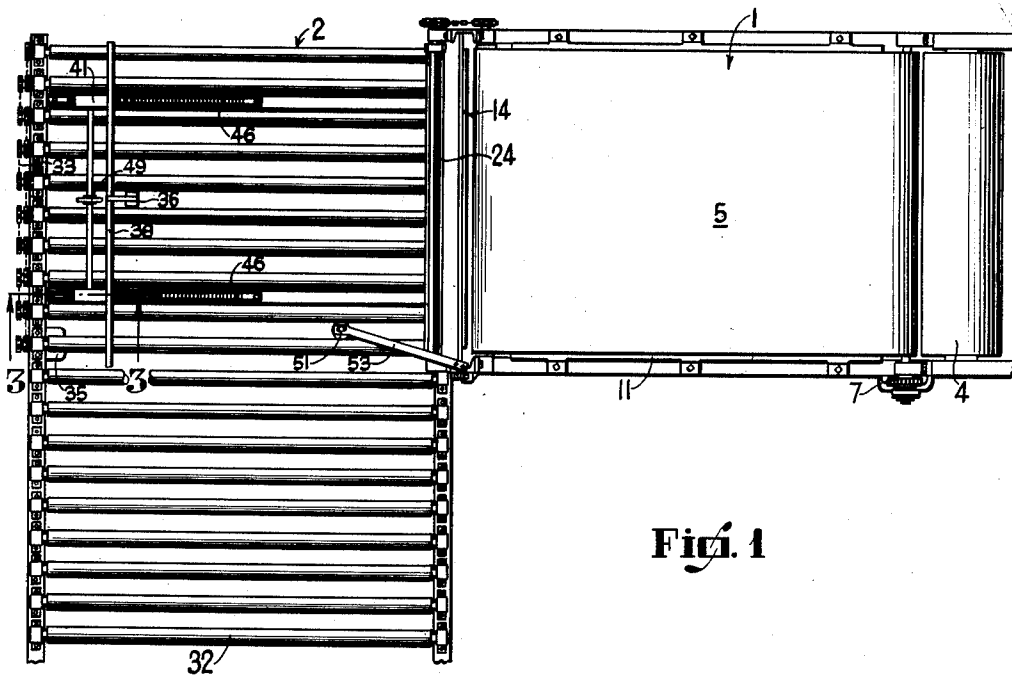


Fig. 1

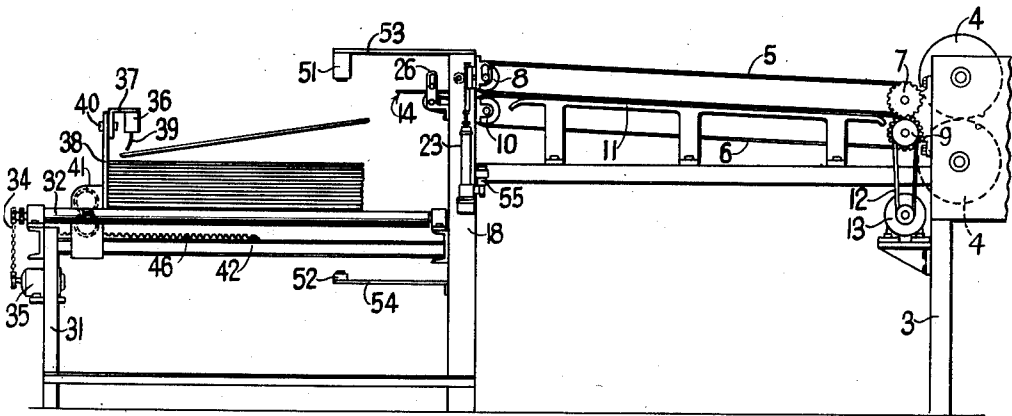


Fig. 2

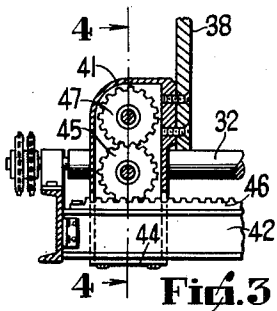


Fig. 3

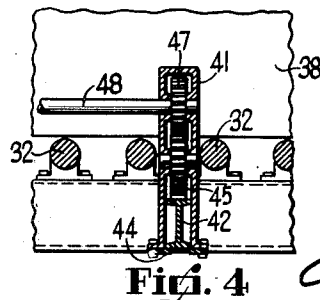


Fig. 4

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3 Sheets-Sheet 2

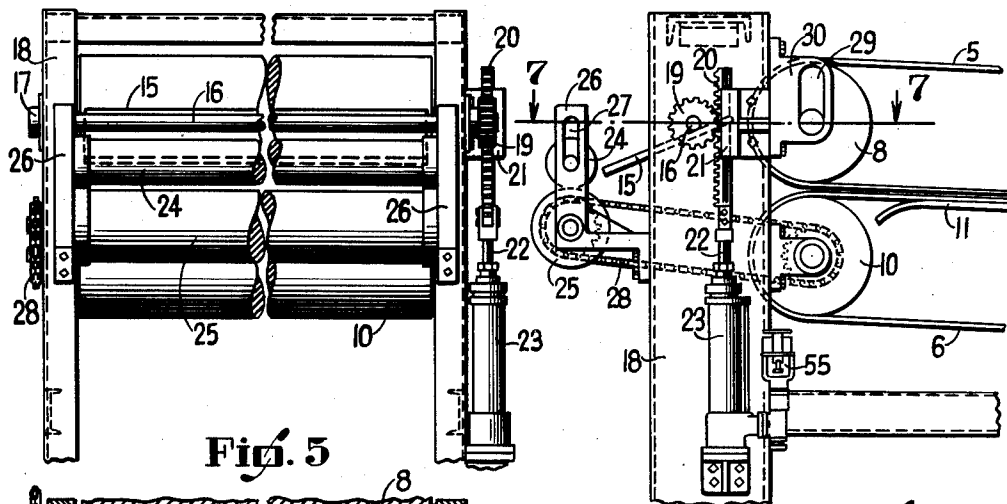


Fig. 5

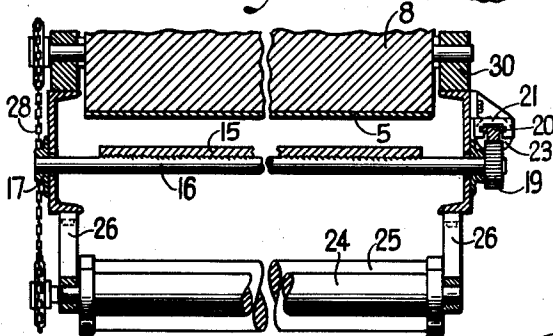


Fig. 6

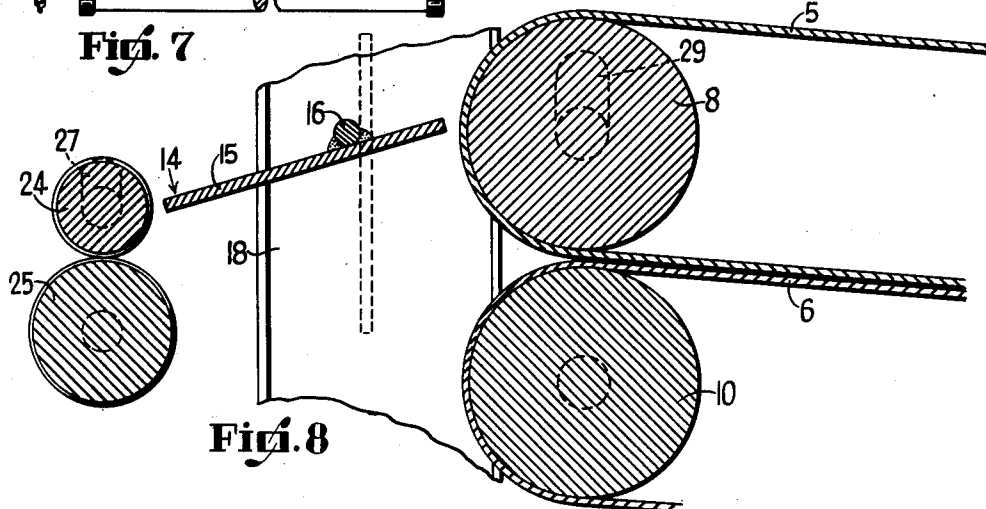


Fig. 7

Fig. 8

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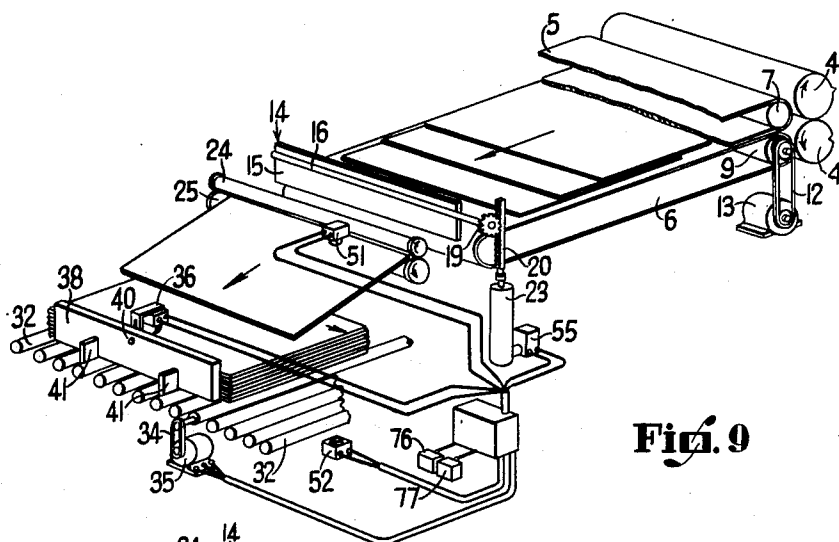


Fig. 9

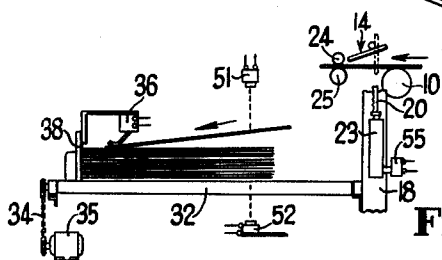


Fig. 10

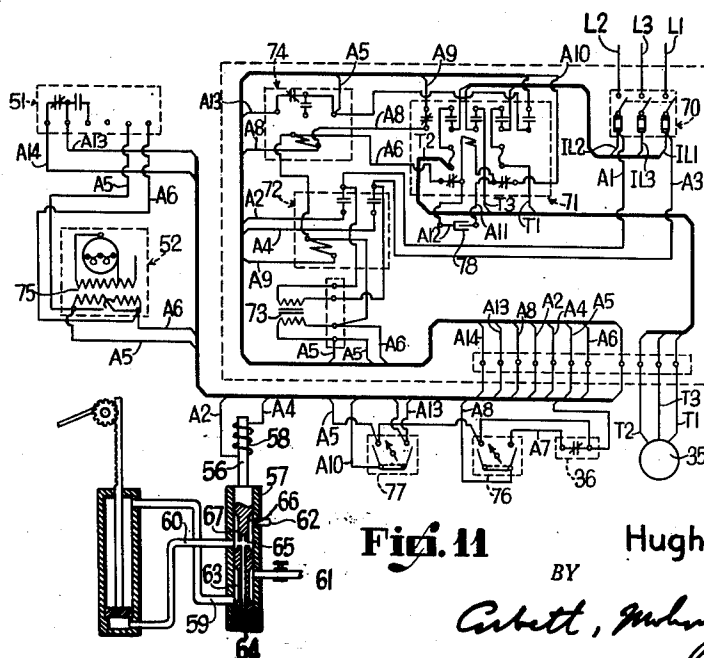


Fig. 11

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2,606,669

SHEET CONVEYING, STACKING, AND
DELIVERING APPARATUS

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12 Claims. (Cl. 214—6)

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My invention relates to sheet conveying, stacking, and delivering apparatus. It has to do, more particularly, with apparatus of this general type which is particularly suitable for handling sheets of paperboard, such as corrugated paperboard sheets. However, my invention is not limited to the handling of paper sheets.

This application is a continuation-in-part of my copending application Serial No. 67,496, filed December 27, 1948, which issued as Patent No. 2,506,550 on May 2, 1950.

In its general construction, the apparatus of the present invention is similar to that disclosed in my copending application. As in such application, I provide in the present apparatus a first conveyor which is continuously driven and which will carry the sheets to a second conveyor which, when receiving the sheets, will be stationary. On this second conveyor, the sheets will be stacked until the stack consists of a preselected number of sheets, or will be of a preselected height, at which time the second conveyor will be actuated to carry the stack to a delivery or removal point. The feed of the sheets from the first continuously driven feed conveyor onto the second intermittently movable conveyor is controlled by a suitable gate associated with the first conveyor which can be actuated to interrupt the feed of the sheets. The actuation of the gate and the movement of the second or delivery conveyor is controlled by automatic control mechanism associated with the second conveyor. This control mechanism is adjustable so that the apparatus can handle and stack sheets of different lengths.

The present invention provides an improved gate structure and improved controlling means therefor. The improved gate structure will prevent jamming of the sheets at the gate, with resulting damage thereto, and the controlling means will serve to more positively and more quickly actuate the gate at the proper intervals.

The preferred embodiment of my invention is illustrated in the accompanying drawings wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a plan view of apparatus constructed according to my invention.

Figure 2 is a side elevational view of the apparatus of Figure 1.

Figure 3 is a vertical transverse sectional view taken substantially along line 3—3 of Figure 1 and illustrating sheet-stopping means associated with the delivery conveyor.

Figure 4 is a vertical sectional view taken along line 4—4 of Figure 3.

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Figure 5 is a front view of the forward end of the feed conveyor and the gate mechanism for controlling feed of sheets therefrom.

Figure 6 is a side elevational view of the mechanism shown in Figure 5.

Figure 7 is a horizontal sectional view taken along line 7—7 of Figure 6.

Figure 8 is an enlarged view illustrating the operation of the gate in association with the discharge end of the feed conveyor.

Figure 9 is a schematic view in perspective of the conveyors and associated control mechanism.

Figure 10 is a schematic view in side elevation illustrating the feed and stacking of the sheets and actuation of the control mechanism.

Figure 11 is an elementary diagram of the electric circuit of my apparatus.

With reference to the drawings, in Figures 1 and 2 I have illustrated the general arrangement of my apparatus. The apparatus consists of a continuously driven feed conveyor 1 and an intermittently actuated delivery conveyor 2 which are preferably disposed at right angles to each other. The feed conveyor 1 will receive the sheets to be stacked, such as corrugated sheets, from a forming machine, or other suitable source, and will feed them to the delivery conveyor 2 upon which they will be stacked in a stack, which will be of a preselected height and, therefore, contain a preselected number of sheets, and the stack will then be carried to a delivery or removal point.

The conveyor 1 comprises a suitable supporting frame 3 which may be associated with a sheet-forming machine that includes a pair of feed rollers 4. The conveyor 1 comprises a pair of endless belts 5 and 6, the belt 5 passing around driving roller 7 and idler roller 8 and the belt 6 passing around driving roller 9 and idler roller 10. The upper run of the belt 6 is supported by a plate 11. The rollers 7 and 9 are geared together and are driven by a belt-drive 12 from a continuously operating electric motor 13. The sheets are fed by the feed rollers 4 into position between the upwardly inclined belts 5 and 6 which will carry them, during the stacking periods, onto the conveyor 2.

In order to control feed of the sheets from the discharge throat between the belts 5 and 6 onto the conveyor 2, a gate unit 14 is associated with the discharge end of the conveyor 1. This gate unit is illustrated best in Figures 5 to 8.

This gate unit comprises a gate member in the form of a metal plate 15 which extends transversely of the feed conveyor 1 just ahead of the rollers 8 and 10. The plate 15 is mounted for

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oscillating or rocking movement about the axis of a transverse shaft 16. This shaft 16 is welded or otherwise suitably secured to the front surface of the plate 15 and projects beyond each end of the plate. The rock shaft 16 has its projecting ends rotatably disposed in bearings 17 mounted in the columns 18 of an upstanding extension of the frame 3 located at the discharge end of the conveyor 1. It will be understood that plate 15 is located and rocks between columns 18. One end of shaft 16 projects through one of the columns 18 and carries a pinion 19 which is keyed thereon. This pinion 19 meshes with a vertical rack bar 20 which is mounted for vertical sliding movement in a guide 21 bolted to the column 18. The lower end of rack bar 20 is attached to the upper end of the piston rod 22 which projects upwardly from a cylinder and piston unit 23. The cylinder of unit 23 is bolted in upstanding position to column 18. The gate member 15 will be open normally as shown in full lines in Figure 8. At proper times, the unit 23 will be actuated to rock the gate member into feed-blocking position across the outlet throat between the belts 5 and 6 as shown by the dotted lines in Figure 8. This will interrupt delivery of sheets from between the belts 5 and 6.

When the sheets are delivered from belts 5 and 6, they pass between the feed rollers 24 and 25 which are carried on columns 18 by brackets 26 attached to the side of the columns opposite the side where rollers 8 and 10 are located. The roller shaft of the upper roller 24 has its ends mounted for vertical sliding movement in slots 27 formed in the supporting brackets 26. The roller 25 is positively driven by a chain and sprocket drive 28 from the shaft of the roller 10. The other roller 24 will be driven by frictional contact with the sheets being forced between the rollers 24 and 25. The roller 24 may move vertically away from roller 25 but will normally rest against roller 25 due to gravity. Thus, it will be possible to force one or more sheets between these rollers which will grip them regardless of their number. Similarly, it will be noted, the roller 8 is vertically movable since the ends of its shaft are mounted in the vertical slots 29 formed in the supporting brackets 30. Thus, the forward end of belt 5 can move vertically relative to the forward end of belt 6 which will permit a number of sheets to pile up between the belts.

The cross conveyor 2 is at a lower level than the conveyor 1 and is supported by a frame 31 extending at right angles to the frame 3 and being attached thereto. This conveyor 2 is in the form of a series of transversely extending rollers 32 which are rotatably mounted on the frame 31 at the upper side thereof and are in spaced relationship throughout the length of the frame. It will be noted from Figure 1, that all of the rollers are connected together by a series of sprocket and chain drives 33 so that they can all be driven simultaneously. As shown in Figure 2, one of the rollers 32 is driven by means of a chain and sprocket drive 34 from an electric motor 35 supported by frame 31, which will be actuated during certain periods. Obviously, when motor 35 is actuated, all of the rollers 32 will be positively driven.

For controlling the gate unit 14, and more specifically for controlling the actuating unit 23 of the gate unit, a limit switch 36 is associated with the conveyor 2. This switch 36 is located

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above the conveyor 2 directly opposite the discharge end of the conveyor 1 and substantially in alignment with the longitudinal center line of the conveyor 1. It will be noted that this switch 36 is at the side of the conveyor 2 which is spaced from the discharge end of the feed conveyor 1.

The switch 36 of the control mechanism is carried by a bracket 37 which is attached to a vertically disposed stop plate or board 38 which extends longitudinally along the conveyor 2 at right angles to the rollers 32 thereof. This plate 38 is of a length at least equal to the width of the conveyor 1 and is directly opposite the discharge end thereof. The limit switch 36 is provided with a depending trigger 39 which has its lower ends spaced above the rollers 32 of the conveyor 2. The sheets discharged from the conveyor 1 will pile up on the conveyor 2, which will be stationary, until the pile or stack is sufficiently high for the last delivered sheet to contact the trigger 39 and actuate the switch 36. The bracket 37 is carried by the plate 38 intermediate its ends and is connected thereto by a screw and slot connection 40 which permits vertical adjustment of the bracket. This, in turn, will permit vertical adjustment of the trigger 39 so that the switch may be set to permit stacking of the sheets in stacks of different heights.

The plate 38, as shown best in Figures 1, 3, and 4 is bolted to the upper ends of a pair of gear housings 41. Each of these housings 41 projects upwardly between two of the rollers 32. The lower end of each housing is shaped to fit around an I-beam 42 of the frame 31, the I-beam extending transversely of the frame. It will be noted from Figure 4, that the lower end of each of the housings 41 is provided with guide flanges 44 that overlap the lower flange of the I-beam. Thus, the housings 41 are slidably mounted on the I-beams 42 which are spaced along frame 31. Each of the housings 41 has rotatably mounted therein a lower pinion 45 which meshes with a rack 46 carried on the upper side of the I-beam 42. This pinion 45 meshes with an upper pinion 47 rotatably disposed in the housing. The pinions 47 are keyed on the shaft 48 which extends laterally of the housings 41 and behind the plate 38 with which it is parallel. This shaft may be rotated by means of a hand wheel 49 in order to move plate 38 and switch 36 towards or away from the discharge end of conveyor 1. This adjustment is desirable to permit stacking of sheets of different lengths.

The control mechanism also includes a photoelectric relay 51 and a light source 52 which are associated with the conveyor 2, as shown in Figures 1 and 2. The relay 51 is carried by the column 18 at the angle between the conveyors 1 and 2 by means of a supporting arm 53 which extends over the conveyor 2. It will be noted that the relay 51 is located just within the adjacent side edge of the conveyor 1, over the conveyor 2, and spaced slightly from the discharge end of the conveyor 1. The light source 52 is carried by an arm 54 which is secured to the lower portion of the column 18. This light source is located below the conveyor 2 in exact alignment with the relay 51 and the light beam will pass up between two of the rollers 32.

The cylinder and piston unit 23 of the gate unit 14, is controlled by means of a solenoid-actuated valve 55 which is mounted on the unit 23, as shown in Figures 2 and 9. This valve, as

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shown best in Figure 11, comprises a stem 56 which is moved vertically within the valve housing 57 by means of a solenoid 58. The valve housing is provided with a passageway 59 leading to the upper end of the cylinder of unit 23 and with a passageway 60 leading to the lower end thereof. Air or other actuating fluid is admitted into valve housing 57 by means of an inlet connection 61 located intermediate its height. It is exhausted through a connection 62 adjacent its upper end. The unit 23 is normally in the condition illustrated in Figure 11 with its piston in its lowermost position. When solenoid 58 is energized, the valve stem 56 is lifted. This permits air from connection 61 to flow into the housing around reduced portion 63 of the valve stem and into passageway 60, through which it will flow into the lower end of the cylinder and raise the piston. Any air in the upper end of the cylinder will exhaust through passageway 59, through a central bore 64 in the lower part of the valve stem and out through a connecting transverse bore 65 into the annular space 66 within the upper end of the housing, which is connected to exhaust connection 62. When the solenoid 58 is de-energized, the valve stem 56 will drop. Air will be supplied to the upper end of the cylinder by passing around reduced portion 63 of the valve stem and through passageway 59. Air in the lower part of the cylinder will exhaust through passageway 60, around the reduced upper portion 67 of the valve stem, through space 66 of the housing and out through connection 62. Thus, when the solenoid is energized, the gate 15 is rocked into feed-obstructing position shown by the dotted lines in Figure 8.

The electric circuit is shown in Figure 11 and comprises the incoming lines L1, L2 and L3, which lead from a suitable source of power to the main switch 70 which has the usual fuses associated therewith. From the switch the lines IL1, IL2 and IL3, lead to the motor starter indicated generally by numeral 71. The lines T1, T2 and T3 lead from the starter 71 and are connected to the three phase electric motor 35. Leading from the two outer fuses of the switch 70 are the lines A1 and A3 which connect to the gate solenoid relay 72. Lines A2 and A4 lead from the relay 72 and connect to the solenoid 58 of the gate control valve 55. Lines A1 and A3 also lead to the transformer 73. A line A5 leads from starter 71 to a time delay relay 74 and then on to the transformer 73. A line A6 leads from starter 71 to relay 74 and then on to the transformer 73. From the transformer, the lines A5 and A6 extend to the photoelectric light source 52 which includes the transformer 75, the lines A5 and A6 continuing on from the transformer to the photoelectric relay 51. The line A5 in passing from the transformer 73 to the photoelectric light source 52 connects with limit switch 36, selector switch 76, and selector switch 77. Each of the switches 76 and 77 can be set for hand operation or automatic operation. Line A7 connects switches 36 and 76. A line A8 also leads from the starter 71 to time delay relay 74 and then continues to the selector switch 76. The line A9 leads from the starter 71 to the gate solenoid relay 72. Line A10 leads from the starter 71 to the switch 77. Line A11 leads from the starter to a capacitor 78 and line A12 leads from such capacitor into the starter. Line A13 leads from the starter to and from the switch 77 and continues on to the photoelectric relay 51. The line A14 leads from the starter 71 and runs to the photoelectric relay 51.

In the operation of my apparatus, the limit

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switch 36 is adjusted to the proper height to permit stacking of the sheets in a selected number. The bar 38 is adjusted to the proper position, depending upon the length of the sheets to be stacked. In general, the sheets will be delivered from the forming and cutting machine to the feed conveyor 1 which will carry them to and discharge them onto the delivery conveyor 2, as shown in Figures 9 and 10. After a predetermined number of sheets have been delivered, or in other words, when the stack is of selected height, the circuit is so arranged as to energize the solenoid 58 of gate control valve 55 and cause the gate 15 to rock downwardly so as to stop the feed of sheets to the side conveyor 2 and to start movement of the conveyor 2 by energizing the motor 35. Since feed conveyor 1 runs continuously, the sheets will merely pile up against gate 15. Thus, the stack of sheets on conveyor 2 will be moved off to a removal point, leaving the conveyor 2 free to receive another stack of sheets. After the conveyor 2 is stopped, by de-energization of the motor 35, the solenoid 58 of gate valve 55 is again de-energized to rock the gate 15 into non-obstructing position, causing the accumulated pile on conveyor 1 to be fed onto conveyor 2 and permitting successive sheets to be stacked. As long as one or more sheets are on conveyor 2 in the stacking position, the light beam from source 52 is broken and the relay 51 will not function, but when the beam is permitted to reach relay 51, the motor 35 is de-energized to stop conveyor 2 and the gate control valve solenoid 58 is again de-energized to rock the gate 15 into non-obstructing position.

With particular reference to the circuit diagram of Figure 11, as indicated, the switches 76 and 77 may be set for manual or automatic operation. On manual operation, the operator can count the sheets and cause the conveyor 2 to move by setting the switch 77 for manual operation and then manipulating it properly. The gate control valve solenoid 58 may be energized and de-energized to operate gate 15 by setting the switch 76 for manual operation and then manipulating it properly. The switches 76 and 77 are shown as hand switches in Figure 9 but may be foot switches. Since the normal operation is automatic, the detailed discussion of the operation will be directed to the circuit with the switches 76 and 77 set for automatic operation.

On automatic operation, assuming that one sheet has been deposited on the delivery conveyor 2, the light beam to the photoelectric relay 51 is broken and the photoelectric relay is closed. As the sheets are built up in the stack, they cause limit switch 36 to open, energizing the gate control valve solenoid 58, which, in turn, rocks the gate 15 into feed obstructing position causing the feed of sheets from the feed conveyor 1 to be stopped. The interlock on the motor starter 71 is closed because the motor is not running. At the same time, limit switch 36 opens the circuit to the time delay relay 74, which is adjustable to vary the period of delay. After a selected time delay, the relay 74 operates and causes the motor starter 71 to be connected in the circuit through the photoelectric relay 51. This time delay allows the last sheet to be deposited on the stack on the side conveyor 2 before it starts to move. As the conveyor 2 starts to move, the limit switch 36 closes again just as the stack of sheets clears it but the gate does not rock into non-obstructing position because the interlock on starter 71 is now open since the motor 35 is running. The motor 35 runs,

so as to drive the conveyor 2, until the stack of sheets is moved entirely to one side of the conveyor 1 on conveyor 2, towards the removal point, and at this time, the photoelectric light beam, passing up between rollers 32, reaches the photoelectric relay 51 and energizes it. This causes the contacts of the relay to open which, in turn, causes the dropping out of the circuit of the contacts of starter 71, because the time delay relay 74 was opened when the stack of sheets cleared the limit switch 36. At the same time, the interlock on starter 71 recloses, which causes the gate 15 to rock upwardly and permits the conveyor 1 to deliver more sheets to the side conveyor 2. The first of the sheets delivered after the gate rocks upwardly, again interrupts the light beam from the source 52 and closes the relay 51 thereby setting the circuit up for a new cycle.

As previously indicated, one or more sheets may be fed simultaneously between rollers 24 and 25 because the belts and rollers can adjust themselves vertically relative to each other to cooperate for the difference in thickness of material passing between them.

The gate 15 is positively rocked between its two positions by means of the rack and gear mechanism which is actuated by the fluid cylinder and piston unit 23. Furthermore, as will be noted from Figure 8, the gate 15 is normally inclined forwardly and downwardly so as to direct the sheets into the inlet throat between rollers 24 and 25. As the gate rocks into open position, it directs the sheets between the rollers 24 and 25 and will prevent jamming thereof.

Thus the sheets are conveyed, stacked and moved to a point of removal automatically. However, as previously indicated, the apparatus can be controlled manually, if desired.

It will be apparent that I have provided novel apparatus for conveying, stacking and delivering sheets or other similar articles. A number of advantages of this structure have been set forth above and other will be apparent.

Having thus described my invention, what I claim is:

1. Apparatus of the type described for conveying and stacking articles comprising a feeding conveyor and a receiving conveyor disposed in association with each other, means for continuously moving the feeding conveyor, means for intermittently moving the receiving conveyor, means for interrupting feed of the articles from the feeding conveyor to the receiving conveyor and comprising a gate, supporting means for mounting said gate adjacent said feeding conveyor for rocking movement between article non-obstructing and obstructing positions, an actuating unit for the gate, and control means for controlling the said gate actuating unit and the means for moving the receiving conveyor, said control means including a control associated with the receiving conveyor and actuated to initiate movement of it when a stack of articles of preselected height is built up on the receiving conveyor, said control means also including a second control associated with the receiving conveyor and which will be actuated by the stack of articles to stop the conveyor after such conveyor moves the stack to a selected position along the conveyor.

2. Apparatus according to claim 1 wherein the first control includes an actuating member which will be engaged by the top of the stack when it reaches a certain height and wherein the second control includes an electric eye, the light beam

of which is broken by any article in stacking position.

3. Apparatus according to claim 2 wherein said gate-actuating unit is a fluid-actuated cylinder and piston unit controlled by a solenoid valve, said valve being connected in an electric circuit actuated by said actuating member, and wherein the receiving conveyor is moved by an electric motor which is controlled both by said actuating member and said electric eye.

4. Apparatus according to claim 3 wherein means is included in the circuit for delaying operation of the motor after operation of said actuating member.

5. Apparatus according to claim 4 wherein said actuating member engaged by the stack of articles operates a limit switch incorporated in said circuit and wherein said circuit also includes a switch for controlling the gate-actuating valve solenoid and a switch for controlling the motor which drives the receiving conveyor, each of said gate-controlling and motor-controlling switches being adjustable for manual or automatic operation.

6. Apparatus for conveying and stacking flat sheets of material comprising a feeding conveyor and a receiving conveyor disposed in association with each other, the receiving conveyor being substantially horizontally disposed at the end of the feeding conveyor and extending transversely thereof, means for continuously moving the feeding conveyor, an electric motor for intermittently moving the receiving conveyor, a transversely disposed gate associated with the feeding conveyor, means for mounting said gate for rocking movement relative to the feeding conveyor to control the feed of the sheets therefrom onto the receiving conveyor, an actuating unit for said gate comprising a fluid actuated rack and gear mechanism and a solenoid control valve, and control mechanism for controlling operation of said gate-control valve and movement of the receiving conveyor, said control mechanism including an electric switch-actuating member associated with the receiving conveyor and spaced thereabove and located directly opposite the discharge end of the feeding conveyor so that it will be engaged when a stack of sheets of preselected height is built up on the receiving conveyor, said control mechanism also including a photoelectric relay and light source associated with the receiving conveyor, said receiving conveyor permitting the light ray of the source to pass therethrough and reach the photoelectric relay, the light ray being interrupted by any sheet in stacking position, said switch actuating member actuating a switch which is in circuit with the gate-control valve solenoid, with said electric motor and with said relay, actuation of said switch serving to close the gate and to initiate movement of the conveyor, and subjecting the relay to the light beam from the source serving to de-energize said motor.

7. Apparatus according to claim 6 wherein a time delay relay is connected in the circuit with said switch to delay energizing of the motor after actuating of said switch.

8. Apparatus according to claim 7 wherein additional switches are incorporated in said circuit for controlling said motor and said gate-control valve solenoid, said switches being adjustable for manual or automatic operation.

9. Apparatus according to claim 8 wherein the switch-actuating member is vertically adjustable to vary the height of stacking and is

adjustable towards and away from the discharge end of the feeding container so as to compensate for sheets of different lengths and wherein the receiving conveyor is disposed at the end of the feeding conveyor at right angles thereto, said receiving conveyor being in the form of rollers, and the photoelectric light source and photoelectric relay being located to permit the light ray to pass up through the rollers, said photoelectric light source and relay being so located that the light ray will be broken as long as one of the sheets is in stacking position.

10. Apparatus according to claim 9 wherein said feeding conveyor comprises superimposed feeding belts between which the sheets pass and having their discharge ends relatively vertically movable to permit one or a number of superimposed sheets to pass therebetween, feeding rollers associated with such discharge ends between which the sheets pass to the receiving conveyor, said rollers being relatively movable to permit one or a number of superimposed sheets to feed therebetween.

11. A feeding conveyor for feeding sheets of material comprising a pair of superimposed driven belts between which the sheets are carried, a pair of driven receiving and feeding rollers adjacent the discharge ends of said belts between which the sheets discharged by said belts will pass, means for mounting the discharge ends of said belts for relative vertical movement, and means for mounting said rollers for free relative vertical movement a transversely extending gate between the discharge ends of said belts and

said rollers, and means for rocking said gate between feed-obstructing and non-obstructing positions.

12. A feeding conveyor for feeding sheets of material comprising a pair of superimposed driven belts between which the sheets are carried, a pair of driven receiving and feeding rollers adjacent the discharge ends of said belts between which the sheets discharged by said belts will pass, means for mounting said belts to permit relative vertical movement of their discharge ends, means for mounting said rollers to permit relative vertical movement, a transversely extending gate between the discharge ends of said belts and said rollers, means for mounting the gate for rocking movement about a transverse axis, and a fluid-actuated rack and gear unit for rocking said gate between feed-obstructing and non-obstructing positions.

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