

April 30, 1957

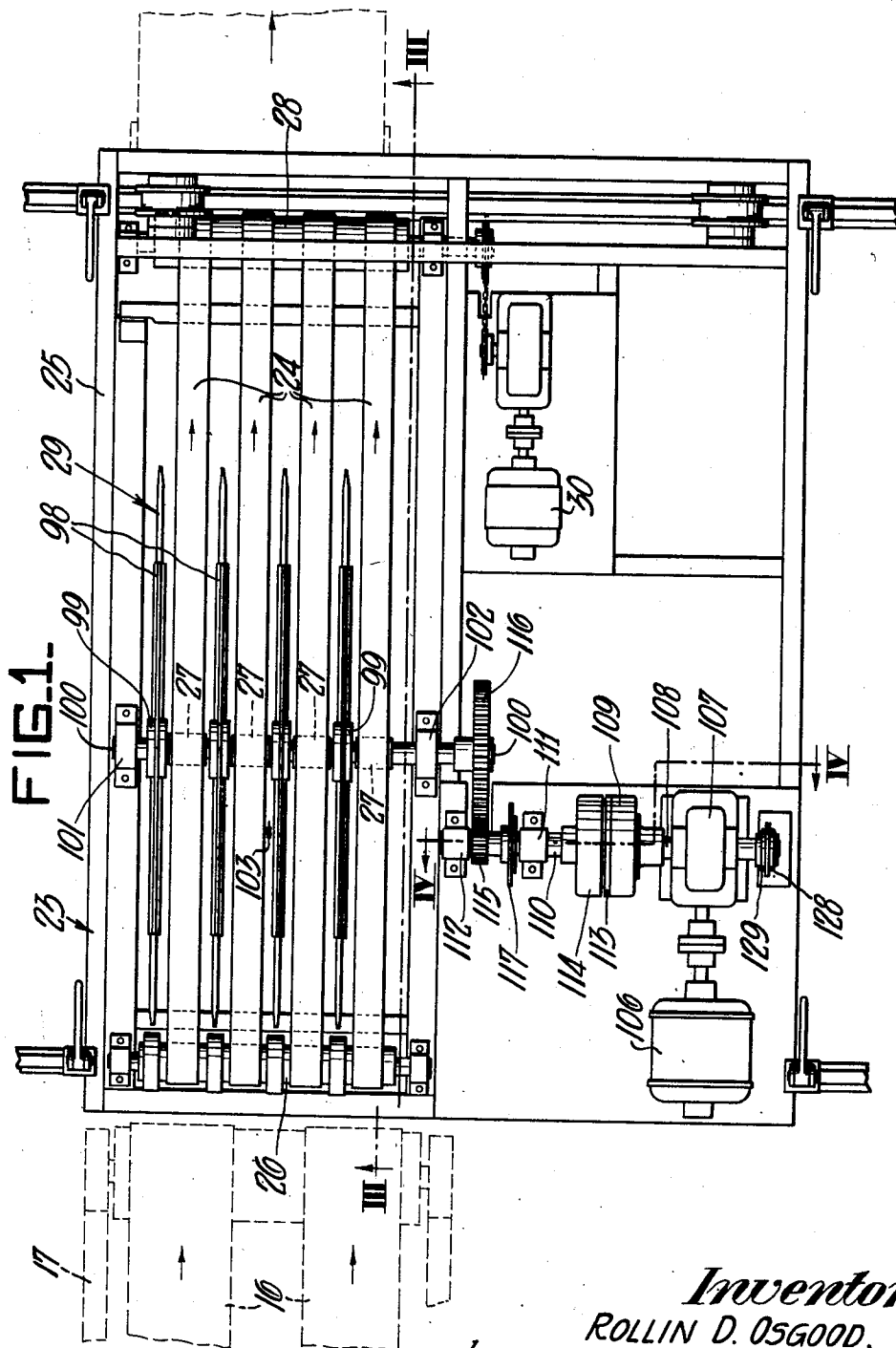
R. D. OSGOOD

2,790,533

SHEET INSPECTION APPARATUS

Original Filed Dec. 3, 1947

4 Sheets-Sheet 1



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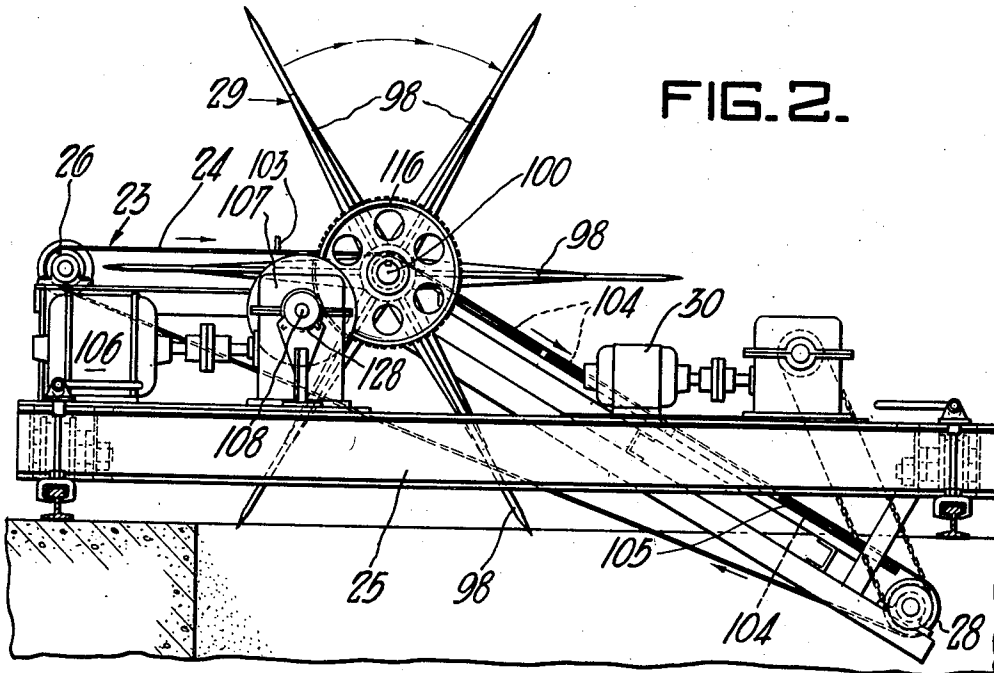
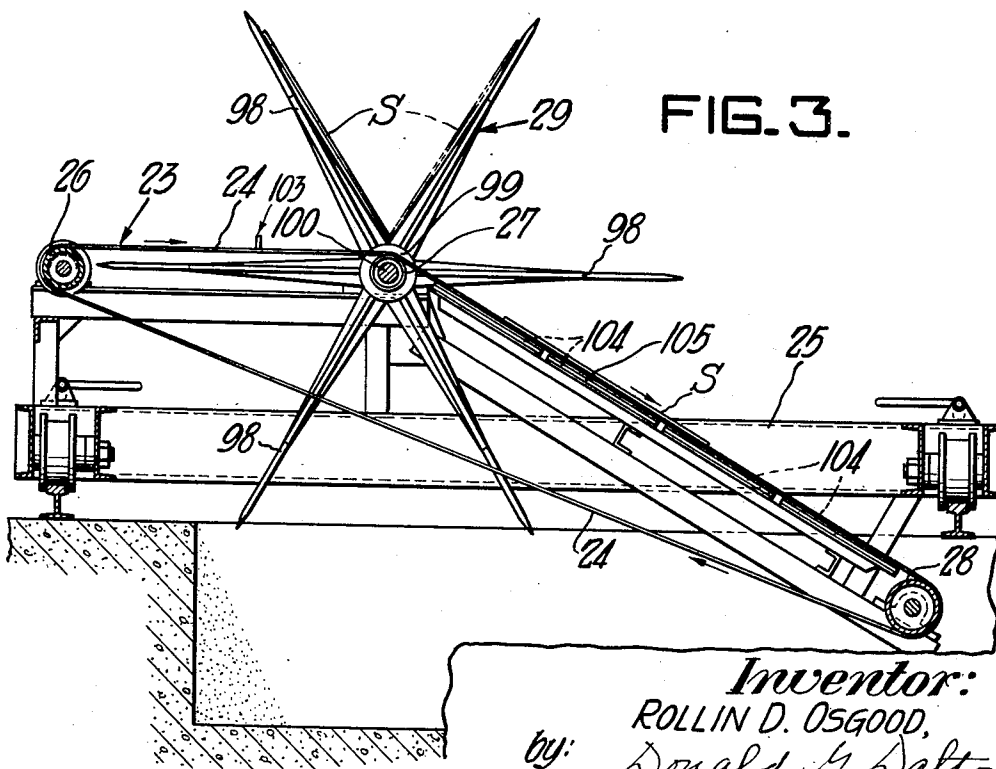
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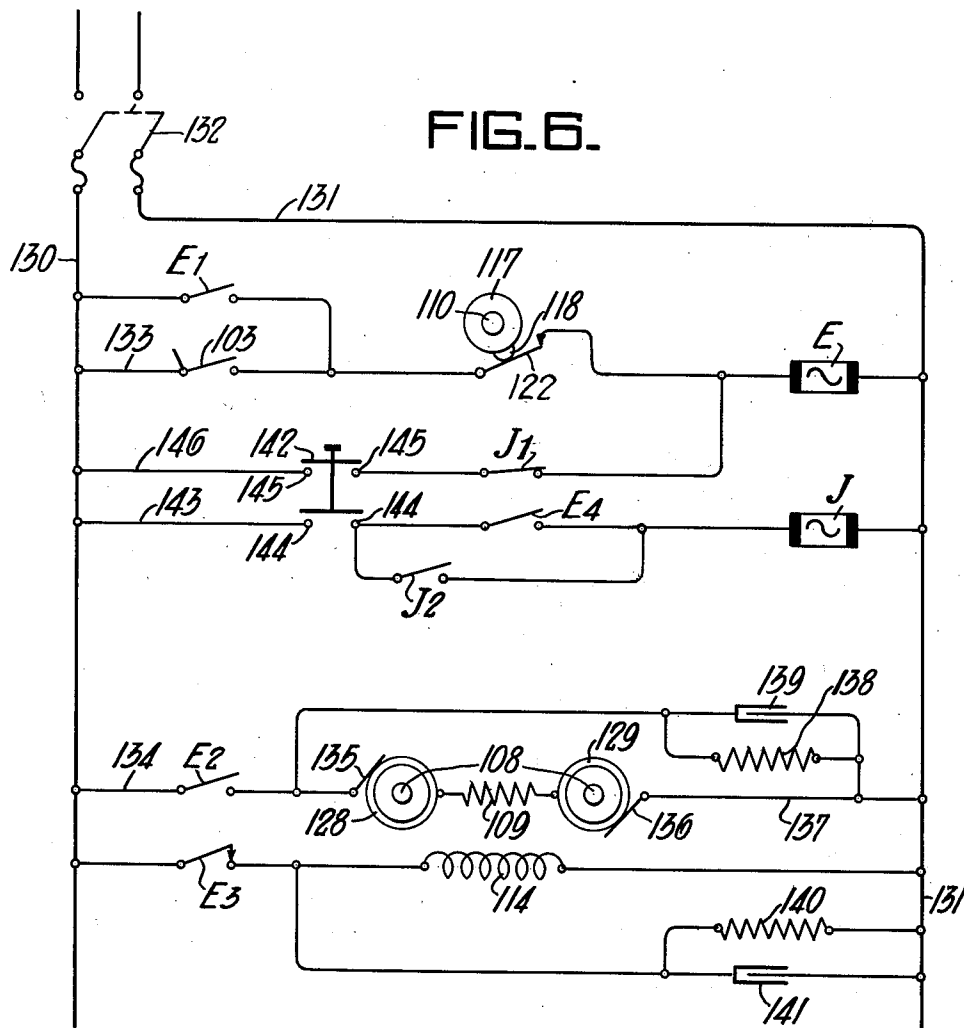
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SHEET INSPECTION APPARATUS

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4 Sheets-Sheet 4



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1

2,790,533

SHEET INSPECTION APPARATUS

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Original application December 3, 1947, Serial No. 789,403. Divided and this application February 16, 1951, Serial No. 211,283

4 Claims. (Cl. 198—33)

This invention relates to improved apparatus for facilitating visual and digital inspection of sheets, such as in metal plating lines.

The present application is a division of my earlier application Serial No. 789,403, filed December 3, 1947, and assigned to the same assignee, which application issued as Patent No. 2,564,027, August 14, 1951. My earlier application relates to an apparatus and method for handling and assorting metal sheets after plating, such as in a hot-dip tinning line. The sheets emerge from the plating equipment in two parallel rows and the trailing or list edge of each sheet is slightly thicker than the leading edge. A turntable lifts each sheet out of one row, turns it around, and deposits it in a space between two sheets in the other row. Thus there is formed a single consolidated row of sheets in which the list edge of each sheet is reversed from that of the sheet next to it so that the sheets can be piled evenly. The apparatus of the present invention is particularly suited for inspecting the sheets in the consolidated double row, although obviously its use is not thus limited.

An object of the present invention is to provide improved inspection apparatus which momentarily arrests movement of each sheet in a moving row and presents the sheet for visual and digital inspection.

A further object of the invention is to provide improved inspection apparatus which comprises a wheel having radial spokes adapted to receive sheets singly from a conveyor, and means to rotate the wheel through a limited arc as each sheet is fed thereto so that the wheel presents the sheet for convenient inspection and also discharges previously inspected sheets to another conveyor.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, a preferred form of which is shown in the accompanying drawings, in which:

Figure 1 is a top plan view of an improved inspection apparatus which embodies features of the present invention;

Figure 2 is a side elevational view of the inspection apparatus;

Figures 3 and 4 are vertical sectional views of the apparatus taken substantially on lines III—III and IV—IV respectively of Figure 1;

Figure 5 is a vertical sectional view taken substantially on line V—V of Figure 4; and

Figure 6 is a schematic wiring diagram.

Figure 1 shows a belt conveyor 16 which is supported on a frame 17. This conveyor introduces sheets to a second conveyor 23, which is formed of a series of transversely spaced parallel belts 24. Said belts are supported on a frame 25, which has rearward rollers 26, intermediate rollers 27 and forward rollers 28 over which the belts pass. The axis of the intermediate rollers 27 coincides with the axis of an inspection wheel 29 hereinafter fully described. Conveyor 23 is driven continu-

2

ously by a motor 30 which is supported on frame 25 and is operatively connected with the forward rollers 28.

From conveyor 23 the sheets traverse a series of conveyors which carry them past reject gates and to a mechanical counter and piler. The gates, counter and piler are of any suitable known construction. The mechanism beyond conveyor 23 is not per se a part of the present invention; hence its construction is not shown nor described in detail.

The operator visually and digitally inspects sheets as they pass inspection wheel 29, where their travel is temporarily arrested. In the example of a hot-dip tinning line, the sheets are classed as "primes," "menders," or "waste-waste." The operator closes a switch as he detects a "mender" sheet and a different switch as he detects a "waste-waste" sheet. Closing said switches operates respective reject gates after a suitable timed interval such that a defective sheet is rejected to the proper group, while the prime sheets continue on to the prime piler. Inasmuch as time delay mechanism for operating reject gates is known and per se is not part of the present invention, such mechanism is not shown nor described in detail.

Wheel 29 comprises six sets of radial spokes 98 fixed to hubs 99, the spokes of each set being parallel with each other and spaced 60° from the adjacent set. Hubs 99 are fixed to a horizontal shaft 100 and spaced longitudinally of said shaft so that a set of spokes is positioned between each pair of belts 24 that make up conveyor 23. Intermediate the hubs, shaft 100 carries the rollers 27 over which pass belts 24 of conveyor 23. Shaft 100 is journaled in bearings 101 and 102 fixed to frame 25. This shaft has intermittent drive mechanism which is actuated by each sheet entering the wheel from the rearward or entry section of conveyor 23. Each such sheet momentarily closes a trigger switch 103 for this purpose, whereupon wheel 29 rotates through an angle of 60°. The wheel thus moves the sheet S to the position shown in full lines in Figure 3 and travel of the sheet is temporarily arrested as the wheel stops.

With the sheet so positioned, the inspector may readily examine the upper surface. The inspector then manually flips the sheet to the position shown in dot-dash lines in Figure 3 and examines the other surface. Presently the conveyor 23 carries another sheet into the wheel, whereupon the wheel rotates another 60°. On one more movement of the wheel, the inspected sheet is picked up by the forward or exit section of conveyor 23 and carried to the piler or else diverted by one of the reject gates.

The adjustment of wheel 29 is such that the wheel comes to rest following each 60° advance when the spokes in the forward and rearward positions are horizontal. As shown in Figures 2 and 3, in the position of rest the upper faces of the rearward spokes are slightly below the upper faces of the substantially horizontal entry section of conveyor 23 in order that sheets entering the wheel do not scrape across the spoke faces. Preferably the forward or exit section of conveyor 23 is downwardly inclined at an angle such that the forward section is intermediate two sets of spokes when the wheel is stopped. As the sector of the wheel containing an inspected sheet rotates past the inclined forward section, said section picks up the sheet and the spokes move cleanly away so that again there is no scraping.

Sheets deposited on the downwardly inclined conveyor section tend to slide down said section, and thus to upset timing of the reject gates. In order to prevent such sliding, magnets 104 are arranged underneath the belts of the inclined conveyor section, preferably being permanent magnets and encased in suitable fixed housings 105.

As shown in Figure 3, the intersection of adjacent sets of spokes 98 is preferably at a sharp angle and the faces of the spokes preferably form a substantially plane surface. This arrangement is desirable in order to keep the sheet flat while undergoing inspection so that it does not distort light reflections. Thus the inspector is enabled to determine more accurately whether there are imperfections in the sheet.

The inspection wheel is preferably driven through a magnetic clutch from a motor 106 which is supported on frame 25 and continuously drives a speed reducing gear 107 through a suitable coupling, Figure 1. Gears 107 continuously rotate a shaft 108, the inner extremity of which carries an annular driving magnet 109 of the magnetic clutch, Figure 4. A horizontal shaft 110, axially aligned with shaft 108, is journaled in suitable bearings 111 and 112 on frame 25 and has limited axial movement. The outer end of shaft 110 carries a clutch plate 113 adjacent the driving magnet 109. An annular braking magnet 114 is positioned adjacent plate 113 on the opposite side from said driving magnet.

Shaft 110 carries a pinion 115 which meshes with a gear 116 on shaft 100 on which hubs 99 of wheel 29 are mounted, Figure 1. Preferably the ratio of pinion 115 and gear 116 is 1 to 6 so that each whole revolution of shaft 110 rotates wheel 29 through an angle of 60°.

Shaft 110 carries a cam ring 117 which has an enlarged sector 118, Figures 4 and 5. A bracket 119 is fixed on a base 120 beneath said cam ring and supports an arcuately adjustable yoke 121. Said yoke carries a normally closed cam switch 122, which has a cam follower 123 riding against said cam ring. Switch 122 is opened momentarily as the enlarged sector 118 of the cam ring engages cam follower 123. The mechanism for adjusting the yoke 121 includes a threaded spindle 124 which is journaled in a fitting 125 that is pivoted to bracket 119, as indicated at 126. The yoke has a projecting boss 127 that has a transverse threaded bore that receives the threaded portion of spindle 124. Thus rotation of said spindle adjusts yoke 121 about the axis of shaft 110. This adjustment varies the position at which cam sector 118 opens cam switch 122 and thus controls the angular position at which wheel 29 comes to rest.

The outer extremity of shaft 108 carries slip rings 128 and 129 which conduct current to the driving magnet 109, as hereinafter explained.

The control circuit for operating the inspection wheel is shown in Figure 6. The circuit includes conductors 130 and 131 connected to a suitable outside power source. Preferably said conductors include a master switch 132 for manually opening and closing the circuit. Conductors 130 and 131 are connected through a conductor 133 that contains trigger switch 103, cam switch 122 and the coil of a relay E. Closing of trigger switch 103 energizes coil E since cam switch 122 is normally closed.

Energization of coil E closes contacts E1 which seal in coil E. Contacts E2 are also closed and complete a circuit to the driving magnet 109 via a conductor 134, a brush 135, slip ring 128, driving magnet 109, slip ring 129, a brush 136, and a conductor 137 to conductor 131. At the same time, normally closed contacts E3 open and thus interrupt the circuit to braking magnet 114. Thus shaft 110 and inspection wheel 29 are set in motion.

Continued rotation of shaft 110 moves cam 117 to a position where its enlarged sector 118 opens cam switch 122, whereupon the circuit to coil E is broken. Contacts E2 open, interrupting the circuit to the driving magnet, and contacts E3 close, completing the circuit to the braking magnet. The adjustment of yoke 121 is such that shaft 110 stops after one complete revolution, which is equivalent to $\frac{1}{6}$ of a revolution of the inspection wheel.

Preferably the driving magnet 109 is shunted by a relatively high resistance 138 and a condenser 139 and the braking magnet 114 is shunted by a similar resistance and condenser 140 and 141 respectively. The purpose

of these shunts is to prevent arcing when the circuits to the magnets are broken. This type of shunting arrangement is a known device for preventing arcing and hence is not described in detail.

Preferably a jog relay J and double pole jog push button switch 142 are provided for rotating inspection wheel 29 by manual actuation when desired. Jog relay J is connected across conductors 130 and 131 in a conductor 143. Switch 142 has a first pair of poles 144 in conductor 143 and a second pair of poles 145 in a parallel conductor 146, which also contains normally closed contacts J1.

Closing of switch 142 completes a circuit to coil E via conductor 146, poles 145 and normally closed contacts J1. Energization of coil E closes contacts E1 which seal in coil E through cam switch 122. Contacts E4 in conductor 143 thereupon close, and poles 144 of switch 142 close at the same time poles 145 close and complete a circuit through jog relay coil J. Completing this circuit closes contacts J2 which seals in coil J as long as push-button 142 is held closed. When relay coil J is energized, contacts J1 open, breaking the circuit through switch 142 and contacts J1 through coil E. When cam switch 122 opens, coil E is deenergized and opens, stopping the inspection wheel. Thus switch 142 must be opened and reclosed to operate the inspection wheel manually another notch and another spoke.

From the foregoing description it is seen that the inspection apparatus of the present invention affords a simple means for enabling an operator to inspect both sides of each sheet moving in a continuous line. The sheets are stopped just long enough to enable an operator to inspect and classify them. The only manual handling is that necessary to flip each sheet about its edge so that it rests against the opposite set of spokes.

While I have shown and described but a single embodiment of the present invention, it is apparent that modifications may arise. Therefore, I do not wish to be limited by the disclosure set forth but only by the scope of the appended claims.

I claim:

1. A sheet inspection apparatus comprising a frame, a series of transversely spaced conveyor belts movably supported on said frame and having entry and exit sections, a transverse shaft mounted on said frame below said belt between their entry and exit sections and being rotatable on an axis perpendicular to the direction of travel of said belts, a plurality of radially extending spokes carried by said shaft, said spokes being arranged in sets which are uniformly spaced around the shaft circumference with the spokes of each set parallel and having sheet supporting surfaces that occupy two common planes on opposite sides of the spokes, the sheet supporting surfaces of spokes of adjacent sets intersecting each other at an acute angle outside the shaft circumference, said spokes being situated opposite the spaces between said belts and alternating with the belts along the length of the shaft, continuous drive means for said belts, intermittent drive means for said shaft, said shaft having positions of rest in which one set of spokes extends beneath the entry section of said belts for receiving a sheet therefrom, actuating means for said intermittent drive means located in the path of sheets on said entry section, and means for stopping said shaft after it turns through a partial revolution with the spokes which previously were beneath said entry section now at an upwardly inclined angle and the succeeding set of spokes in the position previously occupied by the first.

2. An apparatus as defined in claim 1 in which said intermittent drive means includes a continuously rotatable member, an intermittently rotatable member, co-operable magnetic clutch elements carried by said members, and power transmitting mechanism connecting said intermittently rotatable member with said shaft.

3. An apparatus as defined in claim 2 in which the

5

means for stopping said shaft includes a magnetic brake cooperable with the magnetic clutch element on said intermittently rotatable member, and an operating cam on this member for disengaging said clutch elements and applying said brake after rotation of said shaft through a predetermined arc.

4. An apparatus as defined in claim 1 in which said conveyor belts are endless and their entry sections are substantially horizontal and their exit sections are downwardly inclined, and in which said frame carries rollers adjacent each end and said shaft carries rollers intermediate the spokes, said belts extending around said rollers.

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References Cited in the file of this patent

UNITED STATES PATENTS

912,764	Wintgens	Feb. 16, 1909
1,258,115	Henderson	Mar. 5, 1918
1,434,504	Schlaflly	Nov. 7, 1922
1,934,783	Arterburn	Nov. 14, 1933
1,943,530	Hoeffleur	Jan. 16, 1934
1,970,749	Heichert	Aug. 21, 1934
2,000,292	Miller	May 7, 1935
2,029,456	Zuber	Feb. 4, 1936
2,501,224	Kadell	Mar. 21, 1950