June 24, 1958 F. M. LEFIEF 2,840,224

CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

Filed April 24, 1957 7 Sheets-Sheet 1

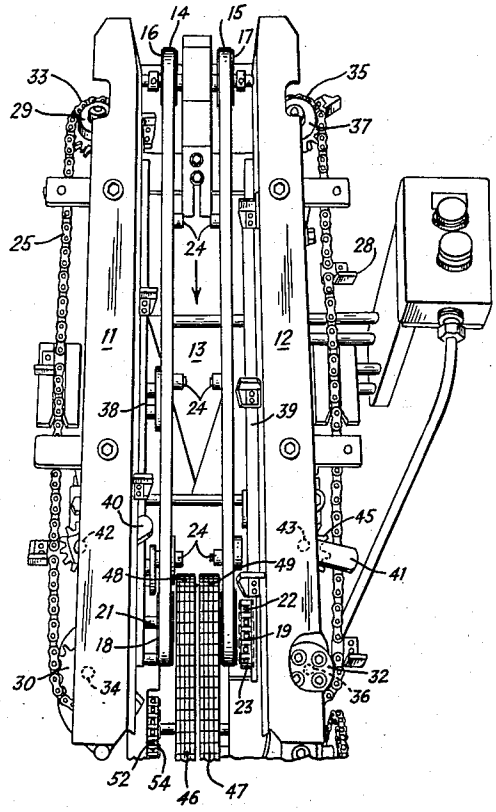


Fig. 1

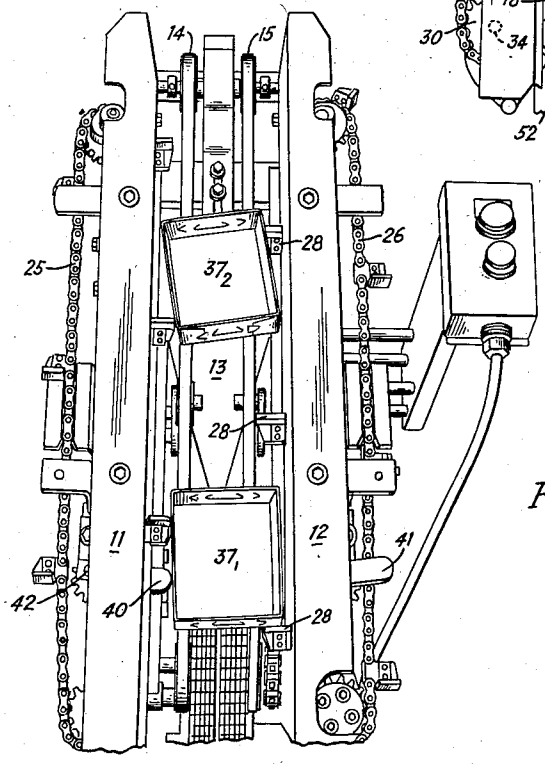


Fig. 2

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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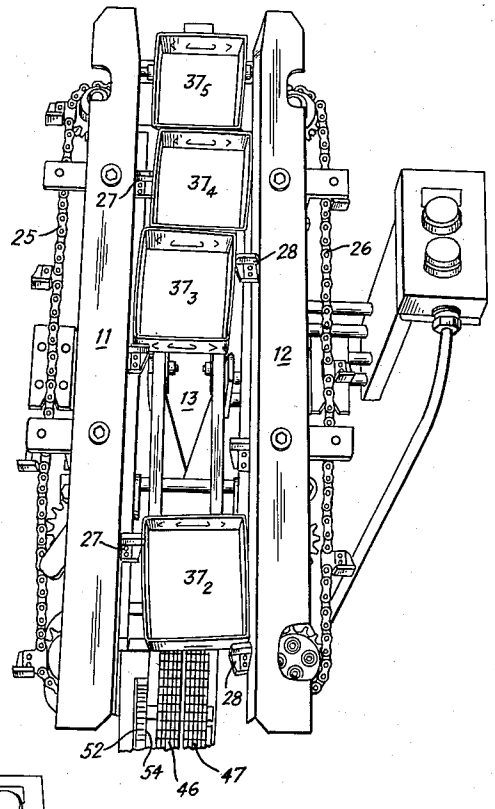


Fig. 3

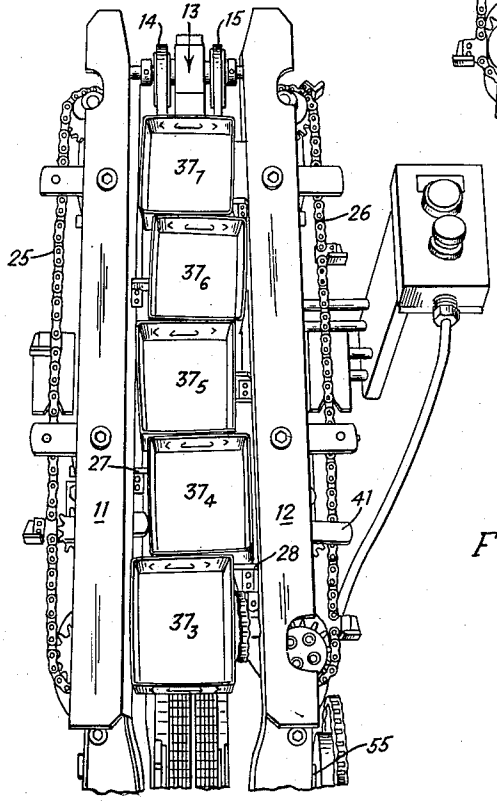


Fig. 4

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

Filed April 24, 1957 7 Sheets-Sheet 3

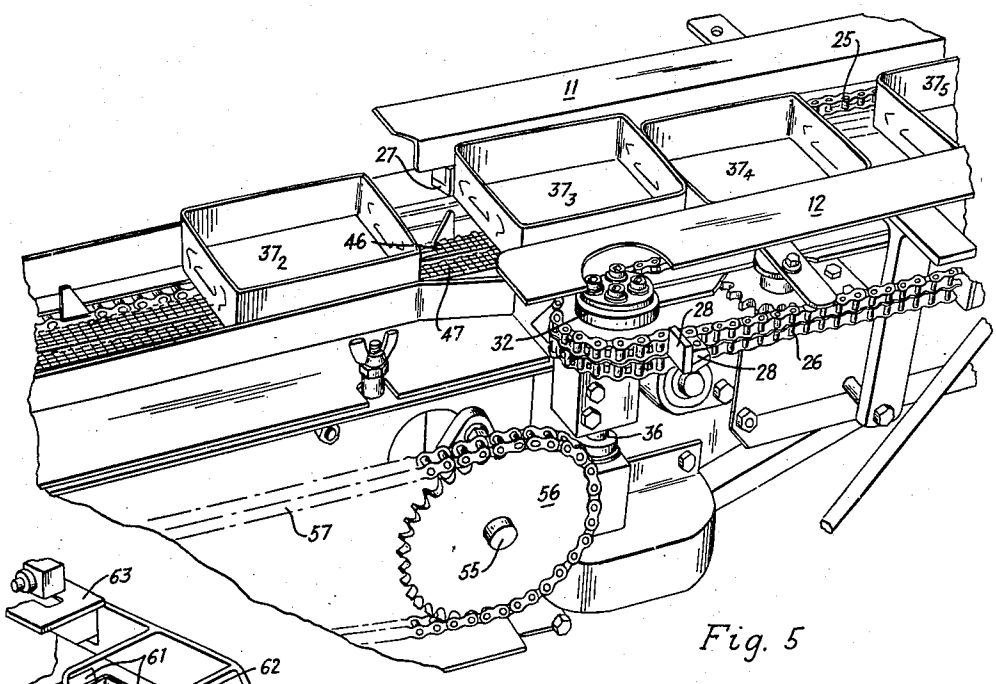


Fig. 5

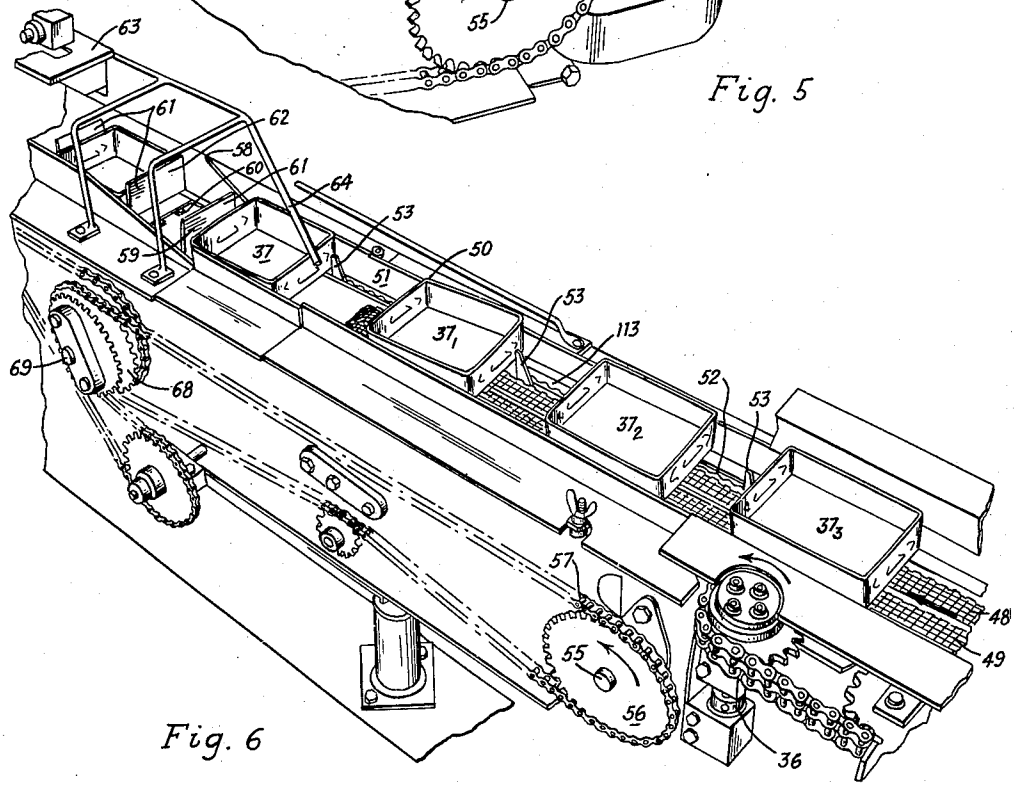


Fig. 6

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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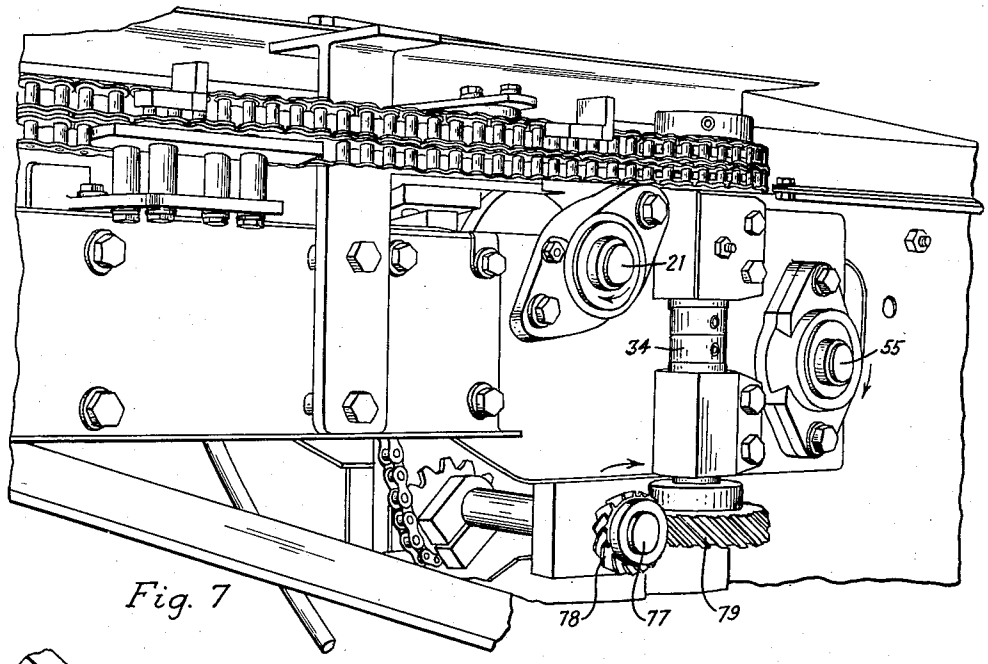


Fig. 7

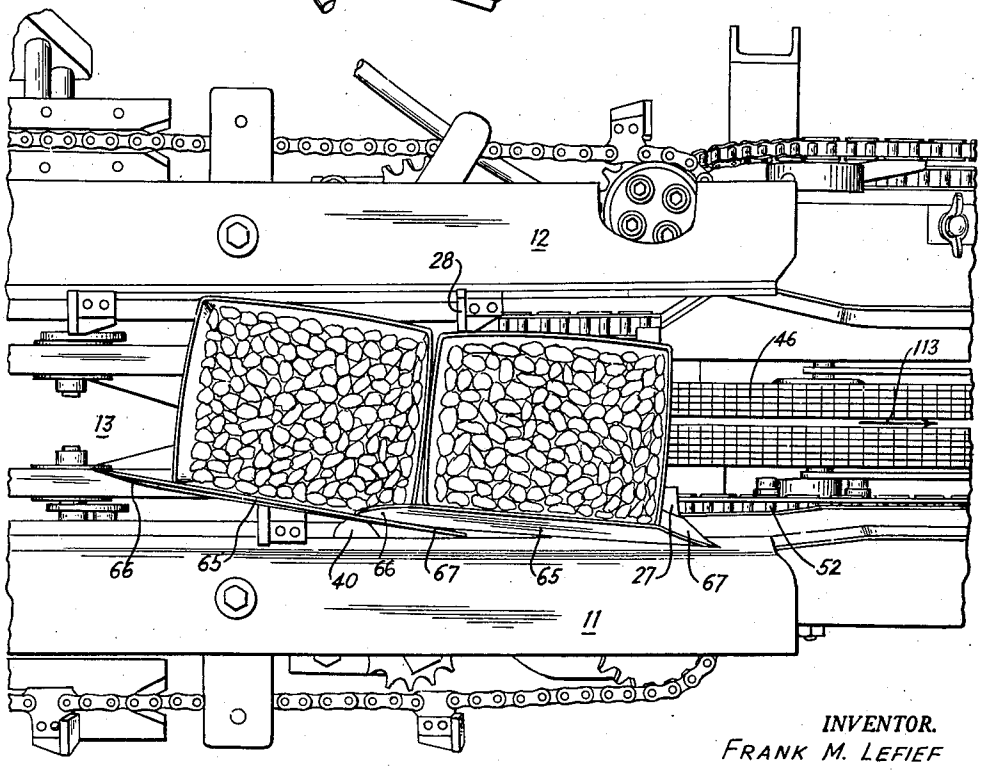


Fig. 8

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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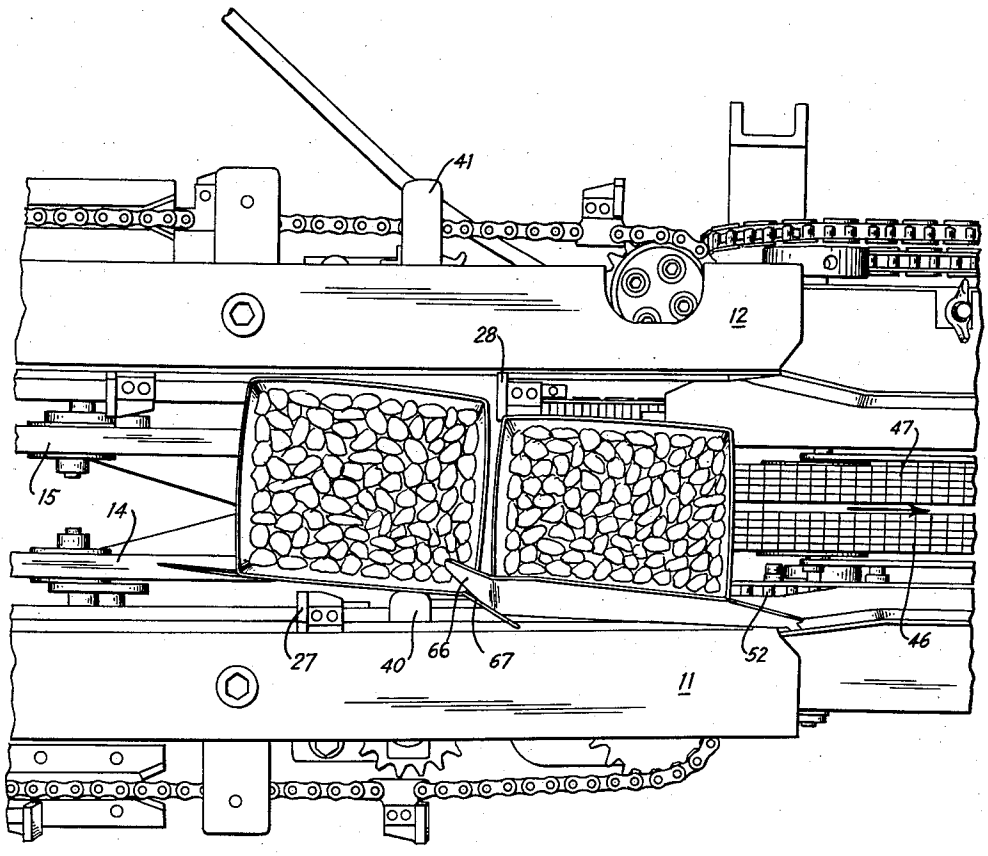


Fig. 9

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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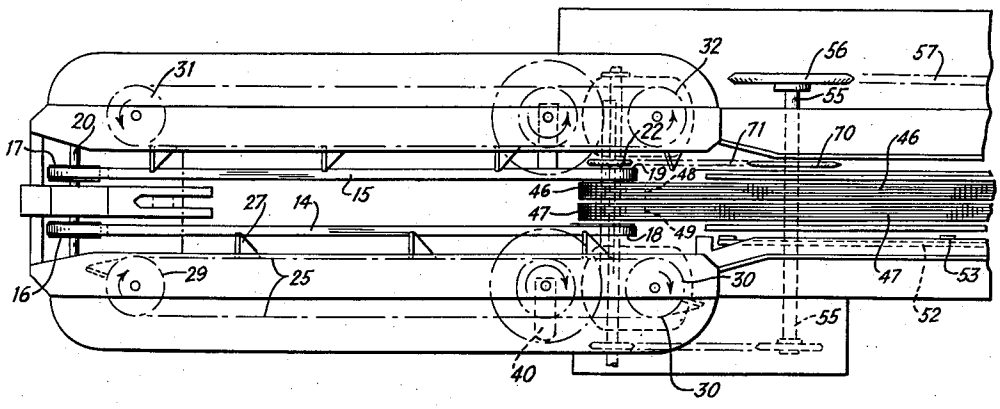


Fig. 10

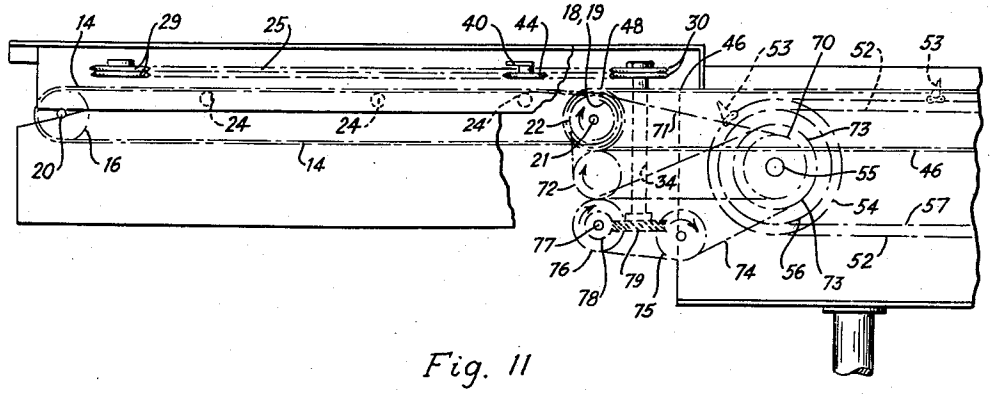


Fig. 11

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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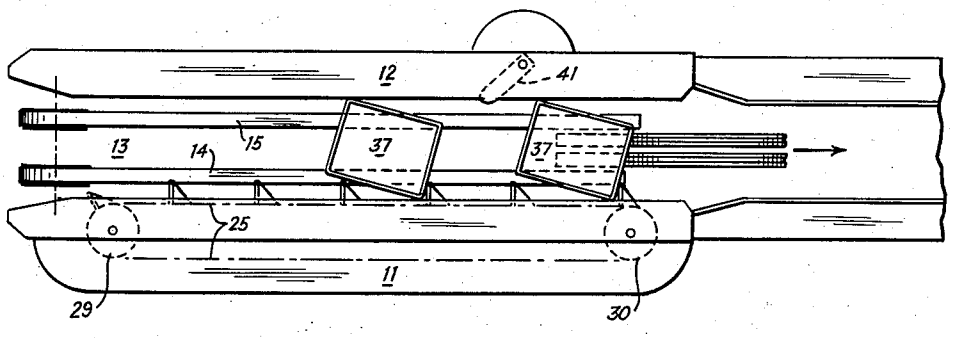


Fig. 12

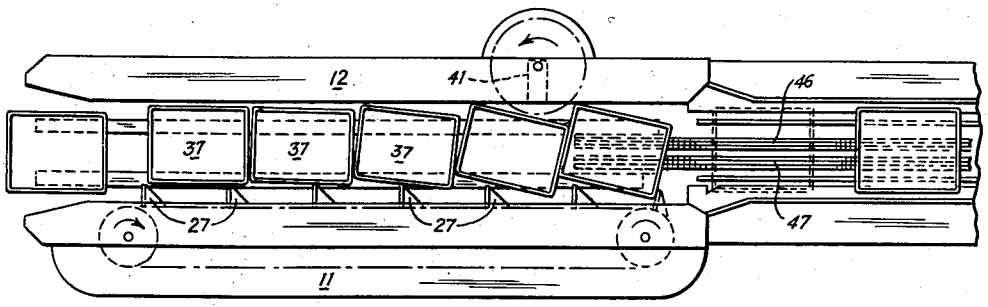


Fig. 13

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CONVEYING DEVICES FOR ACCELERATING AND TIMING ARTICLES

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Application April 24, 1957, Serial No. 654,928

17 Claims. (Cl. 198—34)

This invention relates to the art of packaging.

Articles of merchandise to be packaged undergo a series of operations which are performed by special mechanical equipment at individual stations, and a conveyor is commonly employed for moving the articles from one station to the next. The conveyor motion may be of the stop-and-go type, in which case the output is relatively limited. The conveyor motion may also be continuous, in which event the output is greater.

There are many instances where a packaging station must receive articles in a precisely defined position and in predetermined intervals of time. Frequently a further requirement is added, namely that the articles must pass the station at a predetermined rate of speed.

Problems arise where the supply to a conveyor or packaging line is irregular. Such instances occur, for example, where manual operations are involved either at the initial stage, or at an intermediate stage, of the packaging operation. Such situations arise, for example, where packages are manually filled, weighed, or checked. Similar situations arise at a point of convergence of the output of several fully mechanized supply lines in any one of which irregularities may develop leading to a temporary scarcity or oversupply of articles which then reach the packaging line singly, or in groups comprising a plurality of units backed up end-to-end, with irregular space intervals between the units or groups of units.

Further complications arise where from a point of sometimes uniform and sometimes non-uniform supply the articles must be accelerated to a high velocity for passage through subsequent stations.

Slow rates of acceleration are undesirable, since they result in a great length of the path during which the required acceleration takes place, thus requiring much floor space. Limits are set to the permissible rate of acceleration by the nature of the merchandise which may be damaged or displaced by too rapid rates of acceleration.

A typical example of the aforementioned problems is presented in the packaging of fresh fruits and vegetables about to be frozen. The food is packaged in preformed hinge-cover folding boxes. The packaging is generally done by hand and requires weighing, since many types of food do not lend themselves to loading by volumetric measurement. The output of a manual packaging and weighing line is by necessity non-uniform. At certain times individually filled boxes pass down the line while at other times boxes arrive in such numbers that they are backed up end-to-end. At this point the boxes are still open, to be closed at a subsequent station at which the boxes pass an automatic box closing machine capable of operating at high rates of speed, up to 400 boxes per minute.

Where the packaged food is bulky and where there is danger that portions of the contents project above the top edges of the boxes, so as to interfere with the operation of the box closing machine, it is necessary to compact the contents at a station before the closing station.

The compacting station is usually equipped with an

automatic machine for pressing down the box contents below the top edges of the box by means of paddles or plungers. During this operation the side walls and the end walls of the box must be firmly supported to prevent bursting of the box. Compacting machines are capable of operating at rates of the order of 400 boxes per minute, and it is readily seen that the box must arrive at the machine at a precisely predetermined moment and in a precisely predetermined position so that the paddle or plunger of the machine is accurately centered and bears down on the contents, but not on the box walls.

The compacting station is followed by a closing station at which the hinged cover of the box is closed and locked. The closed box is then usually overwrapped at an overwrapping station at which a sheet of wax paper, regenerated cellulose or other suitable sheet material is applied.

In the given example the problem of conveying the filled boxes from a point of supply at which the boxes are practically at rest, or slowly moving, to a station past which the boxes must move at predetermined spaced and timed intervals and at a predetermined high rate of speed is further complicated by the need for accelerating the boxes and their contents without dislocation or loss of a portion of the contents. Certain foods, such as lima beans, peas, Brussels sprouts, are easily thrown from the boxes unless the acceleration is gradual.

Problems identical with or similar to the ones described are encountered in other phases of the packaging industry and are solved by the present invention which provides a device which accepts articles supplied to the device in irregular order and conveys and delivers them, in timed and spaced order of delivery and at a predetermined high rate of speed.

The invention, illustrated and explained by its particular application to a conveying device for handling filled frozen food boxes, teaches how articles accepted singly or in groups, with irregular spaces between individual articles and groups may be automatically separated and spaced, accelerated, and, if desired, so controlled that they pass certain stations not only at a predetermined high linear velocity, but also in a required positional relationship.

The objects, features and advantages of this invention will appear more fully from the detailed description which follows accompanied by drawings showing, for the purpose of illustration, a preferred embodiment of the invention. The invention also resides in certain new and original features of construction and combination, as well as sub-combination, of elements hereinafter set forth and claimed.

Although the characteristic features of this invention which are believed to be novel will be particularly pointed out in the claims appended hereto, the invention itself, its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part of it, in which:

Figure 1 is a perspective view, from above, of the receiving end of the conveying mechanism, the mechanism being shown empty of boxes;

Figure 2 shows the mechanism of Figure 1 after entry of two spaced boxes into the mechanism;

Figure 3 is a perspective view of the mechanism of Figures 1 and 2 at an advanced stage of the operation at which the boxes shown in Figure 2 have advanced and are followed by a group of boxes backed up end-to-end;

Figure 4 shows the mechanism of Figures 1 to 3 at a further advanced stage of the operation at which certain boxes have moved off and additional boxes are received;

Figure 5 is a perspective side view showing the passage of boxes through a transfer portion of the conveying mechanism, the direction of the view being towards the receiving end of the machine;

Figure 6 is a perspective view of the transfer portion, the direction of the view being toward the delivery end of the mechanism at which the pack-down machine is located;

Figure 7 is a perspective side view of a portion of the drive lying on the opposite side of the transfer portion shown in Figure 5;

Figures 8 and 9 are perspective views, from above, showing the separation of boxes which are interlocked or entangled by reason of overlapping of cover flaps;

Figure 10 is a diagrammatic plan view of the portion of the conveying mechanism shown in Figure 1;

Figure 11 is a diagrammatic elevational view of the mechanism of Figure 10 showing details of the drive, portions of which are also seen in Figure 7;

Figure 12 is a diagrammatic plan view of a modified mechanism in which the timing conveyor has lugs along one side of the box track, instead of along both sides as shown in Figures 1 to 11; and

Figure 13 illustrates the action of the mechanism of Figure 12 when handling a group of boxes backed up end-to-end.

In the following description and in the claims various details will be identified by specific names for convenience. The names, however, are intended to be generic in their application. Corresponding reference characters refer to corresponding parts in the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose certain specific details of the invention for the purpose of explanation of broader aspects, but it is understood that the details may be modified in various respects without departure from the principles of the invention and that the invention may be applied to other structures than the one shown.

The drawings illustrate the principles of the invention applied to a conveying mechanism for supplying filled folding boxes to a pack-down machine which compacts the box contents by means of a rotating plunger arrangement, while the boxes are moving past the plunger mechanism at a rate of the order of 400 boxes per minute. The compacting mechanism is described and illustrated in considerable detail in a prior Patent No. 2,718,992 to T. R. Baker et al. dated September 27, 1955, entitled "Pack-Down Machine for Folding Boxes and Cans."

As previously indicated, the compacting machine is served by a conveyor in which the filled folding boxes are "walled in" along four sides to prevent bursting of the boxes when the plunger compresses the box contents below the level defined by the top edges of the box walls.

The "walling in" of the folding boxes is accomplished by two wide vertically extending rails along the conveyor. These rails are stationary and engage the front wall of the box as well as the back wall to which the cover is hinged. The conveyor proper carries an upright wall or plate for each box against which the leading side wall of the box bears, and a further wall or plate on the conveyor engages the trailing side wall of the box. The latter wall or plate of the conveyor is hinged and is swung down to admit a box entering the conveyor. It is readily understood that in order to place a box into a conveyor pocket formed by the upright wall and the side rails, the box must be advanced faster than the conveyor, so as to move the box against the front plate before the back plate swings into vertical position to complete the enclosure of the box along its fourth side.

The conveyor of a compacting machine is visible at the left of Figure 6 and will be described later.

The conveying mechanism about to be described in greater detail comprises a receiving conveyor which accepts boxes either singly or in groups. The receiving conveyor is combined with a timing conveyor which automatically spaces the boxes and times them. An intermediate conveyor then picks up the spaced and timed boxes and advances them to a delivery conveyor. The delivery conveyor discharges the boxes accurately timed and spaced and at a high linear velocity. In the illustrated application of the invention the delivery conveyor discharges into the conveyor of the pack-down machine.

During the travel of the boxes from the receiving end of the receiving conveyor to the discharge by the delivery conveyor the boxes are accelerated, but the acceleration is so gradual, even though occurring within a relatively short distance, as to prevent loss or even displacement of the box contents.

Referring now to the drawings, Figure 1 shows the receiving end of the conveying mechanism. A pair of rails **11** and **12** define a track **13** within which folding boxes may move from the far end towards the observer.

A receiving conveyor for feeding boxes into the track **13** comprises two friction belts **14** and **15** trained around pulleys **16**, **17**, **18** and **19** on horizontal shafts **20** and **21**. Shaft **21** carries a sprocket gear **22** around which a drive chain **23** extends. Between the shafts **20** and **21** the belts **14** and **15** are supported by rollers **24**. The receiving conveyor **14**, **15** may be termed a vertical conveyor because the feed and return runs of the belts lie in substantially the same vertical plane.

A timing conveyor also extends into the track **13**. The timing conveyor may be termed a horizontal conveyor and comprises chains **25** and **26** equipped with sets of lugs **27** and **28**, respectively. The chains **25** and **26** extend around terminal sprocket gears **29**, **30** and **31**, **32** on vertical shafts **33**, **34**, **35** and **36**. Shafts **34** and **36** are drive shafts and are also seen in Figures 6 and 7.

The chains **25** and **26** are so spaced that only the lugs **27** and **28** protrude beyond the rails **11** and **12** and extend into the track **13**. The lugs **27** of the chain **25** are staggered with respect to the lugs **28** of the chain **26**, and the space between a lug and the opposite rail is slightly more than the width of the boxes to be handled. The space between the two rows of opposite lugs **27** and **28** is less than the width of the boxes. The distance between alternate lugs, i. e. the distance from a lug **28** to the next lug **27** is less than the length of the box to be handled. These dimensions are also apparent from Figures 2 and 3 showing boxes **37** on the track **13**. Supporting rails **38** and **39** support the lugs **27** and **28** and prevent sagging of the chains **25** and **26**.

For the purpose of explanation of the operation of the device it may be assumed that the boxes to be handled measure four inches in width and five and one-quarter inches in length. It may further be assumed that both belts **14** and **15** of the receiving conveyor move at a velocity of 6.5 inches per time unit, and that the lugs **27** and **28** of the timing chains advance at a slower velocity of 4.5 inches per time unit.

In Figures 2 to 7 the boxes **37** are shown without covers for the sake of clarity. The covers were removed so as not to obscure portions of the mechanism, particularly the lugs of the conveyors and other elements about to be described.

Figure 2 shows two boxes 37_1 and 37_2. Box 37_1 entered the track **13** first and was grasped by the receiving conveyor **14**, **15**, which engages the bottom of the box. Box 37_2 entered the track shortly after box 37_1, sufficiently later to provide a substantial space between the two boxes. It is apparent from Figure 2 that box 37_2 entered the track in a slightly slanted position.

The conveyor **14**, **15** moves both boxes at a faster rate than the rate of advance of the lugs **27**, **28** of the

timing conveyor 25, 26. Because of its slanted position the box 37_2 cleared the lug 27 appearing near the center of the figure and is in a position in which its left leading corners will come to bear against the lug 28 appearing between the two boxes. When this happens, the traveling speed of the box which originally was 6.5 inches per time unit is reduced to 4.5 inches per time unit. Box 37_1 is shown in the position which box 37_2 will assume when it approaches the end of the run of the timing conveyor 25, 26, except that the box 37_2 will then be engaged by the lug 28 visible in Figure 2 between the two boxes.

It is also readily seen that box 37_2 would have engaged a lug 27, if the box had been slanted in the opposite direction when it entered the track 13. Since the distance between the lugs 27 and 28 is slightly less than the width of the boxes, spaced boxes automatically run into the row of lugs 27 or into the opposite row 28, whereafter the boxes advance at the rate of the timing conveyor.

Additional means are provided to insure positive engagement of the boxes by the lugs of the timing conveyor. Horizontally disposed pusher elements are provided which are so arranged that all boxes are positively forced into engagement with the lugs of the timing conveyor on one side or on the opposite side of the track.

Referring to Figure 1, rotating arms 40 and 41 are mounted on vertical shafts 42 and 43. The shafts also carry sprocket gears 44 and 45 in mesh with the inner runs of the chains 25 and 26, resulting in rotation of the arms 40 and 41 in timed relationship with the lugs of the timing conveyor.

The distance between the end of the fully extended arm 40 and the opposite rail 12 is slightly more than the width of the box, but the distance between the arm 40 and the lug 28 is less than the width of the boxes, so that boxes engaged by the arm 40 are positively forced into engagement with one of the lugs 28. Similarly, the arm 41 swinging into the track from the opposite side forces boxes engaged by the arm 41 into engagement with the lugs 27.

This action is illustrated in Figure 2 where the arm 40 is shown in approximately fully extended position in which box 37_1 is forced into the path of the lug 28 at the bottom of the illustration. At this phase of the operation the opposite arm 41 is in fully retracted position, 180 degrees out of phase with the arm 40.

In comparing the angular position of the arms 40 and 41 it should be remembered that arm 40 moves in a clockwise direction while arm 41 moves in a counterclockwise direction. At the instant illustrated in Figure 2 the arm 40 has moved a few degrees past the position in which it is fully extended into the track and arm 41 is shown an equal number of degrees advanced beyond the position in which it formed a right angle with regard to the rail 12.

Figure 3 illustrates the machine at a later phase of the operation at which the box 37_2 has nearly reached the end of the track 13. Three further boxes entered the track in the meantime. The first of these, identified as 37_3, has come to rest against the lug 27 visible near the center of the figure. The next two boxes, 37_4 and 37_5, are backed up end-to-end, but have assumed slightly staggered positions because of the staggered arrangement of the lugs 27, 28. The boxes are arrested with respect to the timing conveyor only by reason of the engagement of the leading box 37_3 with the lug 27 and will continue to advance in this position until box 37_3 is released by the timing conveyor. This is shown in Figure 4 illustrating the instant at which the lug 27, which had previously engaged the leading end of box 37_3, was just withdrawn from the track 13. At this point the released box 37_3 is advanced by an intermediate conveyor comprising belts 46 and 47 later to be described. At this point it is sufficient to state that the intermediate conveyor 46, 47 moves at a higher velocity than the timing conveyor 25, 26, thereby removing the released box 37_3 at an accelerated rate.

As soon as the box 37_3 is released by the lug 27 which previously held it, the entire row of boxes 37_4 through 37_7 advances under the action of the receiving conveyor 14, 15 which, as will be remembered, advances two inches farther per time unit than the timing conveyor. The box 37_4, however, which previously was only retarded by its engagement with the trailing wall of the box 37_3 is only free to advance until it comes to bear against the lug 28 which is a fraction of an inch in advance of the box 37_4 and is visible near the bottom of the figure. The box 37_4 cannot escape engagement by the lug 28 because of the action of rotating pusher arm 40 which forces the box over, if the box is not already in a position to move against the lug 28. When the box 37_4 is finally released, the next box 37_5 comes to bear against the lug 27 visible just above the pusher arm 40 and the opposite pusher arm 41 insures that the box 37_5 will not miss the lug 27.

It is seen from Figure 4 that the staggered arrangement of the lugs on the timing conveyor automatically results in a corresponding arrangement of the boxes traveling along the track 13. Since folding boxes are deformable to a certain degree and since the boxes may comprise structural elements, such as covers or flaps (not shown in Figures 1 to 4) which cause the boxes to be entangled to such an extent that the boxes undergo deformation rather than lateral shifting, the pusher arms 40 and 41 are provided as a safety measure to insure that each box prior to its release moves into positive engagement with one of the lugs of the timing conveyor. An example of such entanglement will later be described in connection with Figures 8 and 9.

Figure 5 illustrates the central portion of the conveying mechanism, the end of the rails 11 and 12 and the beginning of further rails 111 and 112 which define a continuation 113 of the track 13 beyond the end of the timing conveyor 25, 26.

The run of the intermediate conveyor 46, 47 is coextensive with the end of the run of the timing conveyor, and boxes released by the timing conveyor are frictionally engaged by the intermediate conveyor and accelerated before being moved into the grip of a further delivery conveyor also located between the rails 111 and 112.

The belts 46 and 47 of the intermediate conveyor are trained around pulleys 48 and 49 on the shaft 21 (Figure 1) at one end and the other end of the intermediate conveyor is defined by further pulleys 50, 51 (Figure 6).

The intermediate conveyor 46, 47 frictionally engages the bottom of the boxes and advances them at an accelerated rate of the order of 8.75 inches per time unit into the track extension 113.

The difference between the speed of 4.5 inches per time unit of the timing conveyor, and the speed of 8.75 inches per time unit of the intermediate conveyor automatically causes separation of boxes which were backed up end-to-end during their travel between the rails 11 and 12.

The delivery conveyor comprises a substantially vertically disposed chain 52 carrying lugs 53 moving alongside the intermediate conveyor 46, 47. The run of the delivery conveyor 52 is coextensive with the end of the run of the intermediate conveyor 46, 47 which feeds the boxes into the path of the lugs 53.

The conveyor chain 52 is trained around a sprocket wheel 54 (Figure 11) fixed on a drive shaft 55. The drive shaft 55 carries a further sprocket gear 56 driven by a chain 57 constituting a part of the driving mechanism later to be described in greater detail.

At this time it is sufficient to state that the velocity of the delivery conveyor 52 exceeds the velocity of the intermediate conveyor 46, 47. A suitable velocity for the delivery conveyor is 11 inches per time unit, slightly more

than two inches faster than the intermediate conveyor moving at a rate of 8.75 inches per time unit.

The lugs **53** of the delivery conveyor are spaced farther than the length of the boxes, the preferred spacing being 11 inches in the illustrated example. The lugs **53** of the delivery conveyor **52** are so timed that boxes carried by the intermediate conveyor **46, 47** move into the path of the lugs **53** some distance behind the last lug raised into the path of the track portion **113**, but well in advance of the next lug **53** about to rise into the path of the boxes at the end of the delivery conveyor. This relationship is illustrated in Figure 6 where the box 37_2 is being moved into the track portion **113** behind the box 37_1 whose trailing wall is engaged by a lug **53**, but well in advance of the next lug **53** which moves into the path of the boxes behind the box 37_2 as the chain **52** moves around the end sprocket wheel **54** (Figure 11).

By reason of the higher speed of the delivery conveyor **52** the lug **53**, which is shown some distance behind the box 37_2, catches up to the box and positively advances it by the time the box has reached the position occupied by the box 37_1 in Figure 6.

Once the boxes are engaged by the lugs **53** of the delivery conveyor they advance at intervals determined by the spacing of the lugs **53** at the high rate of speed of the delivery conveyor.

In Figure 6 the delivery conveyor is shown to discharge the boxes into the pockets of a further conveyor forming a part of a packdown machine. The chain portion of the conveyor **60** of the packdown machine is not visible, but the elements between which the boxes are walled in are shown. These comprise two fixed lateral rails **58** and **59** snugly engaging the front and back walls of the boxes. The conveyor **60** carries upright leading walls or plates **61** and trailing walls **62** hingedly arranged and so controlled that the walls are automatically moved down to admit a box, as the respective conveyor pocket moves into the space between the lateral rails **58** and **59**. The box **37** in advance of the box 37_1 in Figure 6 is in the process of being moved against a leading wall **61** of the conveyor **60**. At this moment the box **37** is still being advanced by the lug **53** engaging its trailing side wall. Shortly thereafter the lug **53** withdraws downwardly as the chain **52** moves around its far end sprocket (not visible). At this moment the hinged trailing wall **62** of the conveyor pocket rises, so that the box **37** is now confined along all four walls in preparation of the decent of the pad or plunger **63** of the packdown machine which enters the space between the box walls and compacts the box contents to a level below the top edges of the box walls.

In Figure 6, as in the preceding figures, the boxes are shown with their covers removed. In actual practice, however, the box covers extend upright from the back walls of the boxes on the far side with respect to the observer, and a guide rail **64** is provided for deflecting any box covers which might accidentally lean over a box body as the boxes approach the packdown station.

Figures 8 and 9 show filled boxes passing towards the intermediate conveyor **46, 47**. The boxes are frozen food boxes with box covers **65**. The covers include flaps along three sides which during the closing operation are folded over and locked with the front and side walls of the box. A detailed disclosure of this form of hinge cover box is found in the United States patent to Stenger, No. 2,785,845, issued March 19, 1957.

Prior to the closing of the boxes the flaps of the box cover overlap, if the boxes are backed up end-to-end. This position is shown in Figure 8 where the trailing flap **66** of the cover **65** on the box about to be released by the timing conveyor overlaps the inside of the leading flap **67** extending from the cover **65** of the next box. This overlap tends to draw the second box away from the lug **28**. At this moment the pusher arm **40** comes into action and forces the leading end of the second box towards the rail **12**. Figure 9 illustrates the result of this operation and shows the second box a safe margin behind the lug **28** to insure timing of the box prior to its release to the action of the intermediate conveyor **46, 47**.

The shifting of the second box involves a flexing or folding of the flaps **66** and **67** along their respective fold lines.

The driving mechanism of the conveying device and the interrelation between the various conveyors is best explained by referring to the diagrammatic Figures 10 and 11.

The main drive shaft **55** of the conveying device carries a chain gear **56** around which the drive chain **57** extends. The chain **57** in the installation shown in Figure 6 extends to a further gear **68** on a power driven shaft **69** of the packdown machine which contains a main prime mover for operating the packdown machine and the conveying mechanism which feeds it.

Referring again to Figures 10 and 11, the drive shaft **55** carries a sprocket gear **70** from which a drive chain **71** extends to a further sprocket gear **22** on the shaft **21**. The gear **22** is also visible in Figure 1. The shaft **21** carries the end pulleys **18, 19** of the vertical receiving conveyor whose other terminal pulleys **16, 17** are on the shaft **20**. The receiving conveyor **14** extends over three guide rollers **24** of which the third one, counting from the left, changes the direction of the upper run of the conveyor **14** so as to move away from the boxes which are about to be engaged by the intermediate conveyor **46, 47**.

The drive shaft **21** further carries drive pulleys **48, 49** for the intermediate conveyor belts **46** and **47**. The pulleys **48** and **49** have a larger diameter than the pulleys **18, 19**, thereby imparting to the conveyors **46, 47** a higher linear speed than the speed of the conveyors **14, 15**.

The chain **71** which extends from the gear **70** and drives the sprocket gear **22** also extends over an idler sprocket gear **72**.

The main drive shaft **55** further carries the sprocket gear **54** around which the delivery conveyor chain **52** carrying lugs **53** is trained. A further sprocket gear **73** on the drive shaft **55** carries a drive chain **74** extending over an idler gear **75** and a sprocket gear **76** on a shaft **77**. The shaft **77** is also visible in Figure 7 and carries a helical gear **78** meshing with a further helical gear **79** on the shaft **34**, the ratio of the helical gears being one to two. The shaft **34** carries the sprocket gears **30** around which the timing conveyor chain **25** extends. The other end of the chain extends around sprocket gears **29**.

The gear ratios are indicated by noting the number of teeth of the various gears in Figure 11. More particularly, gear **70** on shaft **55** is indicated as having 21 teeth; gear **73** as having 28 teeth; gear **56** as having 36 teeth and gear **54** as having 44 teeth.

Gear **76** on shaft **77** is shown as having 14 teeth and being driven by the gear **73** which has 28 teeth. The sprocket gear **22** on the shaft **21** is indicated as having 15 teeth and being driven by the gear **70** which has 21 teeth. The gear **44** of the rotating arm **40** and the gear **30** of the timing conveyor are both indicated as having 18 teeth.

Figures 12 and 13 illustrate a modification of the receiving and timing conveyors in which only one timing conveyor chain **25** having lugs **27** is employed. The conveyor chain **25** extends around gears **29** and **30** and is driven in the same manner as previously described. For the purpose of an example of relative conveyor velocities it may be assumed that the conveyor chain **25** moves at the rate of 4.5 inches per time unit. Its cooperating pusher arm **41** is mounted oppositely, as in the previously described form of the mechanism, but makes twice as many revolutions.

The receiving conveyor is of modified construction and comprises two friction belts **14** and **15'** of which the belt **15'** moves at a faster rate than the belt **14**. A suit-

able speed relationship is 6.5 inches per time unit for the belt 14 and 7.75 inches per time unit for the belt 15'.

As a result, boxes entering the track 13 are pivoted clockwisely to run against the lugs 27 of the timing conveyor 25. Figure 12 illustrates the position which spaced boxes 37 assume within the track 13. The boxes are pivoted until their left trailing corner meets the rail 12 whereafter they advance as shown.

Figure 13 illustrates the passage of boxes through the conveyor which were backed up end-to-end when entering. The pressure between the boxes prevents the boxes from pivoting fully. When the boxes reach the position at which the arm 41 engages the boxes, they are pivoted to such an extent that they cannot escape the arresting action of the lugs 27.

Obviously the principles of the invention explained in their particular application to a conveyor for supplying a pack-down machine may be applied with similar advantages to conveying devices for other purposes.

What is claimed is:

1. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having spaced lugs laterally disposed with respect to the track for engaging the leading ends of articles moved on said track by said receiving conveyor, said timing conveyor being coextensive with a least the end portion of said receiving conveyor; means within the extent of said timing conveyor for laterally displacing at least the leading ends of articles on said track into engagement with lugs of said timing conveyor; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having spaced lugs thereon, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

2. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having lugs laterally disposed with respect to the track for engaging the leading ends of articles moved on said track by said receiving conveyor, said lugs being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; means within the extent of said timing conveyor for laterally displacing at least the leading end of articles on said track into engagement with lugs on the timing conveyor; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having lugs spaced apart farther than the length of the articles to be conveyed, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

3. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having lugs disposed along one side of the track and adapted to engage the leading ends of articles on said track by said receiving conveyor, said lugs being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pusher projectible into and retractable from the path of the articles moving on said track, said pusher being mounted on the other side of the track opposite said lugs and timed with regard to said timing conveyor for displacing the leading ends of said articles into the path of the lugs, the space between the lugs and the projected pusher being less than the width of the articles; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having lugs spaced apart farther than the length of the articles to be conveyed, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

4. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having two parallel rows of lugs laterally disposed with respect to said track, one on each side, the lugs of one row being staggered with respect to the lugs of the other row, successive lugs of the timing conveyor being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pair of pushers projectible into and retractable from the path of the articles moving on said track, said pushers being timed with regard to said timing conveyor and adapted to engage articles moving

on said track to displace the leading ends of said articles into the path of the lugs of one row or the other, one of said pushers being mounted on one side of the track, the other pusher being mounted on the opposite side of the track and longitudinally offset with respect to the one pusher; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having lugs spaced apart farther than the length of the articles to be conveyed, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

5. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a substantially vertically disposed receiving conveyor below said track for frictionally engaging the underside of articles on said track; a substantially horizontally disposed timing conveyor having lugs laterally extending into the path of articles on said track for engaging the leading ends of articles advanced on said track by said receiving conveyor, said lugs being spaced less than the length of the articles to be conveyed, the run of the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pusher arm mounted for rotation in a substantially horizontal plane and adapted to swing into and out of the path of articles moving on said track to engage the sides of said articles and displace at least the leading ends of the articles into the path of lugs of the timing conveyor opposite said pusher arm, said pusher arm being geared to rotate in timed relationship with said timing conveyor; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having lugs spaced apart farther than the length of the articles to be conveyed, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

6. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a substantially vertically disposed receiving conveyor below said track for frictionally engaging the underside of articles on said track; a substantially horizontally disposed timing conveyor composed of two horizontally disposed conveyor units carrying lugs laterally extending into the path of articles on said track, said lugs being adapted to engage the leading ends of articles advanced on said track by said receiving conveyor, the lugs of one unit being staggered with respect to the lugs of the other unit, successive lugs of the timing conveyor being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; two pusher arms mounted for rotation in a substantially horizontal plane and adapted to swing into and out of the path of articles moving on said track, one arm being mounted on one side of the track, the other arm being mounted on the opposite side of the track and offset with respect to the one arm in the direction of the track, said arms being adapted to engage the sides of the articles and displace at least the leading ends of the articles into the path of the lugs of the timing conveyor unit opposite the respective pusher arm, said pusher arms being geared to rotate in timed relationship with said timing conveyor; an intermediate vertically disposed conveyor for receiving, and frictionally engaging the underside of, articles released by said timing conveyor at the end of said timing conveyor; a substantially vertically disposed delivery conveyor having lugs spaced farther apart than the length of the articles to be conveyed, the beginning of the delivery conveyor being spaced from the end of said timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, the speed of the intermediate conveyor is higher than the speed of the receiving conveyor, and the speed of the delivery conveyor is the highest.

7. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles at such velocity in timed and spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track, said receiving conveyor comprising two conveyor units of which one moves at a higher rate of speed than the other, thus tending to pivot articles engaged thereby; a timing conveyor having spaced lugs along one side of said track for engaging the leading ends of articles advancing and pivoting on said track, said timing conveyor being coextensive with at least the end portion of said receiving conveyor, its lugs being adjacent the slower of the two units of the receiving conveyor; an intermediate conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; a delivery conveyor having spaced lugs thereon, the beginning of the delivery conveyor being spaced from the end of the timing conveyor, but overlapping a portion of the extent of said intermediate conveyor, the lugs of the delivery conveyor being so timed that they move into the path of said track behind articles carried on said intermediate conveyor, the length of the delivery conveyor being sufficient to permit its lugs to catch up with articles conveyed by said friction conveyor so that its lugs engage the backs of articles moved by said friction conveyor and advance them positively; and common drive means for driving said conveyors at interrelated speeds of which the speed

of the timing conveyor is the slowest, the speeds of both units of the receiving conveyor are higher than the speed of the timing conveyor, and the speed of the intermediate conveyor is higher than the speed of the faster of the units of the receiving conveyor, and the speed of the delivery conveyor is the highest.

8. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having spaced lugs laterally disposed with respect to the track for engaging the leading ends of articles moved on said track by said receiving conveyor, the said timing conveyor being coextensive with at least the end portion of said receiving conveyor; means within the extent of said timing conveyor for laterally displacing at least the leading ends of articles on said track into engagement with lugs of said timing conveyor; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

9. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having lugs along at least one side of the track for engaging the leading ends of articles moved on said track by said receiving conveyor, successive lugs being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; means within the extent of the timing conveyor for laterally displacing at least the leading end of articles on said track into engagement with lugs on the timing conveyor; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

10. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having a row of lugs along one side of the track and a further row of lugs along the opposite side of the track, the lugs of the one row being staggered with respect to the lugs of the other row, successive lugs of the timing conveyor being spaced apart less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; means within the extent of the timing conveyor for laterally displacing at least the leading end of articles filling the track alternately into engagement with the lugs within one row and the other row; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

11. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having lugs along the side of the track for engaging the leading ends of articles moved on said track by said receiving conveyors, successive lugs being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pusher periodically projectible into the path of articles moving on said track, said pusher being timed with regard to said timing conveyor and mounted on the side of the track opposite said lugs, the distance between the projected pusher and the row of lugs being less than the width of the articles, so that the projected pushed displaces the leading ends of the articles into the path of the lugs; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

12. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having two parallel rows of lugs laterally disposed with respect to said track, one on each side, the lugs of one row being staggered with respect to the lugs of the other row, successive lugs of the timing conveyor being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pair of pushers projectible into and retractable from the path of the articles moving on said track, said pushers being timed with regard to said timing conveyor and adapted to engage articles moving on said track to displace the leading ends of said articles into the path of the lugs of one row or the other, one of said pushers being mounted on one side of the track, the other pusher being mounted on the opposite side of the track and longitudinally offset with respect to the one pusher; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

13. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a substantially horizontally disposed timing conveyor having lugs along at least one side of the track for engaging the leading ends of articles moved on said track by said receiving conveyor, successive lugs being spaced less than the length of the articles to be conveyed, the timing conveyor being coextensive with at least the end portions of said receiving conveyor; a pusher arm

mounted for rotation in a substantially horizontal plane and adapted to swing into and out of the path of articles moving on said track to engage the sides of said articles and displace at least the leading ends of the articles into the path of the lugs of the timing conveyor opposite said pusher arm, said pusher arm being geared to rotate in timed relationship with said timing conveyor; a further vertically disposed conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

14. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor composed of two horizontally disposed conveyor units carrying lugs extending into the path of articles on said track adjacent the sides of the track, said lugs being adapted to engage the leading ends of articles advanced on said track by said receiving conveyor, the lugs of one unit being staggered with respect to the lugs of the other unit, successive lugs of the timing conveyor being spaced less than the length of articles to be conveyed, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; two pusher arms mounted for rotation in a substantially horizontal plane and adapted to swing into and out of the path of articles moving on said track, one arm being mounted on one side of the track, the other arm being mounted on the opposite side of the track and offset with respect to the one arm in the direction of the track, said arms being adapted to engage the sides of the articles and displace at least the leading ends of the articles into the path of the lugs of the timing conveyor unit opposite the respective pusher arm, said pusher arms being geared to rotate in timed relationship with said timing conveyor; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyors at interrelated speeds of which the speed of the timing conveyor is the slowest, the speed of the receiving conveyor is higher, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

15. A device for gradually accelerating articles, such as folding boxes, supplied to the device in irregular order, to a predetermined velocity and for delivering the articles in uniformly spaced order, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; said receiving conveyor comprising two conveyor units of which one moves at a higher rate of speed than the other, thus tending to pivot articles engaged thereby; a timing conveyor having spaced lugs along one side of said track for engaging the leading ends of articles advancing and pivoting on said track, said timing conveyor being coextensive with at least the end portion of said receiving conveyor, its lugs being adjacent the slower of the two units of the receiving conveyor; a further conveyor for receiving and frictionally engaging articles released by said timing conveyor at the end of the timing conveyor; and common drive means for driving said conveyor at interrelated speeds of which the speed of the timing conveyor is the slowest, the speeds of both units of the receiving conveyor are higher than the speed of the timing conveyor, and the speed of said further conveyor is higher than the speed of said receiving conveyor.

16. In a device for conveying and delivering articles, such as folding boxes, supplied to the device in irregular order, in timed and spaced order of delivery, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having spaced lugs laterally disposed with respect to the track for engaging the leading ends of articles moved on said track by said receiving conveyor, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; means within the extent of the timing conveyor for laterally displacing at least the leading ends of articles on said track into engagement with lugs of said timing conveyor, said lugs being spaced less than the length of the articles to be conveyed; and drive means for moving said receiving conveyor at a higher linear speed than said timing conveyor.

17. In a device for conveying and delivering articles, such as folding boxes, supplied to the device in irregular order, in timed and spaced order of delivery, the device comprising, in combination, means forming a track along which said articles are movable; a receiving conveyor below said track for frictionally engaging and advancing articles on said track; a timing conveyor having spaced lugs laterally disposed with respect to the track for engaging the leading ends of articles moved on said track by said receiving conveyor, the timing conveyor being coextensive with at least the end portion of said receiving conveyor; a pusher periodically projectible into the path of articles moving on said track, said pusher being timed with regard to said timing conveyor and mounted on the side of the track opposite said lugs, the distance between the projected pusher and the lugs being less than the width of the articles, so that the projected pusher displaces the leading ends of the articles into the path of said lugs; and drive means for propelling said receiving conveyor at a higher linear speed than said timing conveyor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,840,224 June 24, 1958

Frank M. Lefief

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 60, for "individually" read -- individual --; column 7, line 48, for "decent" read -- descent --; column 14, line 23, for "pushed" read -- pusher --.

Signed and sealed this 2nd day of December 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents