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Rapparlie

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[54] **DEVICE FOR FORMING STACKS FROM A FLOW OF CONSECUTIVELY FURNISHED FLAT ITEMS**

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[52] **U.S. Cl.**.....**198/35**, 271/57

[51] **Int. Cl.**.....**B65h 7/00**

[58] **Field of Search**.....198/35, 37; 271/57, DIG. 7; 141/153

[56] **References Cited**

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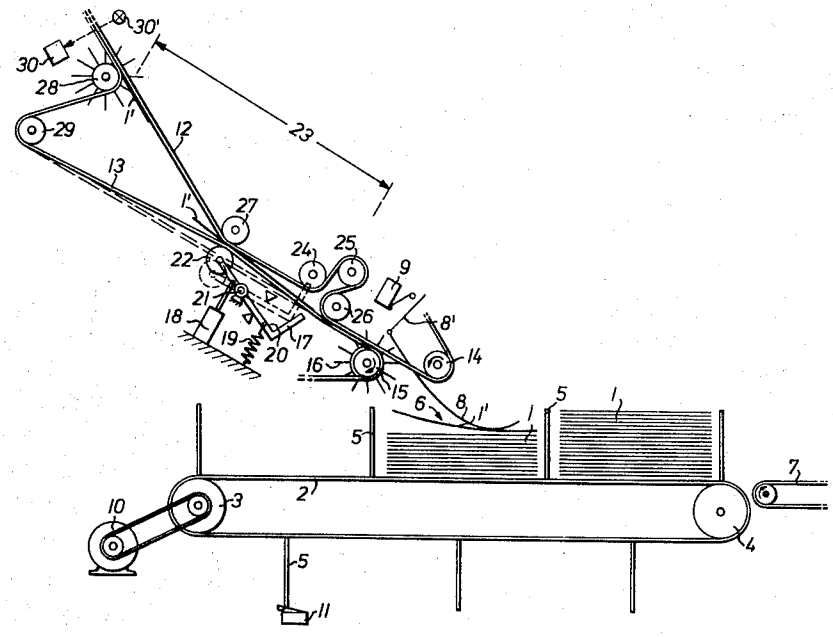
[57] **ABSTRACT**

A stacking device having a conveying system for continuously advancing individual, spaced apart flat items, such as pieces of mail, toward stacking compartments carried on a second conveying system. A monitoring and control system is associated with the second conveying system to move a stacking compartment that has been filled with stacked items away from the conveying system and move an empty compartment into a position for filling. An abutment means is disposed to be movable in response to signals from the monitoring and control system to interrupt the flow of items toward the stacking compartment during a hold time involved during the movement of empty and filled compartments. A buffer area is provided in the conveying system ahead of the interrupting abutment means in which the items are stacked during the hold time. The monitoring and control system is also effective, at the end of the hold period, to move the abutment means from an operative position to a rest position so that the conveying system accelerates the movement at the stack of items in the buffer area as a unit to the operatively positioned empty compartment.

11 Claims, 4 Drawing Figures



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SHEET 1 OF 3

FIG. 1

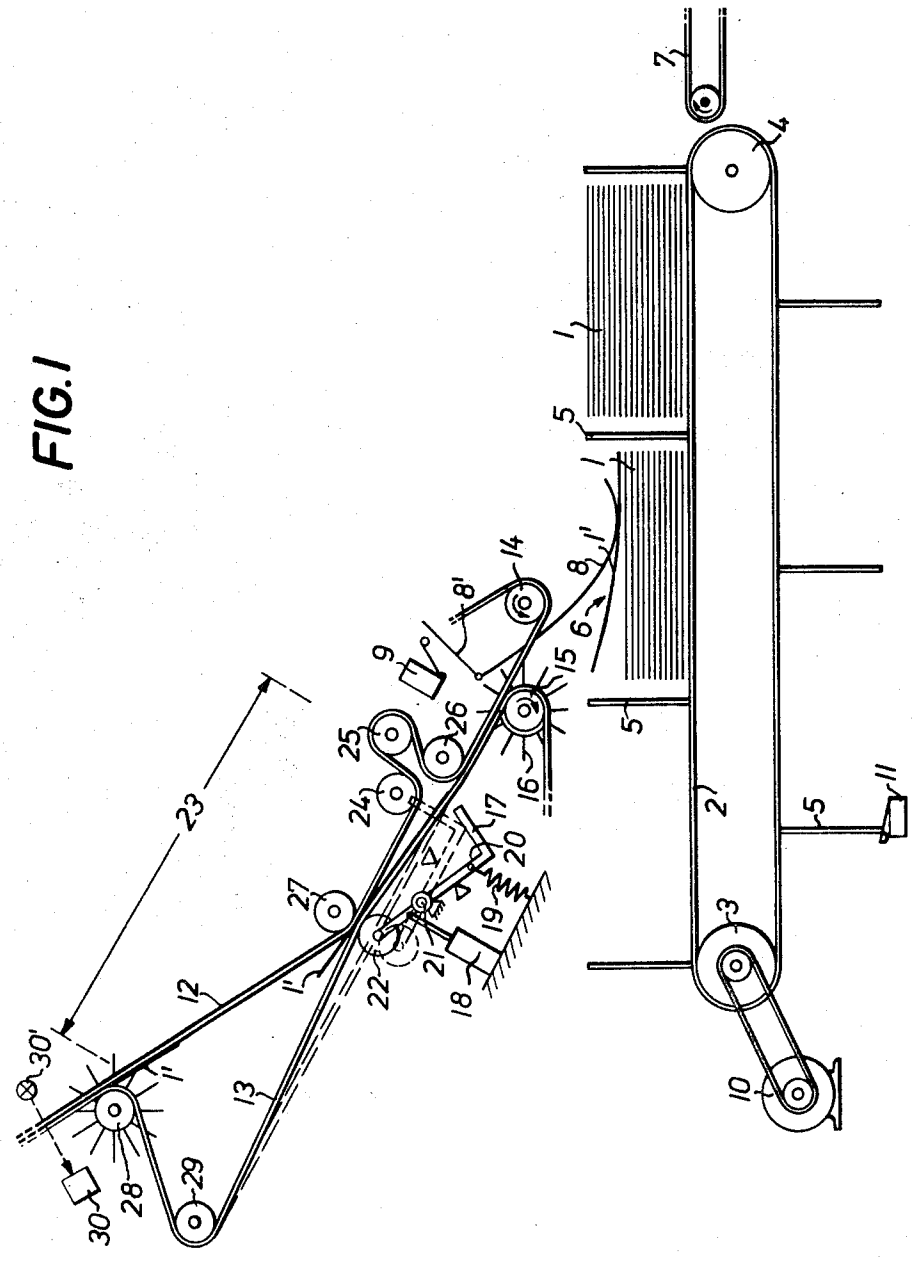

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FIG. 3

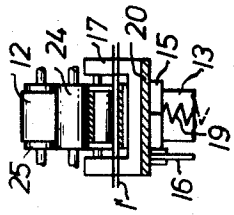

FIG. 2

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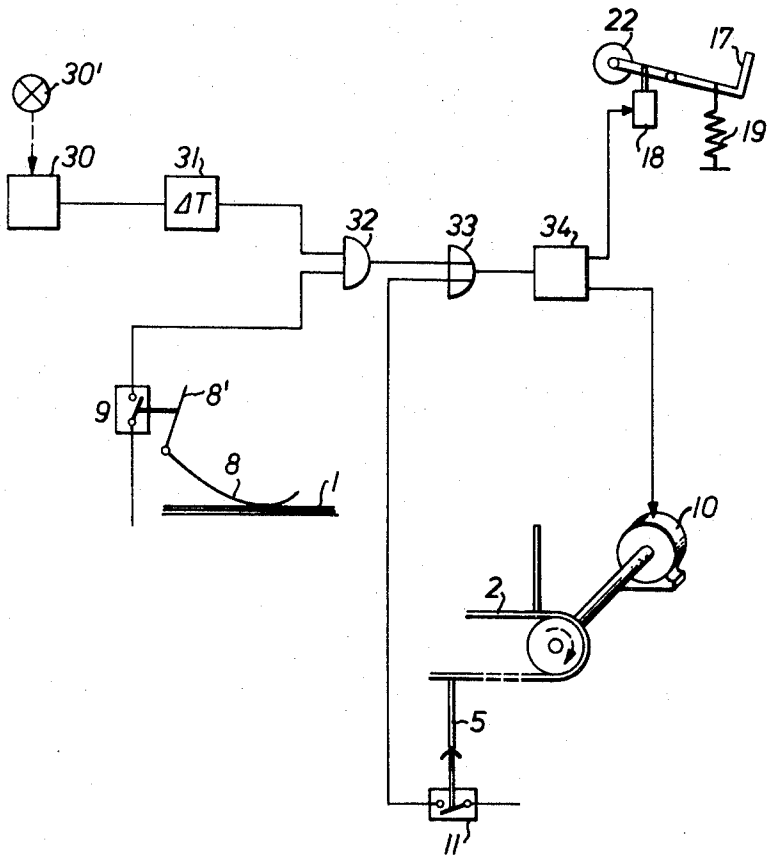
FIG. 4



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DEVICE FOR FORMING STACKS FROM A FLOW OF CONSECUTIVELY FURNISHED FLAT ITEMS

BACKGROUND OF THE INVENTION

The present invention relates to a device for forming stacks from a flow of consecutively furnished flat items, such as pieces of mail. Generally, devices now in use for performing this operation include a conveying system which automatically removes the stacks formed at a stacking point after they have reached a given thickness.

A problem arises in the use of the type of device mentioned above because the time gap between two consecutive items moving through the device generally is much smaller than the time required for removing the stack. For example, in a mail distribution system with an output of approximately six letters per second and a conveying speed of 3.6 m/s there is a spacing of the leading edges of two consecutive items which is 600 mm. With a maximum item length of 240 mm the gap between two such items is then 360 mm, corresponding to a time interval of 100 milliseconds. Because of the different slip of the items in the separator device feeding the distributor and during passage through the machine this interval may be reduced by approximately 20 percent so that the minimum time gap will be approximately 80 milliseconds. It is, however, practically impossible to remove a stack in such a short time without damaging items or disarranging the stack.

A solution for overcoming the above-mentioned difficulties is disclosed in British Pat. No. 944,866 which describes a system for forming stacks from successively fed-in layers of sheets in the production of magazines. In this case not one but two stacking points are provided on both sides of this conveying device to form the stacks which are to be removed by a conveying device. While the stack formed at the one stacking point is pushed onto the conveying device and removed, a stack is formed at the other location via a switch. The changeover of the switch occurs during a gap in the conveying stream so that it is possible to continuously form stacks without difficulties.

The above-mentioned solution could also be used to form stacks from a flow of mail items since the turnover time for the available switches is sufficiently smaller than the above-mentioned minimum possible time gap between two successive mail items. The fact that this solution requires twice the number of stacking points, however, generally constitutes a considerable drawback, particularly in connection with sorting or distributing machines. With such machines the distributing cubicles constitute a high proportion of the entire volume of the machine so that doubling their number would make the machines substantially bigger and more expensive.

German Pat. No. 1,260,384 discloses, inter alia, a solution in which automatic removal of the stacks formed at the stacking point is made possible without the need for diverting the items arriving during the removal time to another stacking location. This is accomplished in that a delaying device or interrupting means is added in the conveying path leading to the stacking location which delaying device interrupts the conveying flow of items for the duration of the removal time of the stack. In this device the items are stacked into a container and removal of the stack is accomplished by a quick relative movement between the stacking location and the container. At the same time the full stack container is moving from the stacking location it is being replaced by an empty container.

German Pat. No. 1,260,384 mentions as the delaying device a so-called pass-through separator whose output conveying member is temporarily stopped or appropriately delayed. After restarting the output conveying member it resumes separate removal of the items, which in the meantime have accumulated, but at a temporarily increased speed and feeds them to the new stack to be formed at the stacking location.

Such a device does avoid the requirement for doubling the stacking locations. However, the technical requirement is still too high for some applications since a separate pass-through separator with temporarily controllable removal is required for each intended stacking location.

SUMMARY OF THE INVENTION

The present invention is concerned with the solution to those problems which arise in the use of a device of the above-mentioned type in which a delaying means is also provided to interrupt the conveying flow of items during the stack removal time.

It is the object of the present invention to improve the known device in such a manner that it can operate with minimum operating expense and with full adherence to operational safety.

Generally the device of the present invention includes an arrangement wherein an abutment means is provided at the item conveying path leading to the stacking location which can be brought from a rest position into an operating position to block the movement of items along the conveying path. The portion of the conveying path disposed ahead of the abutment then forms a holding or buffer area in which the arriving items are stacked when the abutment means is brought to the operating position. A monitoring and control system is provided which monitors the thickness of the stack formed at the stacking location as well as the conveying flow of the arriving items. The system actuates the abutment for the duration of the removal of the stack, and in a time relationship therewith, switches on the drive means for the conveying device, at that time when the stack has reached a predetermined height and the trailing edge of an item passes the abutment location. In addition acceleration means are disposed in the area of the buffer area which are coupled with the means which actuate the abutment in such a manner that they are ineffective when the abutment is in the operating position. Such accelation means do accelerate the items stacked in the buffer area along the conveying path as soon as the abutment has returned to its rest position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of an embodiment of a device according to the invention for continuously stacking mail items during the stacking process.

FIG. 2 shows the embodiment of FIG. 1 in the same view but during the removal of a stack.

FIG. 3 is a cross-sectional view taken along the line III—III of FIG. 2.

FIG. 4 is a schematic representation of the monitoring and control device of the embodiment shown in FIGS. 1 to 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment of a device for continuously forming stacks shown in FIGS. 1 to 3, the conveying device for removing the stacks 1 comprises a conveyor belt 2 which runs around guide rollers 3 and 4. On the conveying belt followers 5 which are uniformly distributed along its periphery form individual stacking compartments. When the stack has reached a given height or thickness in a stacking compartment the full compartment is replaced by an empty one in one conveying step of conveyor belt 2 as seen in FIG. 2. The full or complete stacks are transferred from conveyor belt 2 on continuously driven conveyor belt system 7.

The thickness of the stack of items 1' formed at the stacking point — generally indicated at 6 — is sensed by a sensor lever 8 having an arm 8' which actuates an electrical switch 9 when the desired thickness has been reached.

Conveyor belt 2 is driven by gear motor 10 which is switched on and off by the monitoring and control system to be described later in connection with FIG. 4. The position of conveyor belt 2 or of its followers 5 is monitored by a switch 11. After belt 2 has been set in motion to replace a filled compartment with an empty compartment, switch 11 is closed during the course of this replacement of compartments and is opened by any desired means as soon as the next stack compartment has reached the intended position at the stacking location 6. For reasons of simplicity, switch 11 is illustrated as being opened by a follower 5.

The conveying path leading to stacking location 6 is formed by conveyor belts 12 and 13 which are guided at stacking location 6 by continuously driven guide rollers 14 and 15, respectively. The guide roller 15, is supplemented, in a known manner, by a brush roller 16 which aids the stacking process.

An abutment 17 is disposed at this conveying path and arranged to be moved by a pulling magnet 18 against the force of a tension spring 19 from its rest position (FIG. 1) into an operating position (FIG. 2) in which it blocks the conveying path. The abutment is disposed on a two-armed lever 20 which is pivotal about an axis 21 and whose other arm bears a pressure roller 22 whose function will be explained below.

The portion of the conveying path which is disposed upstream of abutment 17 forms a buffer area which is so designed that in the operating position of the abutment (FIG. 2) the arriving items 1' are held thereat. In the drawing it is generally designated 23. Whereas the conveyor belts 12 and 13 of the conveying path upstream and downstream of the buffer area 23 are disposed adjacent one another, in the buffer area they are spaced in such a manner that they form together with the abutment 17, when the latter is in its operating position, a stacking compartment which is suited to hold a smaller number of items. In the illustrated embodiment this belt spacing is obtained because the conveyor belt 12 is guided around guide rollers 24, 25 and 26 of which guide roller 24 is offset with respect to guide roller 26 by the desired spacing.

In an advantageous manner the portion of the conveying path disposed upstream of the buffer area 23 forms an acute angle α (FIG. 2) with the plane of the items 1' in the buffer area. The vertex of this angle is at a distance A from the operating position of abutment 17 and this distance is less than the length of the smallest item to be stacked. Moreover, the first conveyor belt 12 is guided about a guide roller 27 disposed at the vertex of angle α. The second conveyor belt 13 is guided by two guide rollers 28 and 29 in such a manner that a portion of the belt, as it leaves the last guide roller 29 , extends parallel to the plane of the items 1' in the buffer path. The distance B of the guide roller 28, as well as the distance of guide roller 29, from the operating position of abutment 17 is greater than the length of the longest item to be stacked. The guide roller 28 is designed as a brush roller.

In the device thus far described it is desirable to have acceleration means which are disposed in the region of the buffer area 23. These acceleration means should be coupled with the means actuating the abutment 17 in such a manner that they become ineffective when the abutment is in the operating position (FIG. 2) while the items stacked in the buffer area are accelerated together in the direction toward the stacking location 6 as soon as the abutment has returned to the rest position.

In the illustrated embodiment of the invention, the acceleration means are realized through the use of pressure roller 22 in cooperation with guide roller 27. The arrangement is such that when the abutment 17 is in its rest position the pressure roller 22 presses the second conveyor belt 13 against the first conveyor belt 12, which rotates about guide roller 24.

The operative coupling between pressure roller 22 and abutment 17 is realized in a manner known for stopping and renewed acceleration of individual items on a conveyor. Thus, these two elements 17 and 22 are disposed on respective arms of a two-armed lever 20. However, it would of course also be possible to provide an electric coupling instead of this mechanical coupling.

The monitoring and control system for the stacking device is schematically illustrated in FIG. 4 and comprises, in addition to the sensor lever 8, switch 9 and switch 11, a light barrier 30,30' disposed at the conveying path upstream of the buffer area 23. This barrier emits a signal to a known type of signal delay and shaping stage 31 whenever the trailing edge of an item 1' passes it. The delay obtained in stage 31 corresponds to the travel distance between the light barrier 30,30' and abutment 17 at the item conveying speed and shaping is effected in order to produce a signal of sufficient length in the interest of functional dependability.

The output of stage 31 is linked by means of an AND circuit 32 with the output of switch 9 which is actuated by sensor lever 8. The output of the AND circuit 32 is connected with an OR circuit 33. The second input of the OR circuit is connected to the switch 11 which is actuated by the followers 5 of conveyor belt 2. The signal from the OR circuit 33 controls a known type of switching stage 34 which switches on motor 10 of conveyor belt 2 and the pulling magnet 18 for abutment 17. The operation of the stacking device according to FIGS. 1 through 4 will now be described.

Starting with the stacking phase as illustrated in FIG. 1, switches 9 and 11 are open so that no signal reaches OR circuit 33. Abutment 17 is thus in rest position, motor 10 is not running.

The items 1' furnished by conveyor belts 12 and 13 are gripped by the conveyor belts which are pressed together by rollers 22 and 27 after they pass guide rollers 28 and are fed with the aid of brush roller 16 to the stacking compartment of conveyor belt 2, which is disposed at the stacking location 6. With each passage of a trailing edge of an item at abutment 17 the signal from light barrier 30 which has been delayed by and lengthened stage 31 is given to AND circuit 32 but this circuit remains ineffective because switch 9 is open.

As soon as the stack 1 formed at the stacking location 6 has reached the selected thickness, the stacks are removed as shown in FIG. 2. Switch 9 is closed via sensor lever 8. Upon the next-following signal from light barrier 30 the AND circuit 32 thus can transmit a signal to OR circuit 33. The pulling magnet 18 is excited via switching stage 34 and motor 10 is switched on. The conveyor belt 2 takes a conveying step to the right, the full stacking compartment being replaced by an empty one at this time. The previously open switch 11 is thus released and closes so that the switching stage 34 remains enabled via OR circuit 33 even after the output signal from AND circuit 32 has died out. The items 1' arriving during this time are stacked, as can be seen in FIG. 2, in the buffer area 23 back of abutment 17.

Upon completion of the conveying step of conveyor belt 2 and as soon as the next empty stacking compartment has taken the place of the removed full stacking compartment, the next follower 5 reopens switch 11. Thus motor 10 is switched off and pulling magnet 18 drops off. Abutment 17 returns to its rest position. At the same time conveyor belt 13 is pressed by pressure roller 22 against conveyor belt 12 moving around guide roller 27 so that all items stacked in buffer area 23 are gripped together and accelerated in the direction toward stacking location 6. These items are thus moved together, as a stack, into the stacking compartment, the further arriving items are then again stacked normally as shown in FIG. 1.

In the illustrated and described stacking device the items are stacked in horizontal position. The present invention is of course not limited to such a position but can also be used for stacking devices in which the items are stacked on edge or in any intermediate position. It is further obvious that the stacking device described in the above-mentioned German Pat. No. 1,260,384 can be modified in light of the present invention.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the apended claims.

I claim:

1. A device for forming stacks of flat items that are consecutively delivered as separate items, and with no overlapping between adjacent items, to a stacking location comprising, in combination:

a. a first conveying means continuously driven to advance individual items thereon in a conveying path toward the stacking location;

b. a second conveying means at the stacking location and having compartments positioned to receive and stack items delivered from said first conveying means, said second conveying means having motor means for periodically advancing individual compartments to the stacking location;

c. an abutment means associated with said first conveying means and movable from a rest position to an operative position to interrupt the advancing movement of the items toward said second conveying means, said abutment means and said first conveying means together defining a buffer area in which the items are stacked during the time said abutment means is in operative position, that portion of the conveying path defined by said first conveying means which is located upstream of said buffer area in the conveying direction being positioned to form an acute angle with the plane of the items disposed in said buffer area, and with the vertex of said angle spaced from the operating position of said abutment means at a distance which is less than the length of the shortest item received in said buffer area;

d. a monitoring and control system having monitoring devices associated with said first and second conveying means and at the stacking location, said system being interconnected with said motor means and said power means whereby when a compartment has received a full stack of items said motor means is energized so that this compartment is advanced away from the stacking location and an empty compartment is moved to the stacking location, said system simultaneously energizing said power means to move said abutment means to its operative position during movement of said compartments and then deenergizing said power means of said abutment means when said empty compartment is positioned at the stacking location.

2. A device as defined in claim 1 further comprising means associated with said abutment means to engage said first conveying means when said power means is deenergized whereby a stack of items in the buffer area is accelerated as a unit toward the stacking location.

3. A device as defined in claim 2 wherein said first conveying means comprises two conveyor belts disposed adjacent one another ahead of and behind the buffer area, said belts being guided at said buffer area to provide space for the stacked items.

4. A device as defined in claim 3 wherein said one belt is guided for movement over a guide roller at the vertex of the angle, said other belt is guided for movement over two guide rollers which are spaced apart a distance as determined by the acute angle, the length of said other belt between the vertex of the acute angle and one of said two guide rollers being greater than the length of the longest item to be stacked.

5. A device as defined in claim 4 wherein the other of said two guide rollers is a brush roller.

6. A device as defined in claim 4 wherein said means associated with said abutment means comprises a movable pressure roller which cooperates with said guide roller at the vertex of the angle to guide said one belt and said other belt there between

7. A device as defined in claim 6 wherein said one belt and said other belt are pressed together by the rollers when said abutment means is in rest position.

8. A device as defined in claim 2 wherein said abutment means and said means associated with said abutment means are associated with each other through a two-armed lever system connected to said power means.

9. A device as defined in claim 1 wherein said monitoring devices comprise a photo-electric cell system which is interrupted by the passage of an item on said first conveying means, an electrical switch which is closed and opened by an element on said second conveying means, and a second electrical switch operated to close when the stack of items in a compartment is completed.

10. A device as defined in claim 9 wherein said monitoring and control system further comprises a signal delay stage connected to said photo-electric cell system; an AND circuit connected to said delay stage and to said second electrical switch; an OR circuit having one input connected to the output of said AND circuit and a second input connected to receive the signal transmitted through said electrical switch, the output signal from said OR circuit controlling a switching stage connected to said motor and power means.

11. A device for forming stacks of flat items that are consecutively delivered as separate items, and with no overlapping between adjacent items, to a stacking location comprising, in combination:

a. a first conveying means continuously driven to advance individual items thereon in a conveying path toward the stacking location;

b. a second conveying means periodically advanced by motor means to provide an empty stacking compartment at the stacking location as a compartment which has been fully stacked with items is removed from the stacking location;

c. means comprising abutment means and an associated guide roller movable by power means from a rest position to an operating position in said first conveying means to interrupt the flow of items to the stacking location and provide a buffer area for stacking these items, that portion of the conveying path defined by said first conveying means which is located upstream of said buffer area in the conveying direction being positioned to form an acute angle with the plane of the items disposed in said buffer area, and with the vertex of said angle spaced from the operating position of said abutment means at a distance which is less than the length of the shortest item received in said buffer area;

d. a monitoring and control system interconnected with said motor and power means, said system initiating the movement of the stacking compartments and a simultaneous actuation of said abutment means so that during the movement of said second conveying means said abutment means is in operative position and when said second conveying means is halted, said abutment means returns to a rest position and said associated guide roller engages said first conveying means to accelerate the movement of stack of items in the buffer area as a unit toward an empty stacking compartment at the stacking location.

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