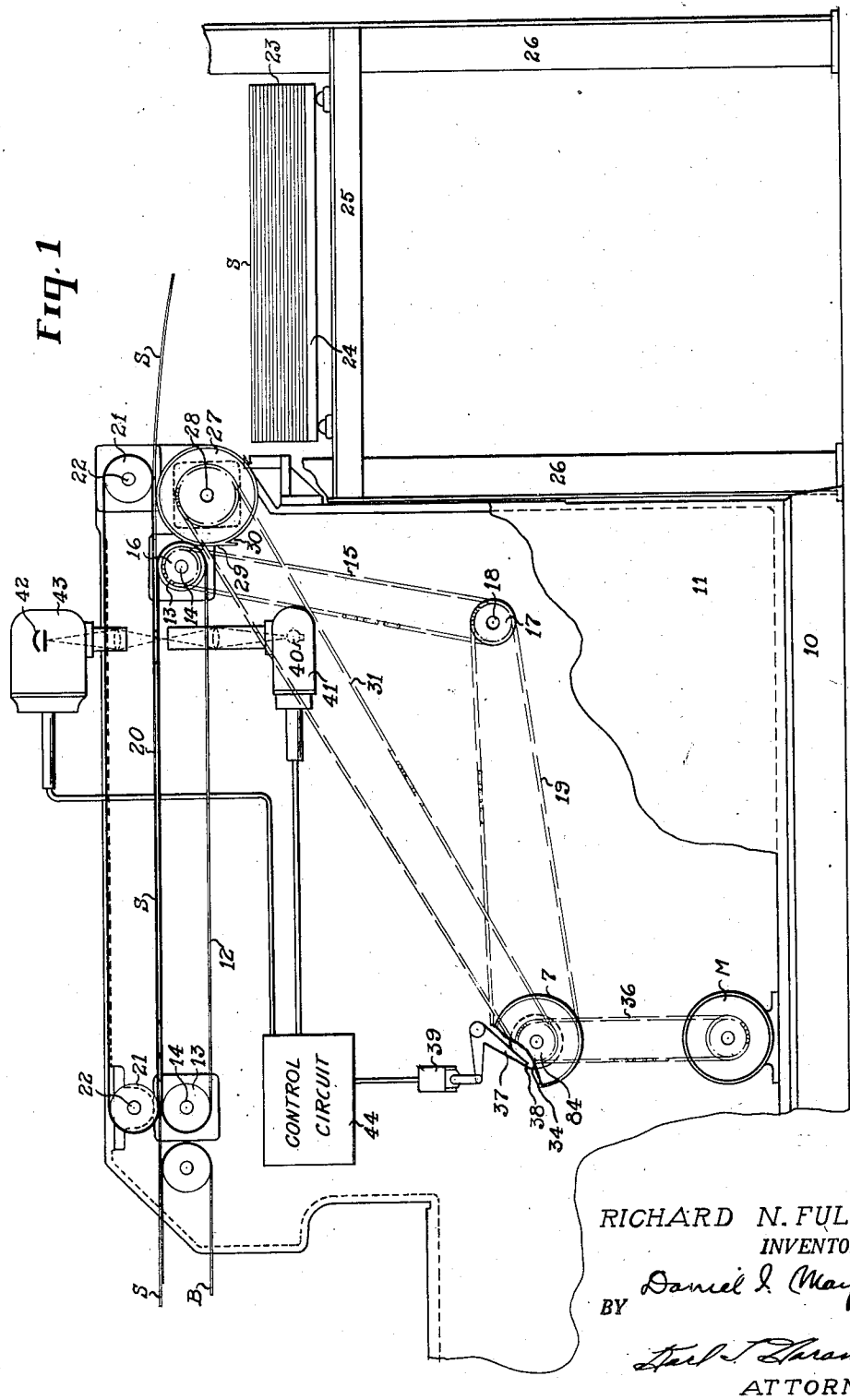
Aug. 18, 1953 R. N. FULLER 2,649,303

SHEET-FEEDING AND TURNING APPARATUS

Filed Oct. 17, 1951 4 Sheets-Sheet 1

Fig. 1



RICHARD N. FULLER
INVENTOR.
BY Daniel L. Mayne
Earl T. Thompson
ATTORNEYS

Aug. 18, 1953 R. N. FULLER 2,649,303

SHEET-FEEDING AND TURNING APPARATUS

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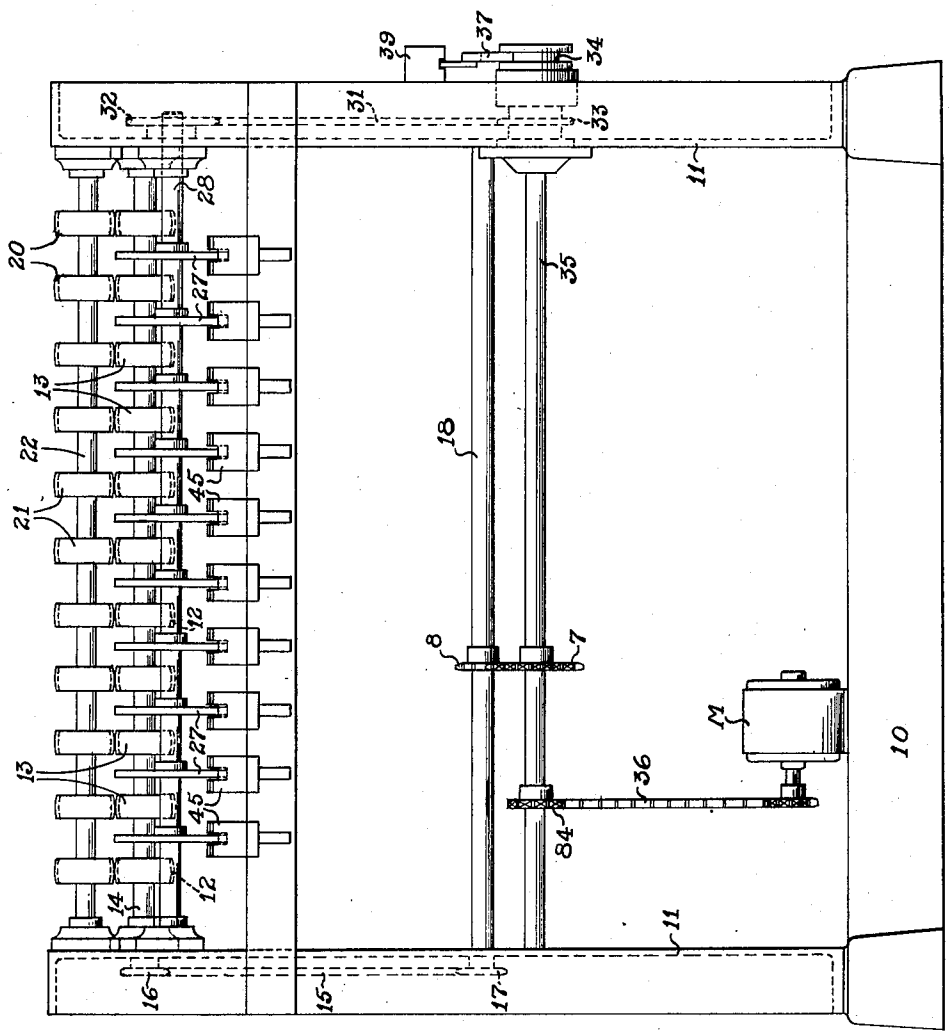


Fig. 2

RICHARD N. FULLER
INVENTOR.

BY Daniel & Mayne

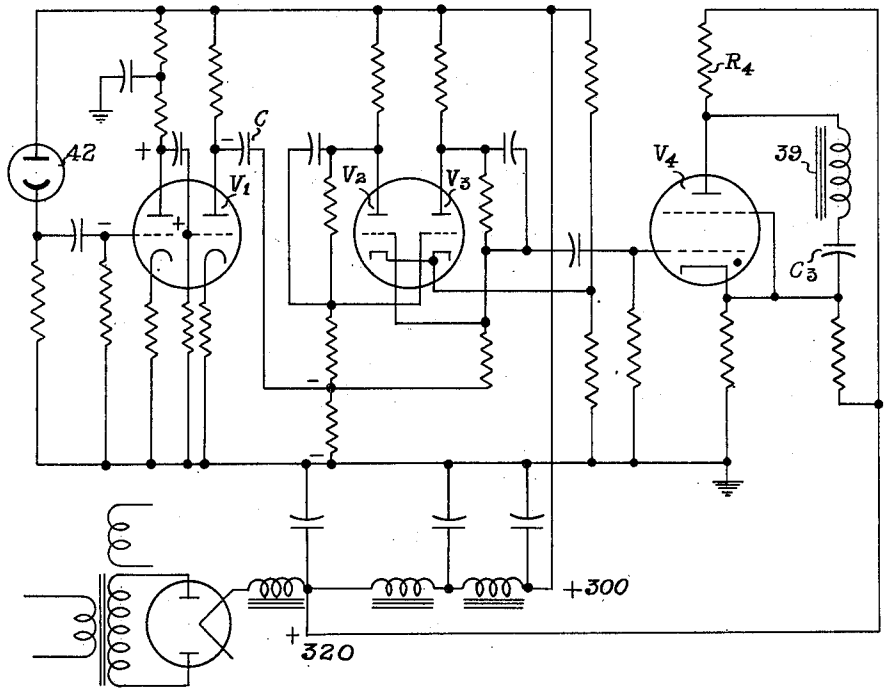
Clark T. Baramore
ATTORNEYS

Aug. 18, 1953 R. N. FULLER 2,649,303

SHEET-FEEDING AND TURNING APPARATUS

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Fig. 5



RICHARD N. FULLER
INVENTOR.

BY Daniel D. Mayne

Kirkpatrick Harmon
ATTORNEYS

Aug. 18, 1953 R. N. FULLER 2,649,303

SHEET-FEEDING AND TURNING APPARATUS

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Fig. 3

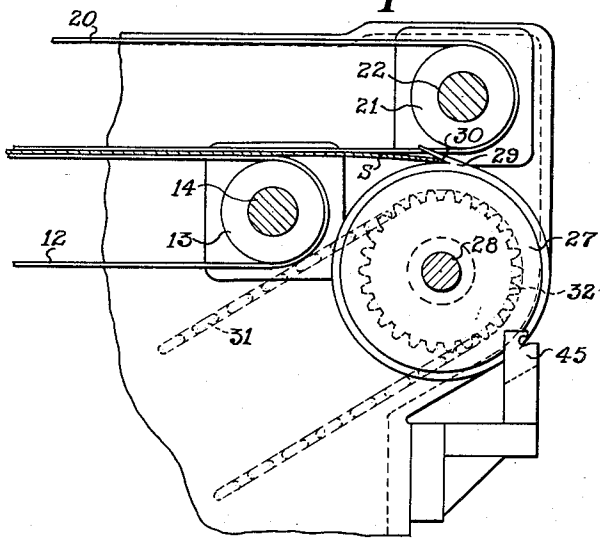
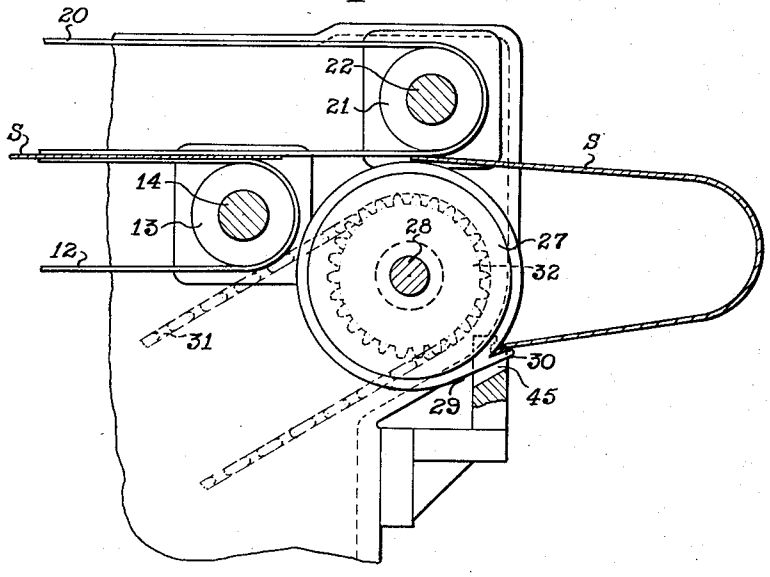


Fig. 4



RICHARD N. FULLER
INVENTOR.
BY Daniel L. Mayne
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,649,303

SHEET-FEEDING AND TURNING APPARATUS

Richard N. Fuller, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey

Application October 17, 1951, Serial No. 251,697

8 Claims. (Cl. 271—65)

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This invention relates to sheet-feeding apparatus, and particularly to an apparatus for feeding sheets individually along a given path to a discharge point where they are stacked and including means for automatically turning over selected sheets as they reach the discharge point in order to cause the natural curl of adjacent sheets to offset each other.

In certain enterprises using individual cut sheets of paper or other flexible material, it is essential that the sheets be flat rather than curled. One enterprise in which curled sheets are particularly troublesome is the photographic finishing business where cut sheets of film and light-sensitive paper are used and must generally be held flat in a focal plane for exposure and should be flat to facilitate certain processing procedures to which the sheets are subjected. Cut sheets of photographic materials are particularly subject to curling tendencies because they are coated on one side with light-sensitive coatings which have different stretch or shrinkage characteristics than the base of the sheet.

In order to present a package of flat sheets of paper to the customer, at the present time it is the practice to turn over alternate sheets in the package so that the curling tendency of adjacent sheets will offset each other. This not only requires the attention of an operator, but is such a tedious procedure that an operator cannot be relied upon to carry it out properly for a full working day and day after day. At the same time, the full attention of an operator for this job adds a considerable item to the cost of packaging such sheets.

The primary object of the present invention is to provide an apparatus for feeding individual cut sheets to a stacking point and which includes means for automatically turning over selected sheets as they approach the stacking position.

Another object is to provide a sheet-feeding apparatus of the type described in which the sheet-turning mechanism is selectively set into operation through a control unit when the leading edge of the sheet passes a given point in the path of travel of the sheets in advance of the turning mechanism and which control unit can be made to turn every sheet, every other sheet, or any selected sheet as desired.

A further object is to provide a sheet-turning mechanism which is adaptable to any type of sheet-conveying means which feeds the sheets forwardly in a flatwise condition, and which positively grips the leading edge of a sheet being moved along a given path and carries said leading edge of the sheet through an arc away from said path while the trailing edge of the sheet continues to be fed along said path, and which can deposit the sheets directly in a stack without in any way damaging the sheet turned thereby.

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The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its methods of operation, together with additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings in which:

Fig. 1 is a side elevation of a sheet-feeding and stacking apparatus constructed in accordance with a preferred embodiment of the present invention and having a portion of the side supporting frames broken away so as to show the parts of the feeding apparatus and their drives in full lines instead of dotted lines;

Fig. 2 is an end view of the feeding and stacking apparatus shown in Fig. 1 and looking from the end thereof at which the sheets are stacked;

Fig. 3 is an enlarged elevational detail of the sheet-turning mechanism and showing the same in an operative position where it is just engaging the leading edge of an advancing sheet;

Fig. 4 is a view similar to Fig. 3, but showing the sheet-turning mechanism advanced to a position where the leading edge of a sheet has been moved out of the feeding path and has engaged the sheet stops to release it from the turning mechanism; and

Fig. 5 is a wiring diagram of one form of electrical control circuit which may be used for selectively energizing the clutch of the turning mechanism.

According to the invention, cut sheets are individually advanced along a given path in a flatwise condition to a discharge point where they may be stacked or otherwise disposed of. Adjacent the discharge point in said path there is located a selectively-operated sheet-turning mechanism which is adapted to turn over selected ones of the advancing sheets as they pass the discharge point. This sheet-turning mechanism comprises a sheet pick-up member which is adapted to be moved from a normal inoperative position, wherein it merely serves to guide said sheets along said path, to an operative position, wherein it grips the leading edge of an advancing sheet. In moving from this operative position back to its normal inoperative position, the pick-up member carries the leading edge of the sheet in

an arc away from the path of the sheet-conveying means while the conveying means continues to advance the trailing edge of the sheet along said path. When the trailing edge of the sheet is just about to leave the conveying means, the leading edge of the sheet engages means which release it from the pick-up member so that the sheet is free to flip or turn over by the action of gravity and land on a plane below that of the path defined by said conveying means. The sheet pick-up member is set into motion by a single revolution clutch which is actuated by a solenoid whose energization is controlled in response to a signal received by a control circuit upon the leading edge of a sheet passing a given detector station in said path in advance of the pick-up member. Means are also provided whereby the control circuit can be made to by-pass only the signal created by every second sheet passing the detector station, thus passing alternate sheets straight through the discharge point and turning alternate sheets.

Referring now to the drawings wherein a preferred embodiment of the present invention is shown, the sheet-feeding and turning apparatus is supported by a framework comprising a horizontal base 10 from which a pair of vertical side frames 11 extend in spaced relation to serve both as supports for the sheet-conveying mechanism and its drives as well as serving as covers for this mechanism. The sheets S of flexible material, such as paper, to be handled by this apparatus are moved along by a plurality of narrow endless horizontal conveyor belts 12 supported on rolls 13 fixed to shafts 14 extending between the side frames 11. One of the shafts 14 is driven by a chain 15 engaging a sprocket 16 on the end of one of the shafts 14 and a sprocket 17 on the end of another shaft 18 extending between the side frames 11 in parallel relation to shafts 14. This latter shaft 18 is, in turn, driven through a chain or belt 19 and sprockets 7 and 8, sprocket 7 being fixed to shaft 35 extending between the side frames 11 and being continuously driven by a motor M through chain 36 engaging a sprocket 84 fixed to shaft 35, see Fig. 1. Although, as shown, the sheet conveyor is made up of eleven narrow belts, see Figs. 2, it will be understood that a less number of belts, even a single belt, could be used. The sheets S can come from any source, the only requirement being that they be placed on belts 12 flatwise and in spaced relation. One representative source of such sheets might be a chopper which intermittently chops a continuous web of paper into sheets of a given length and drops the sheets directly on belts 12 or onto another conveyor belt which feeds them onto belts 12. In Fig. 1, I have shown my feeding apparatus associated with such a belt B which feeds the sheets from a chopper to the belts 12.

The sheets S are held flat on the lower conveyor belts 12 by means of upper conveyor belts 20 corresponding in width and number to belts 12 and carried on rolls 21 mounted on shafts 22 extending between the side frames in parallel relation to shafts 14. The lower reach of the upper conveyor belts may directly contact the upper reach of the lower conveyor belts to be driven by frictional contact if the rolls 13 are fixed to shafts 22 and said shafts are mounted in bearings for free rotation as indicated. On the other hand, the rolls 22 may have their own drive, if desired, in which case the speed of movement of the two belts should be the same. These conveyor belts feed the sheets S to a discharge point where they are deposited in a stack indicated at 23 on a suitable pallet 24 supported by a shelf 25 supported on pillars 26.

If only the conveyor belts were used, the sheets S would all be discharged onto the stack with the same side up as was up during movement to the stack. In order to present a package of flat sheets, the apparatus is provided with means for automatically turning every other sheet as it is deposited on the stack so that the curling tendencies which the sheets might possess will act to counteract one another.

To this end the apparatus is provided with a sheet-turning mechanism comprising sheet pick-up members in the form of rolls 27 fixed to a shaft 28 extending between, and journalled in, the side frames 11 at the discharge point of the conveyor belts. In the arrangement shown, there is a pick-up roll 27 located between each pair of conveyor belts 12 and, while the major portion of the peripheries of these rolls is circular, there is a raised portion 29 on the periphery of each roll provided with a notch 30 into which the leading edge of a sheet S is adapted to be fed when the pick-up rolls 27 are in an operative position, as shown in Fig. 3, wherein the raised portion 29 of the rolls extends into the path of the sheets S carried by the conveyor belts 12 and notch 30 is in a position to accept the leading edge of the sheets.

The drive for the pick-up rolls 27 comprises a chain 31 engaging a sprocket 32 fixed to shaft 28 and a sprocket 33 connected to the driven member of a single revolution clutch 34 which is in turn frictionally connected to said shaft 35 which is continuously driven through a chain or belt 36 and sprocket 84 from motor M. The drive to the pick-up rolls is interrupted when a pivoted pawl 37 engages a single-tooth ratchet 38 on the driven member of the clutch, and is started when pawl 37 is retracted from engagement with the ratchet. The pawl 37 is retracted from engagement with the ratchet. The pawl 37 is normally moved to its operative position by a spring, and is momentarily withdrawn from this position by energization of a solenoid 39. The pawl 37 normally disengages the clutch to stop the pick-up rolls 27 when the notches 30 therein are out of the path of the sheets S and in the position shown in Fig. 1. In this position of the rolls 27 their periphery lies substantially tangent to the plane of the upper reach of the lower conveyor belts and constitutes a guide surface for the sheets moving to the stack without being turned. The upper conveyor belts 20 preferably extend beyond the lower conveyor belts 12 and over the pick-up rolls 27 so as to hold the sheets, which are to be turned, flat as they approach the notches 30 in the pick-up rolls and to guide those sheets not being turned into contact with the periphery of the pick-up rolls and thus direct the sheets properly onto the stack.

A beam of light is directed across the path of the sheets from a lamp 40 contained in a lamp house 41 located below and between two of the lower conveyor belts 12. This beam of light is picked up by a photocell 42 contained in a housing 43 disposed above and between the same two conveyor belts that the lamp house is located between. Suitable lenses are placed in the lamp house and photocell housing to focus the light to a narrow beam at the path of the sheets. The photocell is connected into a suit-

able electric control circuit indicated by a box **44** in Fig. 1 which, in turn, controls the energization of solenoid **39**. Thus, when the leading edge of the cut sheets intercepts the light beam, the solenoid is energized, thus tripping the single revolution clutch and setting the sheet pick-up rolls **27** into motion.

The photocell scanning system is so spaced from the discharge point of the conveyor system that by the time the leading edge of a sheet which tripped the solenoid reaches the discharge point, the pick-up rolls **27** have moved to the position shown in Fig. 3 wherein the notches **30** therein are in a position to receive the leading edge of said sheet. The linear speed of the pick-up rolls **27** is slightly less than that of the conveyor belts so that the leading edge of a sheet is caused to be fed into, and held in, the notches **30** in the rolls. Rotation of the pick-up rolls forms the sheet around its periphery, thus carrying the leading edge of the sheet downwardly and away from the path formed by the conveyor belts while, at the same time, the trailing edge of the sheet continues to be fed along in a horizontal direction. As the leading edge of the sheet reaches a point substantially orthogonal to the horizontal sheet path, and at just about the time the trailing edge of the sheet leaves the discharge point, the leading edge of the sheet engages, and is stopped by, fixed sheet stops **45** extending across the periphery of the pick-up rolls on either side thereof. With the leading edge of the sheet stopped and disengaged from the notches **30** at this point, while the conveyor belts continue to feed the trailing edge of the same, the sheet is flipped over onto the stack as indicated in Fig. 4. The pick-up rolls **27** continue to rotate to their inoperative position where pawl **37** reengages ratchet tooth **38** to disconnect the clutch **34**.

All sheets may be turned over in this manner if desired. However, in the present instance where the primary object is to present a package of flat sheets, and to do this by making the curl tendency of one sheet to counteract that of another, it is desirable to turn alternate sheets as they are stacked. To do this, a switch can be installed into the control box to by-pass the impulse created by alternate sheets cutting the light beam, thus passing the alternate sheets straight through to the stack while the pick-up rolls **27** remain at rest. While any number of different control circuits may be used to selectively energize the solenoid **39** upon the leading edge of alternate sheets passing the light beam within the scope of the present invention, I have schematically shown, in Fig. 5, one circuit which will accomplish the desired result. This circuit is essentially an electronic counting and switching circuit including the well-known Eccles-Jordan trigger circuit that can be flipped from one stable state to the other by one pulse and back to its original stable state by a second pulse. The trigger circuit or counterstage is arranged so that it passes on one pulse for each two that it receives. In the present instance, the operating negative pulses come from the photocell **42** when it becomes dark, said pulses being passed through a two-stage amplifier tube prior to reaching the trigger circuit. The alternate pulses passed by the trigger circuit are fed to the grid of a thyratron to cause the same to fire and, when the thyratron fires, the solenoid **39** is momentarily energized when a condenser discharges through the thyratron and acts to cut the tube off. This produces a momentary energization of the solenoid **39** every second time the photocell becomes dark and, accordingly, trips the clutch **34** each time alternate sheets pass the scanning station so as to turn each alternate sheet. By adding more Eccles-Jordan trigger circuits to increase the chain of counterstages of the control circuit, the number of sheets passed without turning can be readily altered. By the same token, if the Eccles-Jordan trigger circuit is removed from the control circuit and the output of the amplifier is directly connected to the grid of the thyratron, then the solenoid will operate on every pulse received and every sheet will be turned.

To elaborate more on the control circuit and its operation, the phototube **42** is coupled to the first stage of a two-stage amplifier tube V_1 by a resistance-capacitance coupling so that, as the photocell becomes dark, a negative pulse is applied to the grid of the first stage of tube V_1 as indicated by the polarity signs in Fig. 5. This causes the plate of the first stage of tube V_1 to become positive and the plate of the second stage to become negative. The negative voltage pulse from the second stage of the amplifier tube V_1 is used to switch the Eccles-Jordan trigger circuit consisting of tubes V_2 and V_3, here shown as contained within a single envelope, by being applied to the control grids of these tubes through capacitor C. As is well known, the Eccles-Jordan circuit is a two-stability trigger circuit wherein in each stable state one tube is conducting while the other is cut off. This circuit can be flipped from one stable state to the other by one negative voltage pulse received from the amplifier and back to its original stable state by a second pulse. Therefore, since the trigger circuit only passes on one pulse for each two that it receives, the output thereof can be used to trip the solenoid **39** in response to alternate sheets passing the scanning point. The output of the trigger circuit is connected to the grid of the thyratron V_4 so that the pulses passed thereby will fire this tube. The coil of solenoid **39** is connected in series with a capacitor C_3 across the line in parallel with the plate and cathode of the thyratron so that, when the tube V_4 is cut off, the capacitor will be charged to the voltage across the line, 320 v. in the instance shown. The resistance R_4 is chosen of such value that, during charging of the capacitor C_3, sufficient current will not flow through the coil of solenoid **39** to pull it in. Now, when the thyratron fires, a conductive path is provided for discharge of the capacitor C_3 in the direction from the plate to the cathode. This discharge of the capacitor not only energizes the coil of solenoid **39** to release clutch **34** but almost immediately cuts off tube V_4, thereby allowing pawl **37** to return to its clutch-disengaging position and setting the control circuit up for subsequent operation in response to the next alternate sheet passing the photocell. In the event that sheets are being stacked which may be coated on one side, and thus require that the first sheet placed in the stack be fed straight through and not turned, a reset button, not shown, may be placed in the trigger circuit to insure that the first sheet passing through the apparatus upon start-up will or will not be turned, as desired.

It will be understood that, while I have shown the apparatus with a photocell scanning system and an electronic counter and switching control responsive thereto to turn certain sheets, the

present invention is not limited to the use of such means. For instance, the passage of the leading edge of the sheets past a certain point in their path could just as well be detected by other means, i. e., a feeler finger operating a microswitch, and a control circuit for energizing the solenoid 39 in response to certain sheets passing the selected point in the sheet path could be a system of interconnected relays. The advantage of the photocell scanning and electronic control unit is that they are rapid in response and will allow a rapid sheet feed to be used.

While I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be limited to the precise details of construction shown and described, but is intended to cover all modifications coming within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a sheet-feeding and stacking mechanism the combination with means for conveying individual flexible sheets separately and in a flatwise condition along a given path to a discharge point, of a sheet pick-up roll mounted at said discharge point and having a sheet-engaging portion adapted to receive and confine the leading edge of a sheet moving along said path, means for rotatably mounting said pick-up roll to rotate in the direction of feed of the sheets from a normal inoperative position, wherein its sheet-engaging portion is removed from the path of said sheets and through an operative position wherein the sheet-engaging portion is in the path of said sheets to receive and confine the leading edge of the sheet approaching said discharge point after which rotation of said roll carries said leading edge away from the path of said conveying means at a slower rate than that at which the conveying means advances the trailing edge of said sheet and while the conveying means continues to move the trailing edge of the sheet along said path to continually force the leading edge of the sheet into confining relation with said sheet-engaging portion, means for selectively driving said pick-up roll one revolution at a time at said specified rate from its normal position, through said operative position, and back to said normal position, means responsive to the leading edge of a given sheet approaching said discharge point for instigating the drive for said pick-up roll, and means for engaging the leading edge of said sheet to disengage it from said sheet-engaging portion of said pick-up roll when the leading edge is displaced sufficiently from said path to cause the sheet to be turned over as the result of the continued feeding of the trailing edge along said path.

2. In a sheet-feeding and stacking apparatus the combination with means for conveying individual flexible sheets separately and in a flatwise condition along a given path to a discharge point above the plane in which the sheets are to be stacked, a sheet pick-up roll having a raised portion on its periphery provided with a sheet-engaging notch, means for rotatably mounting said pick-up roll adjacent said discharge point so that its periphery lies substantially in the path of said sheets while said sheet-engaging notch is adapted to interrupt said path, means for rotating said roll in the direction of movement of said sheets with the open end of said notch trailing and directed toward the advancing sheets, means normally holding said roll in an inoperative position with its sheet-engaging notch removed from said path and for limiting said roll to a single revolution, means actuated by the leading edge of a sheet passing a given point in said path for releasing the holding means for said roll whereby said roll rotates to move said sheet-engaging notch into said path to receive and grip the leading edge of said sheet and carry it away from said path while the trailing edge of said sheet is moved along said path by said conveying means, and a stop member adapted to engage the leading edge of said sheet gripped by said roll to disengage it from said notch as the same reaches a point sufficiently displaced from said path to cause the sheet to be turned over as the result of continued movement of the trailing edge along said path.

3. A sheet-feeding and stacking apparatus according to claim 2, characterized by the fact that the peripheral speed of the pick-up roll is less than the linear speed of the sheet-conveying means at said discharge point whereby said conveying means serves to feed said sheets into gripping relation with the notch in said pick-up roll and acts to feed the trailing edge of said sheets along said path faster than the leading edge is directed away from said path by said pick-up roll.

4. In a sheet-feeding and stacking apparatus the combination with means for conveying individual flexible sheets separately and in a flatwise condition along a given path to a discharge point above the plane in which the sheets are to be stacked, a sheet pick-up roll having a raised portion on its periphery provided with a sheet-engaging notch, means for rotatably mounting said pick-up roll adjacent said discharge point so that its periphery lies substantially in the path of said sheets while said sheet-engaging notch is adapted to intercept said path, means for rotating said roll in the direction of movement of said sheets with the open end of said notch trailing and directed toward the advancing sheets to grip the leading end of a sheet and carry it on its periphery away from said path, said means including a tendency drive and a single revolution clutch between said roll and drive adapted to disconnect said roll from the drive in an inoperative position where the sheet-engaging notch is removed from said path, means responsive to the leading edge of a sheet passing a given point in said path for actuating said clutch to connect said roll to said drive, and a stationary paper stop adjacent said roll and intersecting the circular plane defined by the periphery thereof to be engaged by the edge of the sheet carried by said roll and disengage the edge from said notch, said sheet stop positioned at a point sufficiently removed from said path that when the leading edge of a sheet is removed from said notch the trailing edge of the sheet has been fed to the discharge point by said conveying means so that the sheet is turned over when deposited on the stack.

5. A sheet-feeding and stacking apparatus according to claim 4 characterized by the fact that the linear speed of the sheet-conveying means is faster than the linear speed of the periphery of the pick-up roll whereby said conveying means acts to force the leading edge of a sheet into the bottom of the notch on the roll when the latter is in the path of the sheets and the trailing edge of the sheet gripped by said notch reaches

the discharge point of said conveying means at substantially the same time the leading edge of the sheet engaging said paper stop and is removed by the notch thereby.

6. In a sheet-feeding and stacking apparatus the combination with means for conveying individual flexible sheets separately and in a flatwise condition along a given path to a discharge point above the plane in which the sheets are to be stacked and comprising an endless horizontally arranged feed belt on the upper reach of which the sheets are adapted to be placed flatwise, means for advancing said belt at a given linear speed, a second endless guiding belt horizontally arranged above said feed belt with its lower reach substantially in contact with the upper reach of said feed belt for holding said sheets flat on said feed belt, means for feeding said guide belt in the same direction and at the same linear speed as said feed belt, a generally circular sheet pick-up roll rotatably mounted beyond the end of said feed belt so that the circular portion of its periphery is substantially tangent to the horizontal plane of upper reach of said feed belt, a raised portion on the periphery of said roller provided with a sheet-engaging notch, the open end of which is adapted to lie in the path of and receive the leading end of a sheet advanced by said belt when the roller is in an operative position, means for rotating said roller in the same direction as the movement of said sheets to move the notch into a sheet-engaging position and then carrying the leading end of the sheet downwardly and away from said given path, said last-mentioned means including a single revolution clutch acting to normally hold the pick-up roll in an inoperative position and upon actuation allowing the roll a single revolution through its operative position and back to its inoperative position, means responsive to the leading edge of a sheet passing a given point in said path for actuating said clutch to set said roll in motion, and a stationary sheet stop lying adjacent and intercepting the plane defined by the periphery of said roll for engaging and removing the leading edge of the sheet from the notch in said roll at substantially the instant the trailing edge of said sheet leaves the end of said conveying means.

7. A sheet-feeding and stacking apparatus according to claim 6, characterized by the fact that said means responsive to the leading edge of said sheet passing a given point in said path for actuating said clutch includes a solenoid which actuates the clutch when energized, means for directing a light beam across the path of said sheets, a photocell on the other side of said path for picking up said light beam, and means electrically connected with said photocell for momentarily connecting said solenoid to a power source when said light beam is cut off from said photocell.

8. A sheet-feeding and stacking apparatus according to claim 6, characterized by the fact that the drives for the feed belt and pick-up roll have a relation such that the linear speed of the feed belt is faster than the linear speed of the roll whereby the feed belt will force the leading edge of a sheet into said notch in the roll and the trailing edge of a sheet gripped by said roll will be fed along said path faster than the leading edge is drawn therefrom to effect the desired turnover of the sheet.

RICHARD N. FULLER.

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