United States Patent [19]

Del Rosso

[11] **3,731,782**

[45] **May 8, 1973**

[54] **MAGNETIC FLOW DIRECTOR**

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[73] Assignee: **Hi-Speed Checkweigher Co., Inc.**, Ithaca, N.Y.

[22] Filed: **June 9, 1971**

[21] Appl. No.: **151,218**

[52] **U.S. Cl.** .....**198/31 R**, 198/41

[51] **Int. Cl.** **B65g 47/26**, B65g 47/00

[58] **Field of Search** .....198/31 AA, 41, 31 R, 198/31 AN

[56] **References Cited**

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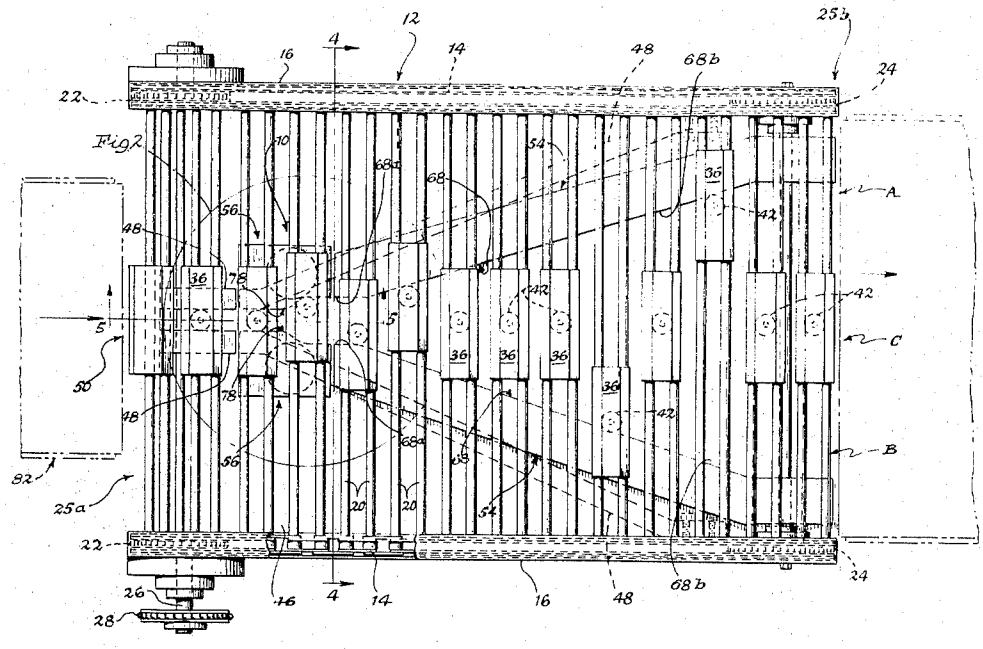
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[57] **ABSTRACT**

A magnetic flow director for use in combination with an article conveyor movable along a pre-determined path and having at least one article carrier supported by the conveyor for independent movement thereon under the influence of magnetic attraction transversely of the path. In a preferred form, the director includes a permanent magnet and a selectively operable electromagnet for deflecting the carrier transversely of the path for attractive engagement with a guide surface of the permanent magnet; such guide surface being characterized as including upstream and downstream surface portions relative to the direction of conveyor movement. The upstream portion is arranged for initial magnetic engagement by the deflected article carrier and extends substantially codirectionally with the path, and the downstream surface portion extends from the upstream surface portion in a diverging direction relative to the direction of conveyor movement. The electromagnet includes a guide surface terminating in a relatively downstream surface portion arranged in alignment with the upstream surface portion of the permanent magnet guide surface.

28 Claims, 12 Drawing Figures



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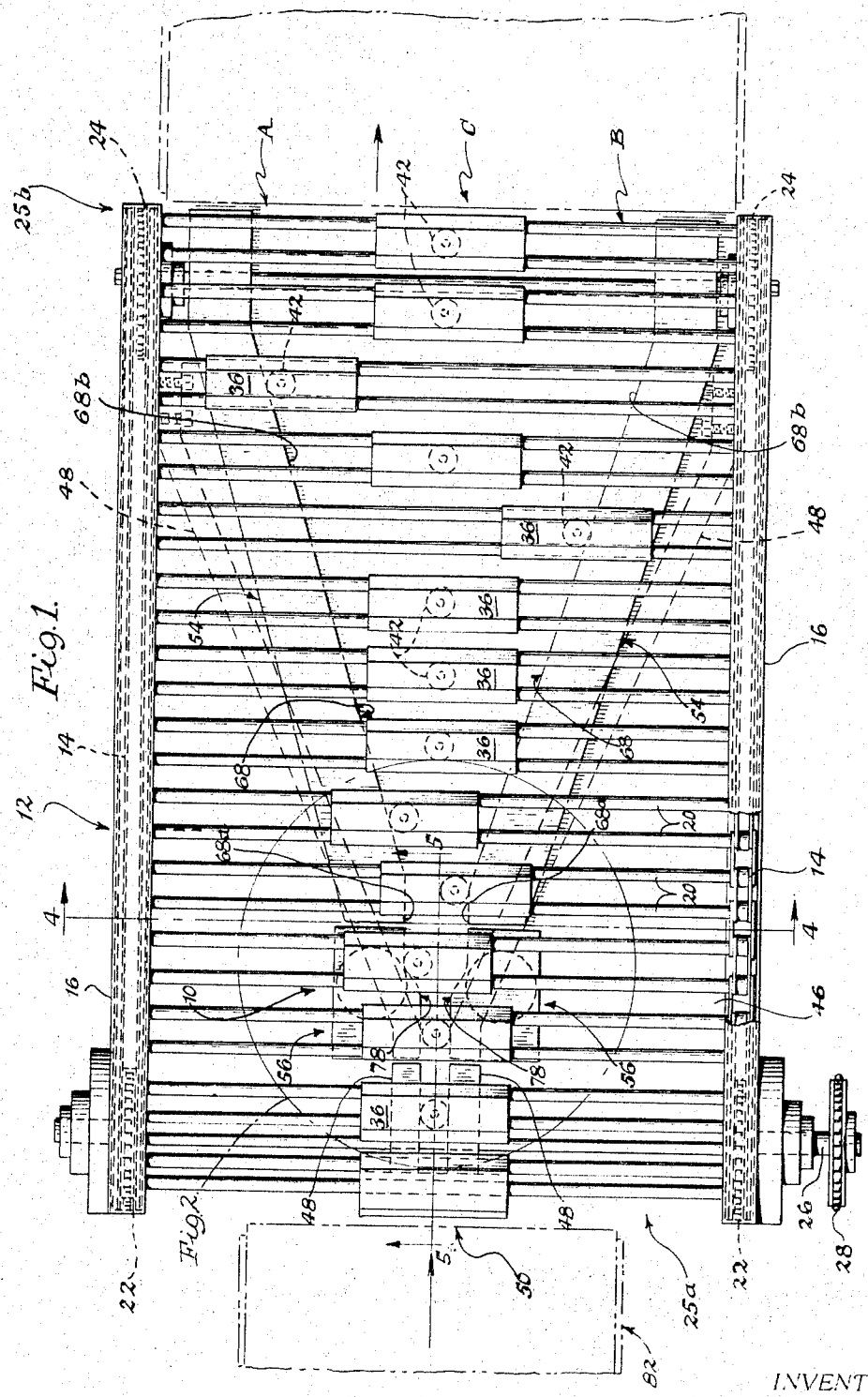


Fig. 1.

Fig. 2

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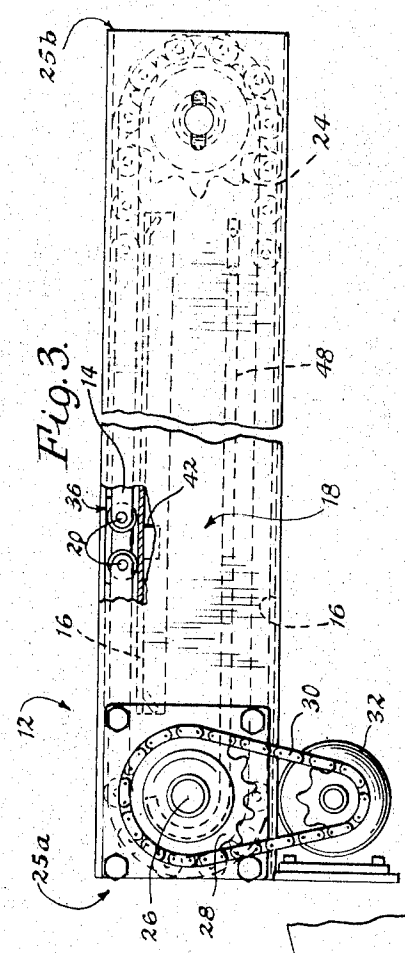


Fig. 3.

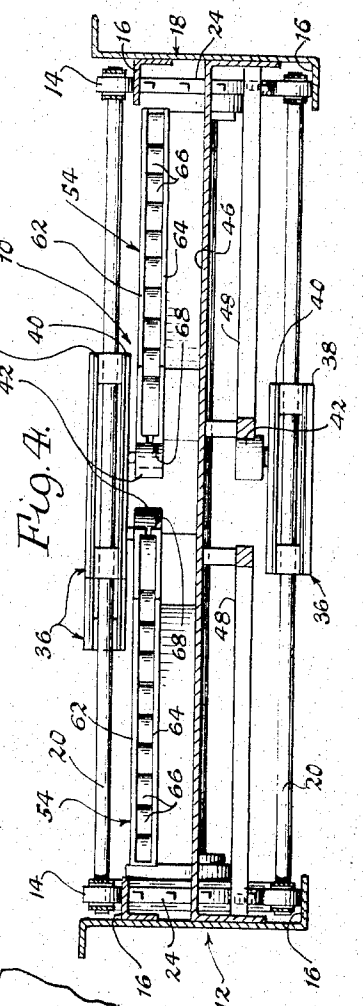


Fig. 4.

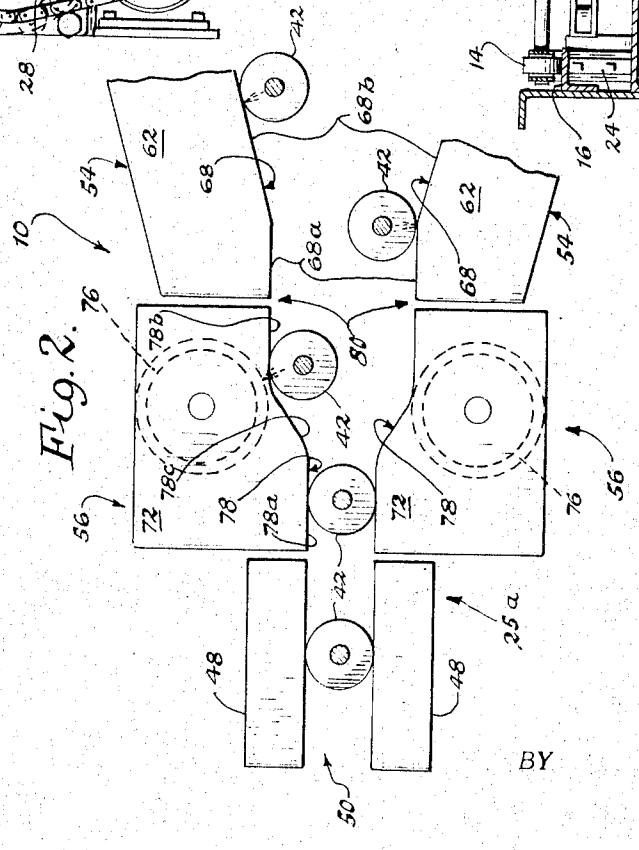


Fig. 2.

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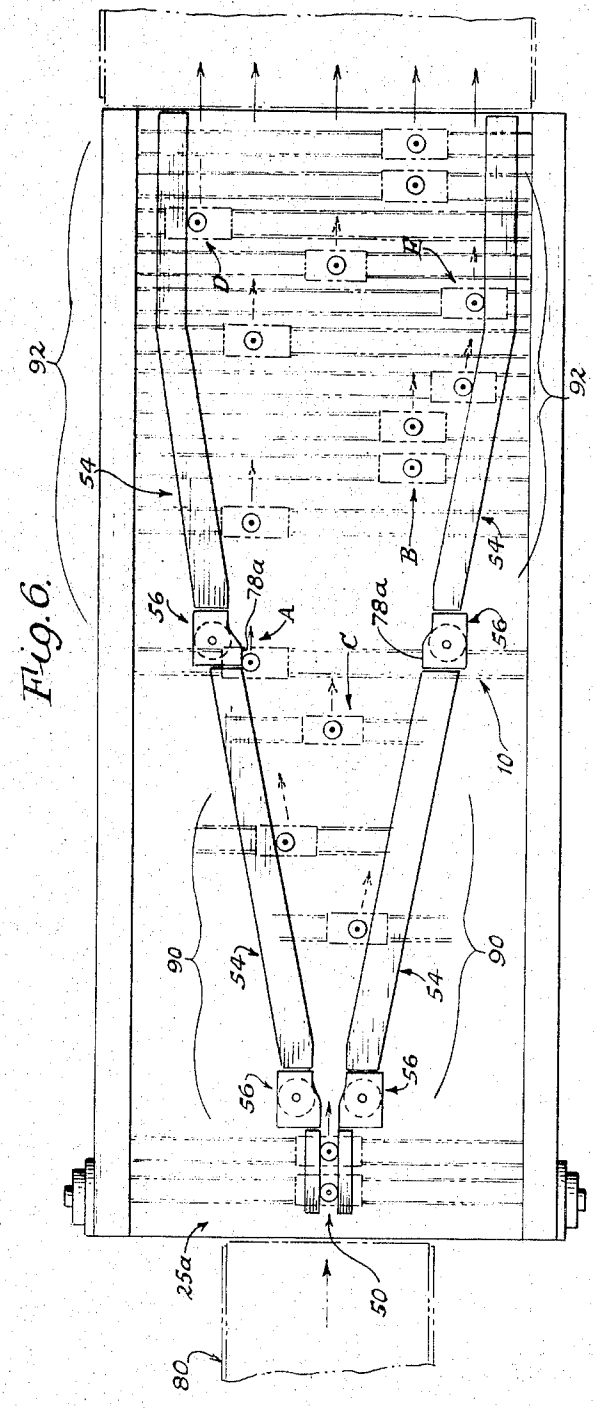


Fig. 6.

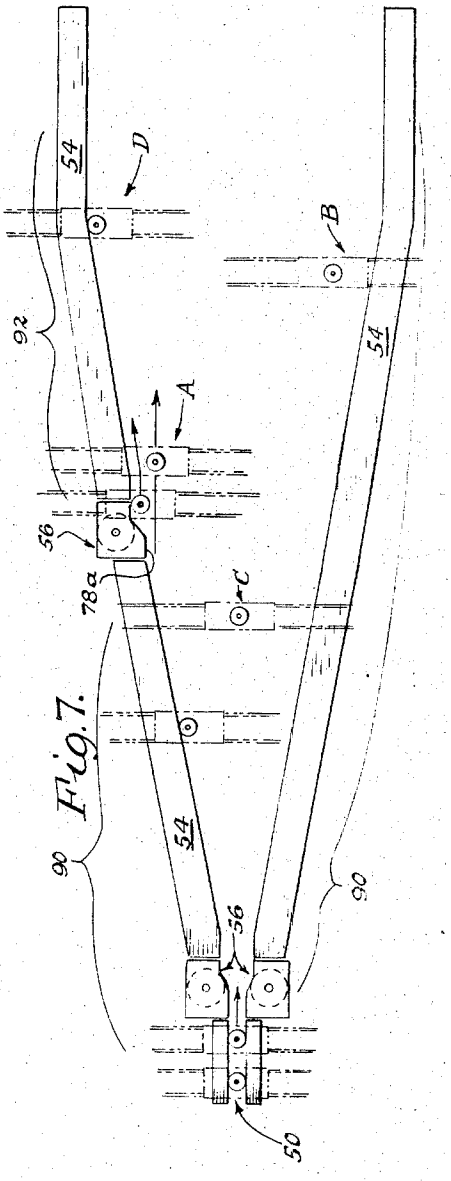


Fig. 7.

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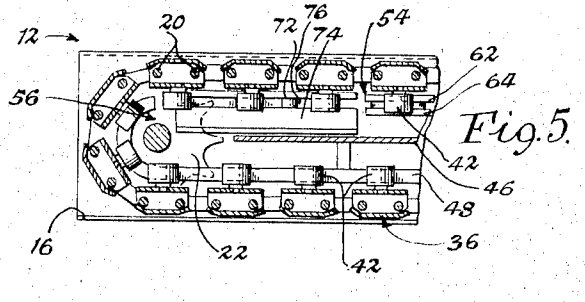
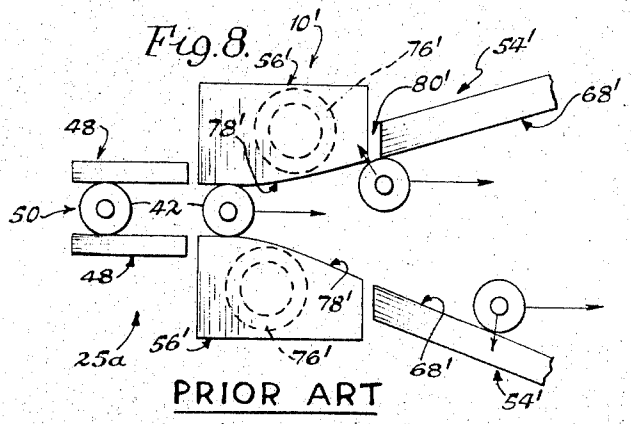


Fig. 5.

Fig. 8.



PRIOR ART

Fig. 9

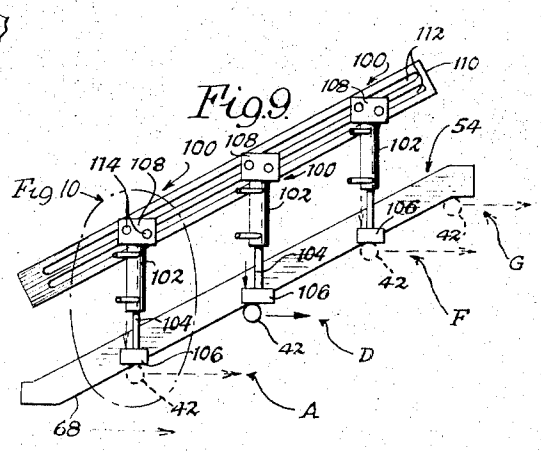
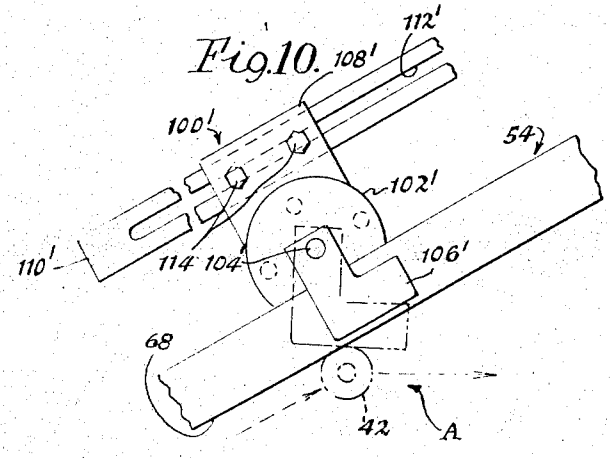


Fig. 10.



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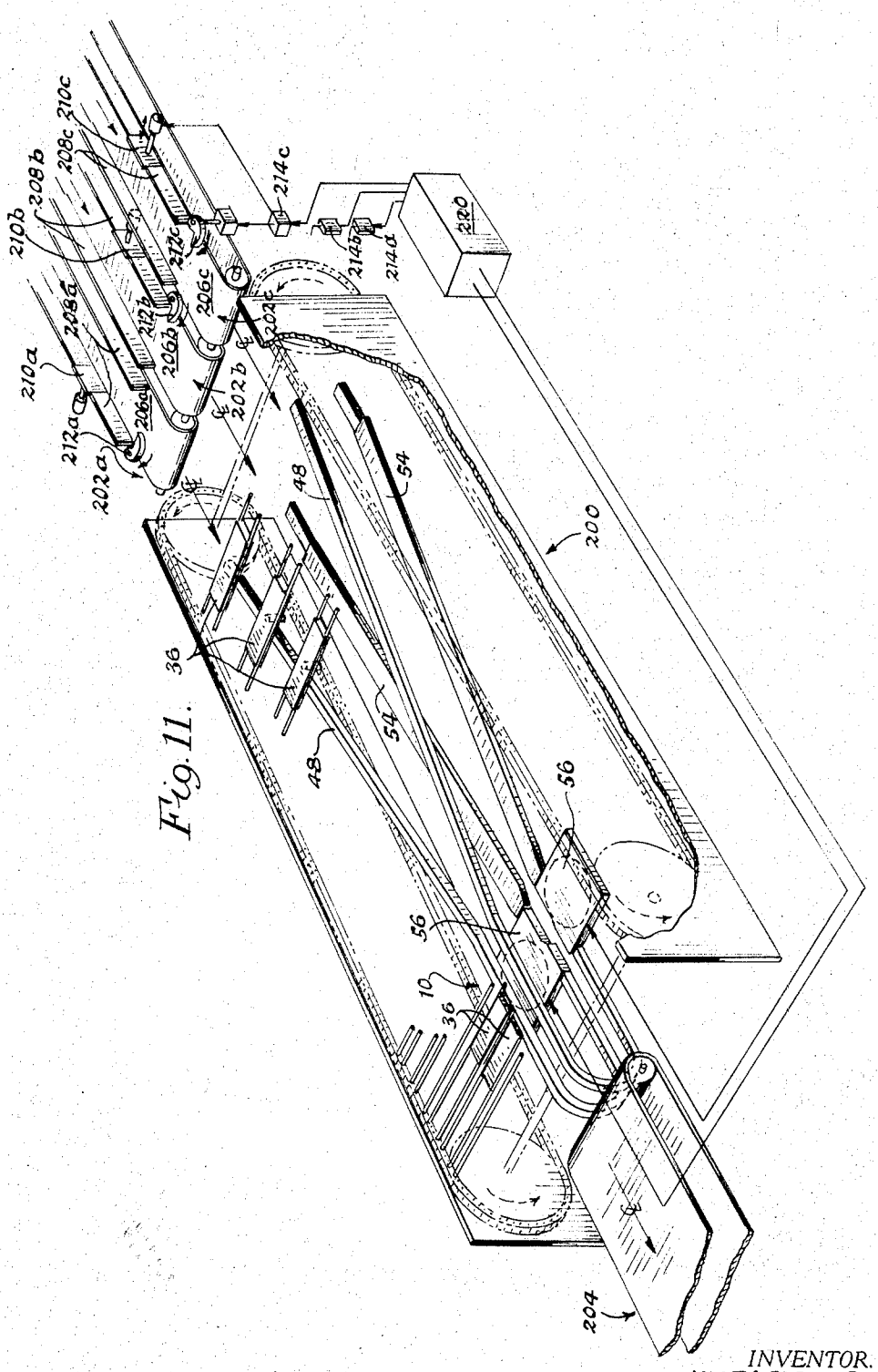


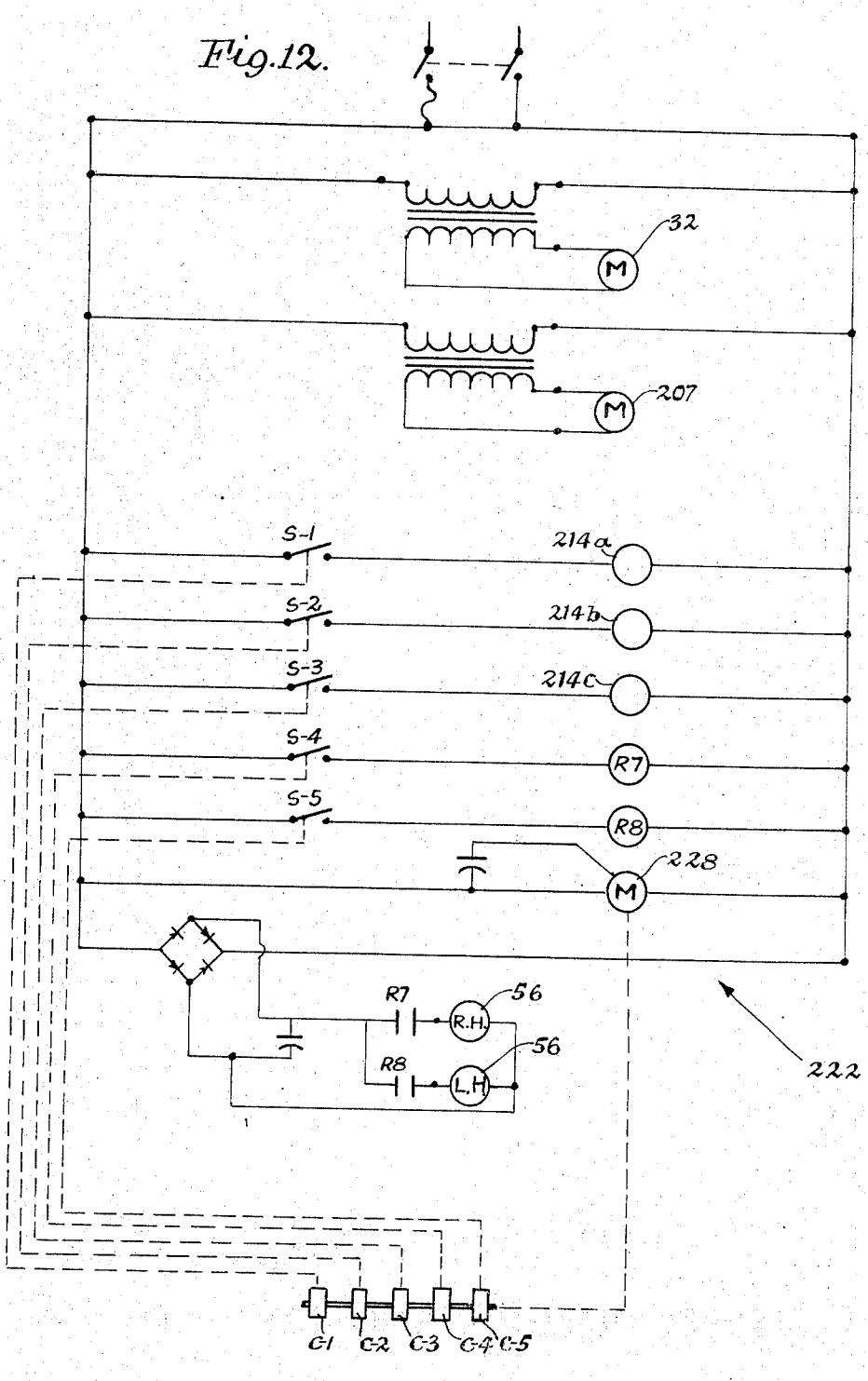
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Fig. 12.



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MAGNETIC FLOW DIRECTOR

BACKGROUND OF THE INVENTION

This invention relates to flow directing mechanisms having use as by way of example in machines of the general type disclosed by U.S. Pat. No. 3,167,171.

In U.S. Patent 3,167,171 there is disclosed a machine for rejecting packages determined by a checkweigher to be above or below a prescribed weight. The machine includes an endless conveyor having transverse guide rods on which article carriers are slideably mounted for independent movement transversely of the path of conveyor travel. Each of the article carriers is provided with a roller formed of a ferro-magnetic material. At the entrance end of the conveyor, all of the carriers are centered relative to the conveyor for passage of their rollers between a pair of spaced or opposing electromagnets. Whenever a package presented adjacent the electromagnets is either underweight or overweight, an apporpriate electromagnet is energized by a signal from the checkweigher in order to attract the roller of such carrier and thereby deflect it transversely of its normal path of travel into engagement with an associated one of a pair of diagonally extending elongated permanent magnets. When the electromagnet is deenergized, the roller continues to follow the permanent magnet with which it had been placed in engagement, whereby its carrier is deflected or progressively moved away from the central region of the conveyor as the conveyor advances.

Thus, in the machine of U.S. Pat. No. 3,167,171, articles delivered from the checkweigher pass centrally along the machine if they are of a correct weight, but are deflected to one side or the other if they are of an incorrect weight. The articles are suitably removed from the carriers adjacent the outlet end of the machine and the empty carriers are centered relative to the conveyor during movement thereof towards the entrance end of the machine by cam elements arranged beneath the permanent magnets.

Tests performed on actual commercial machines manufactured in accordance with the teachings of U.S. Pat. No. 3,167,171 reveal that the reject mechanism thereof is only operable with any degree of reliability when articles being transported by the carriers are very light in weight. Repeated failures were even encountered with unloaded carriers for conveyor speeds above about 100 feet per minute. As will be readily appreciated, these performance limitations are decided drawbacks in view of the varied weight and high speed requirements of the package and article handling industry, and appear to have prevented wide commercial acceptance of the machine.

Repeated tests of the rejection mechanism have revealed that the reason for its failure to perform satisfactorily is due to the gap, which is necessarily provided between adjacent ends of the roller guide surfaces of the electromagnet and permanent magnet in order to prevent magnetic coupling therebetween. The gap causes a reduction in the magnetic force available for transferring the roller of a selected carrier to the permanent magnet at a point where the permanent magnet is attempting to attract the roller for movement along a path diverging relative to the path along which the carrier is normally drawn by the conveyor. As a result, the magnetic force availale in the area of the gap

is ofttimes insufficient to move the carrier transversely of its normal path of travel, and the roller simply breaks away at the gap before being positively "picked up" by the permanent magnet.

When break away occurs, the article carrier is only partially deflected and when presented adjacent the outlet end of the machine will likely produce an article transfer malfunction. The problem is particularly acute when two or more adjacent carriers are employed to support a single article. As will be apparent, if one of the carriers is fully deflected and the other only partially deflected, misalignment of the article relative to the direction of travel of the conveyor or upsetting of the conveyed article will result.

Attempts to overcome the roller break away problem by increasing the strength of the permanent magnet and/or reducing the gap as by interfitting the pole pieces of the permanent magnet and electromagnet have not been successful, since the resultant coupling of the magnets produces uncontrolled deflections of non-selected ones of the article carriers.

SUMMARY OF THE INVENTION

The present invention is directed to an improved directing mechanism having use as by way of example in machines of the general type described in U.S. Pat. No. 3,167,171, which insures controlled diversion or deflection of article carriers under high load-high speed operating conditions.

In accordance with the present invention, the above discussed problem is eliminated by deflecting a selected article carrier into initial engagement with a relatively upstream portion of an elongated guide surface of the permanent magnet, which is arranged substantially co-directionally of or parallel with the normal path of carrier travel; the carrier being subsequently deflected during movement along a relatively downstream surface portion of such guide surface, which extends from the upstream surface portion in a diverging relation to the direction of conveyor movement. This arrangement permits the roller of the selected carrier to be magnetically "picked up" and "locked" onto the guide surface during a period of conveyor travel when there is no tendency to pull the carrier away from the permanent magnet. Thereafter, the full attractive force of the permanent magnet is available for use in deflecting the carrier to the extent desired.

In a preferred form of the present invention, deflection of the roller of the article carrier into engagement with the guide surface of the permanent magnet is effected by a selectively operable electromagnet having a novelly configured guide surface. The guide surface of the electromagnet is arranged to be initially engaged by a deflected carrier and terminates in a relatively downstream surface portion arranged in alignment with the upstream surface portion of the permanent magnet in the direction of conveyor travel. Thus, during transfer between adjacent ends of the guide surfaces of the electromagnet and the permanent magnet, the carrier is merely drawn by the conveyor along a path parallel to such guide surfaces. Accordingly, a gap of any desired width may be provided between the adjacent ends of the guide surfaces in order to prevent magnetic coupling of the permanent magnet and elec-

tromagnet without adversely effecting the transfer of a carrier therebetween.

As by way of providing a comparison, a commercially available machine constructed in accordance with the teachings of U.S. Pat. No. 3,167,171 was modified solely by replacing the pole pieces of the permanent magnet and electromagnet with pole pieces configured to define guide surfaces arranged in the manner described above. Whereas tests with the unmodified machine showed repeated malfunctions for unloaded article carriers at conveyor speeds over about 100 feet per minute, no malfunctions were encountered with the modified machine until the conveyor was driven at over 300 feet per minute with a loading on the article carriers of up to 40 pounds per square foot.

The present invention provides for a further departure from the machine construction disclosed in U.S. Pat. No. 3,167,171 by arranging plural groups of electromagnets and permanent magnets serially of the path of conveyor movement in order that a single line of articles may be diverted into any desired number of separate lines.

Also, division of a single line of articles into any desired number of output lines having any desired spacing between lines may be accomplished by a simplified form of the present construction, wherein a plurality of selectively operable "flags" or separators are adjustably positioned lengthwise of the permanent magnet. The "flags," when operated, are merely projected into the path of movement of an attracted carrier and serve to deflect such carrier away from the guide surface of the permanent magnet.

Further, the improved construction of the present invention may be employed in fabricating machines, which are alternatively adapted to converge any number of separate lines into a single line by merely inverting the machine.

DRAWINGS

The nature and mode of the present invention will be more fully described in the following detailed description taken with the accompanying drawings wherein:

FIG. 1 is a top plan view of a flow diverting mechanism embodying the present invention;

FIG. 2 is an enlarged fragmentary view of the area designated as FIG. 2 in FIG. 1 with parts removed for purposes of clarity;

FIG. 3 is a side elevational view of the mechanism shown in FIG. 1;

FIG. 4 is a sectional view taken generally along the line 4—4 in FIG. 1;

FIG. 5 is a sectional view taken generally along line 5—5 in FIG. 1;

FIG. 6 is a view illustrating a modified construction permitting the mechanism of FIG. 1 to divert a single line of packages into five separate lines;

FIG. 7 is a view illustrating a modified construction permitting the mechanism of FIG. 1 to divert a single line of packages into four separate lines;

FIG. 8 is a view similar to FIG. 2 but illustrating a prior art construction over which the present invention is an improvement;

FIG. 9 is a view illustrating a modified form of the invention employing pneumatically operated "flags" to selectively separate diverted carriers from the permanent magnet;

FIG. 10 is an enlarged view of the area designated as FIG. 10 in FIG. 9, but showing a solenoid operated "-flag;"

FIG. 11 is a perspective view showing the mechanism of FIG. 1 inverted so as to provide a converger mechanism for bringing together articles from two or more input lines into a single output line of articles; and

FIG. 12 is a diagrammatic view of a control circuit having utility in controlling the mechanism of FIG. 11.

DETAILED DESCRIPTION

For purposes of reference, the improved magnetic flow director of the present invention, which is generally designated as 10 in the drawings, will be described with particular reference to its use with a checkweigher reject mechanism 12 constructed in accordance with the teachings of U.S. Pat. No. 3,167,171. Further, for purposes of comparison, reference will be hereinafter made to a known flow director, which is generally designated as 10′ in FIG. 8 and described in greater detail in U.S. Pat. No. 3,167,171.

Mechanism 12 is shown in the drawings as including an endless conveyor comprising side chains 14, each of which is supported and guided on suitable guide means 16 carried on a framework 18. As best shown in FIGS. 1, 3 and 4, the links of chains 14 are pivotally connected by pairs of transversely extending parallel guide rods 20; the chains being trained over drive sprockets 22 and idler sprockets 24 arranged at the entrance end 25a and discharge end 25b of the conveyor, respectively. Sprockets 22 are fixedly mounted on a transverse drive shaft 26, which is driven by any suitable means including for instance drive sprocket 28, chain drive 30 and an electric motor 32.

By referring specifically to FIG. 1, it will be seen that each pair of adjacent transverse rods 20 serve to support a single article carrier 36 for independent movement transversely of the path of conveyor travel. While the article carriers may be of any desired construction, they are shown as including an article supporting plate 38 and a relatively bottom plate 40 having journaled centrally thereon a roller 42. Roller 42 is preferably formed at least in part of a magnetically attractable material, such as for instance a ferro-magnetic material, which permits the roller and thus the article carrier to be magnetically attracted to a permanent magnet or electromagnet. While, in the arrangement illustrated, a single carrier is employed to support an article, it will be appreciated that ofttimes articles are of such size as to require two or more carriers for each article.

Framework 18 is best shown in FIG. 4 as including a horizontal partition member 46 arranged midway between the relatively upper and lower runs of the conveyor. Fixed to the lower surface of partition 46 in position adjacent the lower run of the conveyor are elongated cam elements 48, which extend from the lateral extremities of the conveyor adjacent discharge end 25b and converge inwardly toward each other at conveyor entrance end 25a, as best shown in FIG. 1. At the entrance end, cam elements 48 are curved upwardly and forwardly in the direction of conveyor movement, such as to be arranged substantially concentric with drive shaft 26, as best shown in FIG. 5. As will be apparent, cam elements 48 are arranged at the same elevation as rollers 42 along the lower flight of the conveyor and ad-

jacent the inlet end thereof. Accordingly, each of article conveyors **36**, regardless of the transverse position in which it is disposed adjacent the discharge end of the conveyor will be forced by engagement with the cam elements **48** to move into the central part or region **50** of the conveyor for presentation at the inlet end, as best shown in FIG. **1**.

It will be understood that in the preferred form of the present invention, which is illustrated in FIGS. **1**, **2**, **4** and **5**, flow director **10** includes a pair of continuously operable magnetic means, such as permanent magnet devices **54**, and a pair of selectively operable electromagnets **56**, which are suitably mounted immediately below the upper run of the conveyor and on opposite sides of region **50**.

As best seen in FIGS. **4** and **5**, permanent magnet devices **54** each include an upper pole piece **62**, a lower pole piece **64** and a plurality of permanent magnets **66**, which are arranged between the pole pieces. Magnets **66** are so magnetized and oriented that one of the pole pieces of each pair constitutes a "north" pole, while the other constitutes a "south" pole. It will be noted that the edges of pole pieces **62** and **64** cooperate to define a guide surface **68** for rollers **42** and that rollers **42** are of such a length as to extend across the edges of both pole pieces in order to complete a circuit for maximum flux and thus achieve maximum attraction between the parts. Thus, it will be apparent that whenever roller **42** of any of carriers **36** is deflected or moved transversely of the conveyor into engagement with guide surface **68** of either of permanent magnet devices **54**, the roller will be picked up and held in rolling engagement with such guide surface during advanced movement of the deflected carrier with the endless conveyor.

It is a particular feature of the present invention that each of guide surfaces **68** is elongated and formed with relatively upstream and downstream surface portions **68*a*** and **68*b***, respectively. By referring to FIGS. **1** and **2**, it will be seen that upstream surface portions **68*a*** are arranged adjacent region **50** so as to extend substantially co-directionally with the path of conveyor movement, whereas downstream surface portions **68*b*** are arranged to extend from their associated upstream surface portions in a diverging direction relative to the direction of conveyor movement into discharge regions "A" and "B", which are spaced transversely of the path of conveyor travel from central region **50**. Thus, upstream surface portions **68*a*** are substantially parallel and the downstream portions **68*b*** diverge relative to each other in the direction of conveyor movement. It is to be further noted that upstream surface portions **68a** are spaced apart transversely of the endless conveyor a sufficient distance so that an article carrier positioned centrally of the conveyor will pass therebetween without being attracted by either sufficiently to be moved thereto. In other words, in the absence of an additional force, the permanent magnet devices in and of themselves cannot draw or deflect article carriers from their central position on the endless conveyor.

Electromagnets **56** are best shown in FIG. **1** as being arranged one on either side of central region **50** and as being disposed intermediate conveyor inlet end **25*a*** and permanent magnet devices **54**. As will be understood by reference to FIG. **5**, each of electromagnets **56** include upper and lower pole pieces **72** and **74**, respectively, which are arranged substantially coplanar with permanent magnet device pole pieces **62** and **64** respectively, and one or more electromagnetic coils **76**, which are arranged between each pair of pole pieces **72** and **74**. As will be apparent, the edges of each pair of pole pieces **72** and **74** cooperate to define a guide surface **78** along which rollers **42** move when magnetically deflected upon operation of their associated coils **76**.

It is also a particularly important feature of the present invention that the electromagnet guide surfaces **78** include relatively upstream and downstream surface portions **78*a*** and **78*b***, respectively, which are arranged parallel to one another and extend co-directionally with the path of conveyor movement; and an intermediate surface portion **78*c*** formed with a double curvature configuration. Also, by referring to FIG. **2**, it will be apparent that downstream surface portions **78*b*** are arranged in alignment with the upstream surface portions **68*a*** of the permanent magnet devices, and that the length of intermediate surface portions **78*c*** in the direction of conveyor travel is equal to or less than the spacing between rollers **42** of adjacent article carriers supported for movement by the conveyor. Preferably, upstream surface portions **78*a*** are parallel and arranged approximately in alignment with cam elements **48**.

In order to prevent magnetic coupling between permanent magnet devices **54** and electromagnets **56**, a gap **80** is provided between the adjacent ends of the pole pieces, as shown in the case of pole pieces **62** and **72** in FIG. **2**.

Coils **76** may be connected to any suitable signal generating device, not shown, so as to be energized in accordance with the signal received. As by way of example, the signal generating device may be associated with a checkweighing apparatus having a delivery conveyor generally designated at **82** in FIG. **1**. The checkweigher apparatus is adapted to energize the coils of one or the other of devices **56** in accordance with whether an article, package or the like presented at the inlet end of the conveyor is determined to be either overweight or underweight.

As will be obvious from the structure thus far described, articles being delivered from the checkweigher are successively deposited on article carriers **36** as the latter are presented adjacent the inlet end of the conveyor and signals generated by the checkweigher mechanism are delivered to the appropriate coil **76**. For example, if the checkweigher detects an article which is underweight, the resultant signal will be applied to the upper or left hand electromagnet, as viewed in FIG. **1**, at the time when such article and its carrier reaches a position between the electromagnetic devices. As a result, pole pieces **72** and **74** of such electromagnet are magnetized in order to draw the roller of the carriage from a line of travel intermediate the electromagnets towards the energized electromagnet and to hold it in engagement successively with guide surface portions **78*a***, **78*c*** and **78*b***, as the carrier is advanced by the endless conveyor in order to produce an initial deflection of the engaged roller from its normal or non-deflected path or line of travel. The coil energizing signal is preferably terminated immediately after the deflected roller is placed in engagement with surface portion **78*b*** in order to prevent the

roller of an adjacent following carrier from being unintentionally deflected by the same signal. Even if the roller of a following carrier is momentarily attracted by the same signal, termination of the signal before such roller reaches intermediate portion **78***c* will leave such roller located centrally of the conveyor.

After the coil energizing signal is terminated, the deflected roller merely rolls off guide surface portion **78***b* and onto upstream surface portion **68***a* of the associated permanent magnet device, whereupon it is magnetically "picked up" and retained for subsequent deflecting movement along the downstream guide surface **68***b* to a laterally displaced discharge region "A." It will be noted that, due to the fact that adjacent guide surface portion **78***b* and **68***a* are in alignment and codirectional with the path of conveyor movement, the deflected roller is transferred between such surface portions and magnetically "locked" onto the permanent magnet, during a period of conveyor travel wherein the deflected roller is not subject to displacing movements in a transverse direction. Accordingly, the presence of the necessary gap **80**, which reduces the magnetic field of permanent magnet device **54**, has no influence on the transfer of the roller.

If the article reaching the mechanism is overweight, the signal from the checkweigher is applied to the coil of the lower or right hand electromagnet, as viewed in FIG. **1** in order to deflect the carrier of such overweight article to the right and to carry same to opposite discharge region "B."

If the article reaching mechanism **12** is of a correct weight, neither of coils **76** is energized, thereby permitting the carrier on which the correct weight article is carried to move along a line of travel centrally of the endless conveyor without deflection in a transverse direction, as indicated for example at "C" in FIG. **1**.

For purposes of comparison, reference is now made to FIG. **8**, which generally illustrates a magnetic flow director **10'** of the type described in U.S. Pat. No. 3,167,171. In FIG. **8**, the several parts of flow director **10'**, which are similar to those of flow director **10**, are designated by primed numbers. By viewing FIG. **8**, it will be apparent that prior director **10'** is to be distinguished from director **10** on the basis that both of guide surfaces **78'** and **68'** are configured so as to continuously diverge relative to the direction of conveyor movement. Thus, when the signal to the coil of an attracting electromagnet **56'** is terminated, the partially deflected roller tends to move along a path, which is parallel to its non-deflected path or line of travel and at a small acute angle relative to downstream end of surface **78'** and thus the upstream end of guide surface **68'**. In order to maintain a minimal spacing between rollers of adjacent carriers, it is desirable to terminate the signal before the partially deflected roller reaches the end of surface **78'** in order to prevent unacceptable deflection of an immediately succeeding carrier by the same signal.

When the articles being conveyed are very light in weight and the conveyor is driven at a speed less than 100 feet per minute, the magnetic field set up adjacent the upstream end of guide surface **68'** is normally sufficient to maintain the partially deflected roller, after it has been freed from attraction by electromagnet **56'** in engagement with the downstream end of guide surface **78'** for transfer onto the upstream portion of guide surface **68'**. Thus, it will be noted that in this construction, permanent magnet **54'** must have a field strength, which is sufficiently strong to effect transverse displacement of the roller both immediately before and during transfer of the roller across gap **80'** and onto the upstream end of guide surface **68'**. As will be apparent, the presence of gap **80'** greatly reduces the field strength at the very point during conveyor travel at which it is most needed and permits the roller to break away at the point of transfer during high load and/or high speed operating conditions. After a roller has broken away, it will remain in a transversely displaced position, which is intermediate its initial non-deflected position and its desired fully deflected position, and will likely cause a malfunction.

Unexpectedly, the mere replacement of the pole pieces with pole pieces shaped in accordance with the present invention results in mechanism **12** having greatly improved operating characteristics. Comparison tests have demonstrated that, whereas repeated malfunctions occur in unmodified machines with unloaded carriers at conveyor speed of over about 100 ft./min., no malfunctions are encountered in a modified machine until the conveyor is driven at over 300 ft./min. with a carrier loading of up to about 40 lb./sq. ft.

FIGS. **6** and **7** illustrate modified forms of the present invention, wherein articles from a single input line may be selectively separated into five or four output lines, respectively. In each of these modified forms, groups **90**, **92** of electromagnets **56** and permanent magnets **54** are arranged serially of the path of conveyor movement such that guide surface portion **78**a of the electromagnet of a downstream group **92** is arranged immediately adjacent the path of travel of roller **92** of a carrier when discharged in region "A" from the downstream end of a permanent magnet **54** of an associated upstream group **90**. The operation of the electromagnet and permanent magnets of each of groups **90** and **92** will of course be similar, such that a carrier deflected by group **90** into region "A" or "B" may be subsequently deflected, if desired, into region "D" or "E."

While the preferred embodiment of the present invention has been described with reference to the use of pairs of electromagnets and permanent magnets for diverting carriers in opposite directions from a central region of the conveyor, it will of course be understood that either the right or left hand group may be omitted and articles diverted only in a single direction from adjacent either the central region or a side region of the conveyor.

FIG. **9** illustrates a modified form of the invention, wherein downstream magnetic diverting groups of the type shown in FIGS. **6** and **7** are replaced by one or more mechanical separators **100**, which are arranged to permit separation of carriers from a single permanent magnet **54** selectively in one of a plurality of regions, such as A, D, F and G. Each of separators **100** includes a pneumatically operated cylinder **102**, which is operable to reciprocate a piston rod **104** carrying "flag" or deflector plate **106** formed of a non-magnetic material. Piston rods **104** are normally retracted, such as to position "flags" **106** rearwardly of guide surface **68** and permit roller **42** of a carrier, which has been

deflected from region "C," as by operation of an associated electromagnet, not shown, to move outwardly along the guide surface into discharge region "G." If it is desired to discharge a carrier in an intermediate region, such as "D," the piston rod of the associated separator is extended, as indicated in FIG. 9, so as to move its "flag" beyond guide surface 68 and force roller 42 to break away from magnet 54.

Preferably, each of separators 100 is removably and adjustably mounted, so as to permit the number and distance between discharge regions to be varied. To this end, mounting blocks 108 are suitably fixed one to each of cylinders 102 and the blocks in turn adjustably affixed to a mounting bar 110 having slots 112 adapted to receive block adjustment bolts 114. Of course, cylinders 102 may be replaced, if desired, by suitable reciprocating type solenoids.

FIG. 10 illustrates a modified separator 100', which includes a rotary solenoid 102' having a rod 104' for carrying an L-shaped "flag" 106'. As will be apparent, the positioning of "flag" 106' lengthwise of magnet 54 may be effected by moving bolts 114' of solenoid mounting block 108' lengthwise within slot 112' of mounting bar 110'.

It will be apparent that a single separator of the type discussed with reference to FIGS. 9 and 10, may be employed to permit a modification of the basic electromagnet-permanent magnet combination. In this respect, a single electromagnet 56 and a single permanent magnet 54, such as the left hand pair viewed in FIG. 1, provide for two output or discharge lines of carriers, that is, one line of non-deflected carriers passing along their initial or non-deflected line of travel centrally of the conveyor within central region "C" and one line of diverted carriers passing along the conveyor within region "A." These same two output lines may also be obtained by the utilization of a permanent magnet and a single separator 100 or 100', and by arranging cam guides or elements 48 to deliver rollers directly into surface engagement with upstream surface portion 68*a*. By positioning a separator immediately adjacent the junction of surface portions 68*a* and 68*b*, a roller passing along surface portion 68*a* may be selectively prevented from "turning the corner" onto surface 68*b*, thereby to break away from permanent magnet 54 at this point for continued movement centrally along the upper run of the conveyor. As will be apparent, an advantage obtained from this modified form of the invention is that the distance between the two discharge lines may be readily adjusted by merely varying the positioning of the separator lengthwise of surface portion 68*b*.

FIG. 11 illustrates the flow director 10 employed in combination with a converging mechanism 200 for use in bringing together articles from three input lines 202*a*–202*c* into a single output line or conveyor 204.

It will be understood that converging mechanism 200 is identical in construction to reject mechanism 12, except that the former is inverted in order to place director 10 and cam elements 48 adjacent the lower and upper runs of the conveyor, respectively; guides 16 of course being arranged to provide support for side chains 14.

Input lines would for instance include continuously driven, endless conveyor belts 206*a*–206*c*, which are driven by electric motor 207, shown only in FIG. 12, and marginally bounded by guide plates 208*a*–208*c*; upstream gates 210*a*–210*c*; and downstream gates 212*a*–212*c*. In the arrangement illustrated, input line 202*b* is disposed in alignment with the path of non-diverted carriers passing direction 10, whereas input lines 202*a* and 202*c* are disposed in alignment with the downstream ends of each of magnets 54. The upstream and downstream gates of each input line are synchronized to alternatively open and close, as by controls 214*a*–214*c*, such that one or more articles may be initially built up as a group between the gates when the downstream gate is closed, such group being thereafter fed onto carriers presented by mechanism 200 when the downstream gate is opened. Controls 214*a*–214*c* may be of any desired form, such as for instance electrically operated valves for controlling flow of air to and from suitable gate operators.

A suitable memory unit 220 is provided to control operation of director 10 and gate controls 214*a*–214*c* in time sequence. Unit 220 includes an electrical control circuit 222 and a cam timer 224, which are illustrated in FIG. 12. For the three input lines illustrated in FIG. 11, circuit 222 in its simplest form would generally include five normally open micro-switches S-1 through S-5, which are closable by contact with cams C-1 through C-5, respectively, carried by rotatable cam shaft 226. Cam shaft 226 may be conveniently driven by cam motor 228 or by being mechanically coupled to conveyor drive shaft 26, if desired.

Again referring to FIG. 12, it will be seen that switches S-1 through S-3 are arranged in series with gate controls 214*a*–214*c*, respectively, and switches S-4 and S-5 are arranged in series with relays R7 and R8, respectively. When switches S-1 through S-3 are closed, controls 214*a*–214*c* are energized to open their respective downstream gates and close their respective upstream gates. When energized by closing of switches S-4 and S-5, relays R7 and R8 serve to close switches R7-1 and R8-1, which when closed in turn serve to establish a direct current circuit for energizing the left or right hand electromagnets L.H. and R.H., respectively.

If it is assured that there are three sequentially operated input lines from each of which a single group of two articles is to be discharged during each full cycle of operation, and that it is necessary to employ four carriers to support each article, operation will be as follows. During each operational cycle, switch S-4 would be closed first in order to energize left hand electromagnet L.H. 56 (as viewed in FIGS. 11 and 12) for a time sufficient to divert eight carriers to the left for subsequent positioning in alignment with input line 202*a*; both of electro magnets 56 would then remain deenergized (both of switches S-4 and S-5 open) for a time sufficient to permit the next eight carriers to pass centrally along mechanism 200; and finally switch S-5 would be closed to energize the right hand electromagnet R.H. 56 (as viewed in FIGS. 11 and 12) for a time sufficient to divert the next eight carriers to the right for positioning in alignment with input line 202*c*. As the groups of carriers are presented to the input lines 202*a*–202*c*, switches S-1 through S-3 would be successively closed, such that their associated gates would be operated to permit feeding of their article groups onto the presented carrier groups. Thereafter, the left and

right hand groups of loaded carriers are converged by cams **48** toward the central region of mechanism **200**, so as to form with the central group of loader carriers a single line of carriers; articles being removed from such single line by conveyor **204**.

As will be apparent, depending upon system parameters, such as the length and speed of the converger conveyor, groups of articles will be deposited on the groups of carriers diverted during the same or a preceding cycle of cam timer rotation.

I claim:

1. In a mechanism comprising a conveyor movable along a predetermined path, at least one article carrier supported by said conveyor for independent movement thereon transversely of said path, continuously operable magnetic means fixed adjacent said conveyor and having an elongated guide surface arranged to extend from adjacent one region of said conveyor in a diverging direction relative to the direction of movement of said conveyor into another region spaced transversely of said path from said one region, each said carrier having a portion attractable by said magnetic means upon engagement of said carrier therewith, and selectively operable means for deflecting said carrier transversely of said path from a line of travel within said one region for engagement with said guide surface adjacent said one region, said magnetic means tending to magnetically constrain said carrier when engaged for movement along said guide surface from said one region to said other region upon movement of said conveyor along said path, the improvement in combination wherein:

said guide surface includes upstream and downstream surface portions relative to the direction of conveyor movement, said upstream surface portion being arranged adjacent said one region for initial magnetic engagement by said deflected carrier and extending substantially co-directionally with said path, the distance between said upstream surface portion and said attractable portion of said carrier when moving along said line of travel being sufficient to prevent said magnetic means from magnetically attracting said attractable portion thereto, and said downstream surface portion extending from said upstream surface portion in a diverging direction relative to the direction of conveyor movement into said other region.

2. The improvement according to claim **1**, wherein said magnetic means is a permanent magnet device, said guide surface is defined by at least one pole piece of said magnet device, and said attractable portion is a roller journalled on said carrier and engageable with said pole piece.

3. The improvement according to claim **1**, wherein separator means is arranged adjacent said magnet means intermediate opposite ends of said downstream portion of said guide surface for selectively separating said carrier from engagement therewith in at least one further region intermediate said one and said other regions.

4. The improvement according to claim **3**, wherein means are provided to adjustably position said separator means lengthwise of said downstream portion of said guide surface thereby to vary the spacing of said further region from said one region in a direction transversely of said path.

5. The improvement according to claim **3**, wherein said separator means includes a non-magnetic member and means to selectively move said member into the path of movement of said carrier along said guide surface thereby to disengage said carrier therefrom in said further region.

6. In a mechanism comprising a conveyor movable along a predetermined path, at least one article carrier supported by said conveyor for independent movement thereon transversely of said path, a pair of continuously operable magnetic means fixed adjacent said conveyor and having elongated guide surfaces arranged to extend from adjacent opposite sides of said one region of said conveyor in directions outwardly diverging relative to the direction of movement of said conveyor into other regions spaced transversely of said path from said one region, means upstream of said magnetic means in the direction of conveyor movement for positioning said carrier for movement along a line of travel within said one region substantially equally spaced transversely of said path from said magnetic means, each said carrier having a portion attractable by said magnetic means upon engagement of said carrier therewith, and selectively operable means for deflecting said carrier transversely of said path from said line of travel for positioning said attractable portion thereof in engagement with said guide surface of a selected one of said magnetic means adjacent said one region, said selected one of said magnetic means tending to magnetically constrain said carrier when engaged for movement along said guide surface thereof transversely of said path from said one region into an associated other region upon movement of said conveyor along said path, the improvement in combination wherein:

each of said guide surfaces include upstream and downstream surface portions relative to the direction of conveyor movement, said upstream surface portions being substantially parallel and arranged adjacent opposite sides of said one region for initial magnetic engagement by said deflected carrier and extending substantially co-directionally with said path, the distance between each said upstream surface portion and said attractable portion of said carrier when moving along said line of travel being sufficient to prevent said magnetic means from magnetically attracting said attractable portion thereto, and said downstream surface portions extending from said upstream surface portions associated therewith in a relatively diverging relationship in the direction of conveyor movement into said other regions.

7. A mechanism according to claim **6**, wherein each said magnetic means is a permanent magnet device and each said guide surface is defined by at least one pole piece of one of said magnet devices.

8. A flow directing mechanism comprising in combination:

a conveyor movable along a predetermined path;

at least one article carrier supported by said conveyor for independent movement thereon transversely of said path, said article carrier having a magnetically attractable portion;

at least one magnet device fixed adjacent said conveyor, said device defining an elongated guide surface having upstream and downstream surface portions relative to the direction of conveyor movement, said upstream surface portion being arranged adjacent one region of said conveyor and extending substantially co-directionally with said path, said downstream portion extending from said upstream surface portion in a diverging direction relative to the direction of conveyor movement into another region spaced transversely of said path from said one region, said device attracting said portion of said article carrier upon engagement of said carrier with said guide surface, whereby to magnetically constrain an engaged carrier for movement along said guide surface from said one region to said other region upon movement of said conveyor along said path; and

at least one electromagnetic means fixed adjacent said conveyor relatively upstream of said device, said electromagnetic means including a guide surface, said electromagnetic means being selectively operable to attract said portion of said article carrier for deflecting said carrier transversely of said path into engagement with said guide surface thereof, a relatively downstream portion of the last said guide surface being arranged in alignment with said upstream surface portion in the direction of conveyor movement.

9. A mechanism according to claim 8, wherein said electromagnetic means guide surface also includes upstream and intermediate surface portions, said upstream and downstream surface portions of said electromagnetic means being arranged in a spaced and substantially parallel relationship, and said intermediate surface portion being of double curvature configuration.

10. A mechanism according to claim 8, wherein said electromagnetic means guide surface also includes an upstream surface portion and an intermediate surface portion joining said upstream and downstream surface portions thereof, said upstream and downstream surface portions of said electromagnetic means being arranged in a spaced substantially parallel relationship, and wherein a plurality of article carriers are provided in combination, said article carriers being spaced apart in the direction of conveyor movement and the distance between said portions of adjacent article carriers is equal to or greater than the length of said intermediate surface portion measured in a direction aligned with said path of conveyor movement.

11. A mechanism according to claim 8, wherein a pair of magnet devices and a pair of electromagnetic means are provided in combination, said upstream surface portions of said devices being arranged in substantially parallel relationship and adjacent opposite sides of said one region, said downstream surface portions of said devices being arranged in relatively outwardly diverging relationship in the direction of conveyor movement, and said pair of electromagnetic means being selectively operable for deflecting said carrier transversely of said path for engagement with a selected one of said upstream surface portions of said devices.

12. A mechanism according to claim 11, wherein said guide surface of each said electromagnetic means also includes an upstream and an intermediate surface portion joining said upstream surface and said downstream portions thereof, said upstream and downstream surface portions of each said electromagnetic means being arranged in a spaced and substantially parallel relationship, the spacing between said downstream surface portions of said pair of electromagnetic means being greater than the spacing between said upstream surface portions thereof; and wherein a plurality of article carriers are provided in combination, said article carriers being spaced apart in the direction of conveyor movement and the distance between said portions of adjacent article carriers is equal to or greater than the length of said intermediate surface portion measured in a direction aligned with said path of conveyor movement.

13. A mechanism according to claim 8, wherein at least one separator means is arranged adjacent said magnet device intermediate opposite ends of said guide surface downstream portion thereof for selectively separating said carrier from engagement therewith in at least one further region intermediate said one and said other regions.

14. A mechanism according to claim 13, wherein said separator means is adjustable lengthwise of said guide surface downstream portion thereby to vary the spacing of said further region from said one region in a direction transversely of said path.

15. A mechanism according to claim 8, wherein said magnet device is a permanent magnet, and a plurality of groups of said magnet devices and electromagnetic means are provided in combination and said groups are arranged serially of said path of travel, said downstream surface portion of a magnet device of a first of said groups delivering into said other region, said electromagnetic means of a second of said groups being selectively operable for deflecting said carrier presented in said other region transversely of said path in a direction away from said one region for engagement with said upstream guide surface portion of its associated magnet device.

16. A mechanism according to claim 8, wherein adjacent ends of said upstream surface portion and said downstream portion of said last said guide surface are spaced apart in the direction of conveyor movement.

17. A mechanism according to claim 16, wherein said magnet device is a permanent magnet device.

18. In a mechanism comprising a conveyor movable along a predetermined path, at least one article carrier supported by said conveyor for independent movement thereon transversely of said path, magnetic means fixed adjacent said conveyor and having an elongated guide surface arranged to extend from adjacent one region of said conveyor in a diverging direction relative to the direction of movement of said conveyor into another region spaced transversely of said path from said one region, each said carrier having a portion attractable by said magnetic means upon engagement of said carrier therewith, whereby upon engagement of said carrier with said guide surface adjacent said one region said magnetic means tends to magnetically constrain said carrier for movement along said guide surface from adjacent said one region to said other region upon movement of said conveyor, the improvement comprising:

at least one separator means arranged intermediate opposite ends of said guide surface, said separator means being selectively operable to separate said carrier from engagement with said guide surface in a further region arranged intermediate said one and said other regions.

19. A mechanism according to claim 18, wherein said separator means is adjustable lengthwise of said guide surface thereby to vary the spacing of said further region from said one region in a direction transversely of said path.

20. A mechanism according to claim 18, wherein said separator means includes a non-magnetic member and means to selectively move said member into the path of movement of said carrier along said guide surface thereby to disengage said carrier therefrom in said further region.

21. A flow directing mechanism comprising in combination:

an endless conveyor movable along a predetermined path and having upper and lower runs;

a plurality of article carriers spaced apart in the direction of said path and supported by said conveyor for independent movement thereon transversely of said path, each said carrier having a magnetically attractable portion;

a magnet device extending along one of said runs and defining an elongated guide surface having upstream and downstream surface portions relative to the direction of conveyor movement, said upstream surface portion being arranged adjacent one region of said conveyor and extending substantially co-directionally with said path, said downstream portion extending from said upstream surface portion in a diverging direction relative to said path into a discharge region spaced transversely of said one region, said device attracting said portion of said carrier upon engagement of said carrier with said guide surface whereby normally tending to magnetically constrain said engaged carrier for movement along said guide surface from adjacent said one region to said discharge region upon movement of said conveyor along said path;

at least one separator means for separating selective ones of said carriers from engagement with said guide surface in a further discharge region spaced from said discharge region in a direction transversely of said path towards said one region, whereby to selectively establish at least two lines for travel of said carriers along said one run of said conveyor downstream of said magnet device; and

means including means arranged along an other of said runs for gathering together said carriers traveling along said lines of travel into a single line and for positioning at least some of said carriers from said single line in engagement with said upstream portion of said guide surface.

22. A mechanism according to claim 21, wherein said magnet means extends along said upper run thereby to permit said mechanism to be employed to diverge articles passing along a single input selectively into at least two essentially parallel outputs, said input being substantially aligned with said single line, and said outputs being substantially aligned with said carrier lines of travel.

23. A mechanism according to claim 21, wherein said magnet means extends along said lower run thereby to permit said mechanism to be employed to converge articles passing along at least two inputs into a single output, said inputs being substantially aligned with said carrier lines of travel and said output being substantially aligned with said single line.

24. A mechanism according to claim 21, wherein said means for positioning carriers in engagement with said magnet means includes means selectively operable to displace said carriers transversely of said conveyor path of travel from said single line for engagement with said upstream portion of said guide surface, carriers not displaced from said single line passing along said one run along a third line of travel parallel to said two lines of travel.

25. A mechanism according to claim 21, wherein said means for positioning carriers positions all of said carriers in said single line for engagement with said upstream portion of said guide surface, and said separator means is arranged to separate carriers at the junction of said upstream and downstream surface portions, whereby said further discharge region is said one region and one of said lines of travel is aligned with said single line.

26. A flow directing mechanism comprising in combination:

an endless conveyor movable along a predetermined path and having upper and lower runs:

a plurality of article carriers spaced apart in the direction of said path and supported by said conveyor for independent movement thereon transversely of said path, each said article carrier having a magnetically attractable portion;

means arranged along one of said runs for positioning all of said attractable portions of said carriers in one region of said conveyor when presented adjacent one end of said conveyor;

selectively operable electromagnetic means arranged along another of said runs for attracting said attractable portion of selected ones of said carriers for deflecting same from said one region transversely of said path during passage thereof along said other run, said electromagnetic means including a guide surface engageable by said deflected carriers, at least a downstream end portion of said guide surface relative to the direction of conveyor movement being co-directional with said path of travel and being spaced transversely of said conveyor relative to the path of travel of non-deflected ones of said carriers; and

a magnet device extending along said other run downstream of said electromagnetic means in the direction of conveyor movement, said magnet device including an elongated guide surface engageable by said deflected carriers, said guide surface of said device including an upstream surface portion arranged in alignment with said downstream end portion of said electromagnetic means in the direction of conveyor movement and a downstream surface portion extending from said upstream surface portion thereof in a diverging direction relative to the direction of conveyor movement into an other region spaced transversely of said path from said one region, said magnet

device attracting said attractable portion of said deflected carriers for further deflecting same transversely of said path away from said one region towards said other region when in engagement with said guide surface thereof.

27. A mechanism according to claim 26, wherein said electromagnetic means is arranged along said upper run thereby to permit said flow directing mechanism to be employed to diverge articles passing along a single input into at least two essentially parallel outputs, said input delivering articles onto carriers arranged within said one region adjacent said one end of said conveyor, and each of said outputs receiving articles from carriers arranged within one of said one region and said other region adjacent an opposite end of said conveyor.

28. A mechanism according to claim 26, wherein said electromagnetic means is arranged along said lower run thereby to permit said flow directing mechanism to be employed to converge articles passing from at least two essentially parallel inputs into a single output during passage of said carriers along said upper run from an opposite end of said conveyor towards said one end thereof, each of said inputs being arranged to deliver articles onto carriers presented within one of said one region and said other region adjacent said opposite end of said conveyor, and said output being arranged to receive articles from said carriers presented within said one region adjacent said one end of said conveyor, each of said inputs including gate means operable for discharging articles onto said carriers when presented thereto, and there is further provided in combination control means for controlling operation of said electromagnetic means and said gate means whereby said carriers are presented successively to said inputs and said gate means are operated to deliver articles onto said presented carriers.

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