May 16, 1967 H. J. GRANGER 3,319,784

APPARATUS FOR DETECTING AND REJECTING IMPROPERLY FILLED PACKAGES

Filed July 1, 1965 3 Sheets-Sheet 1

Fig. 1

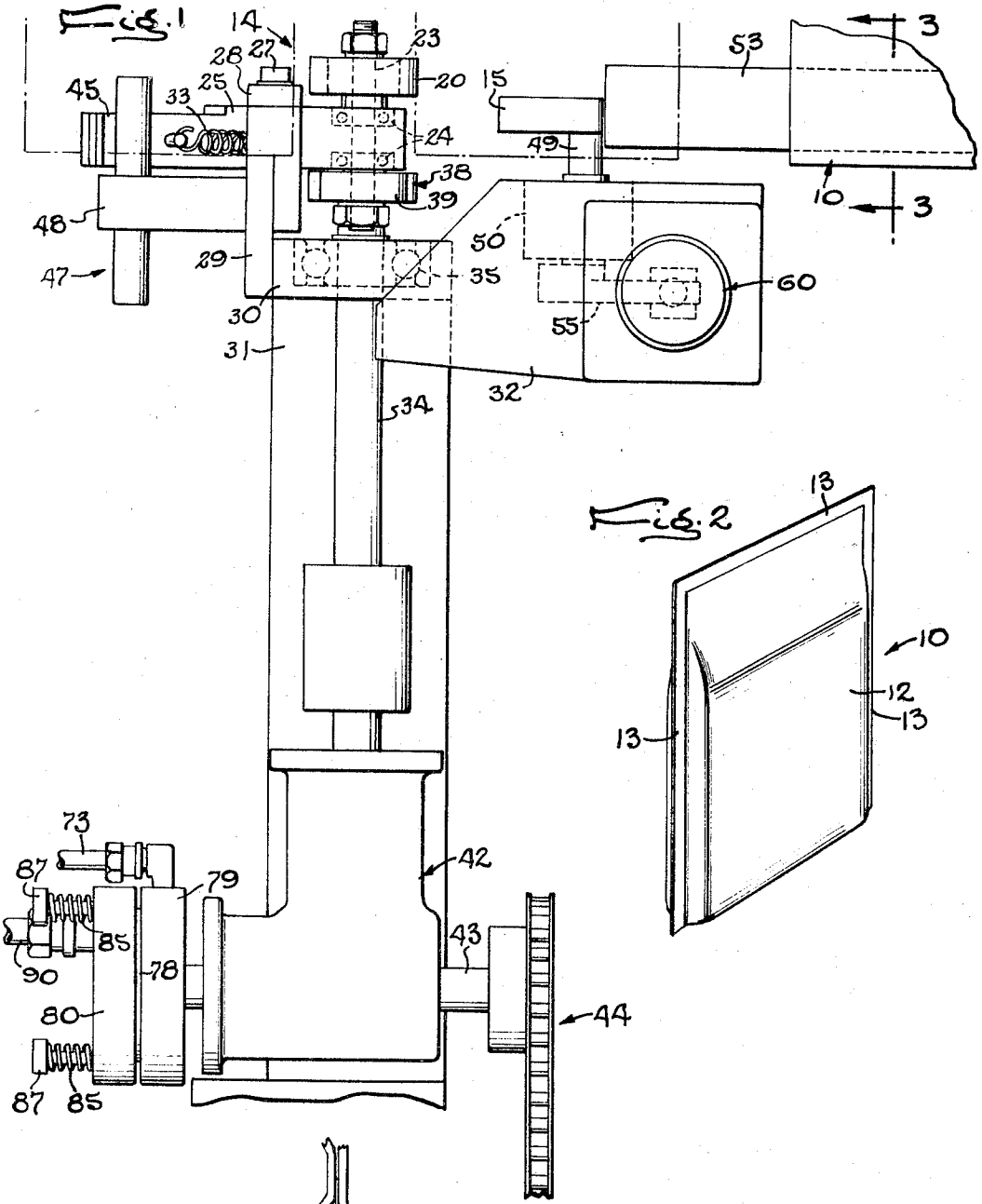
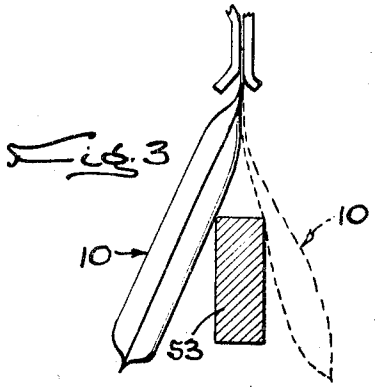


Fig. 2

Fig. 3



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Fig. 4

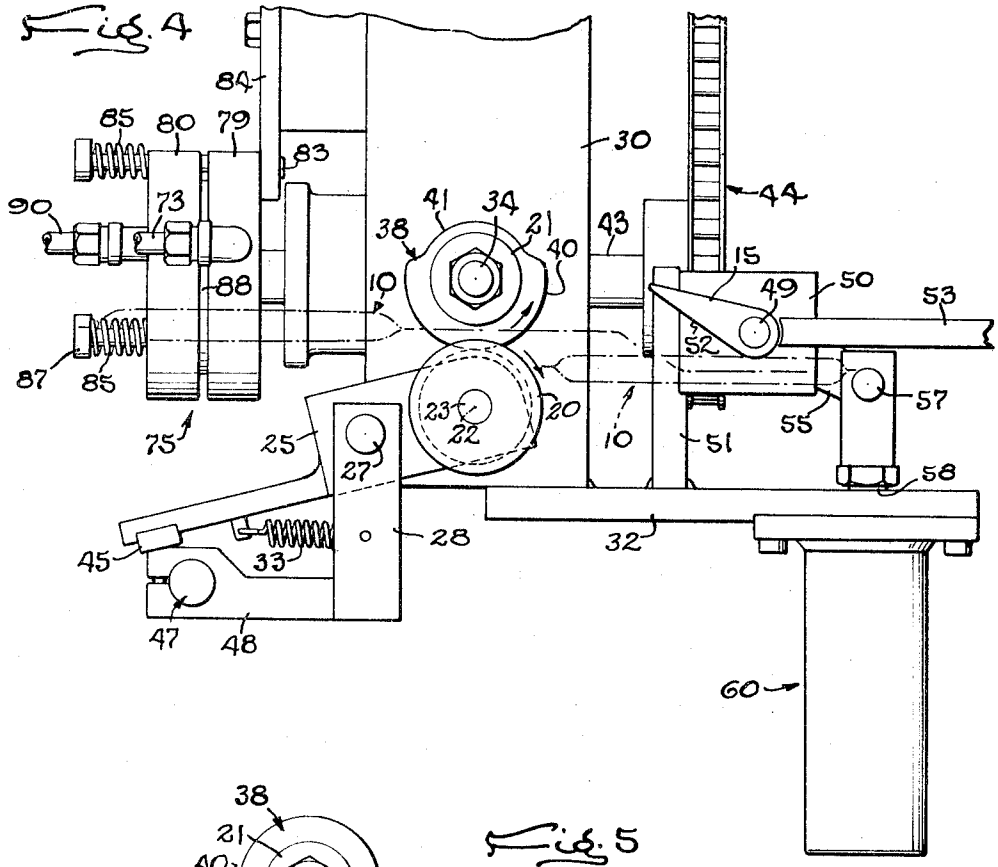


Fig. 5

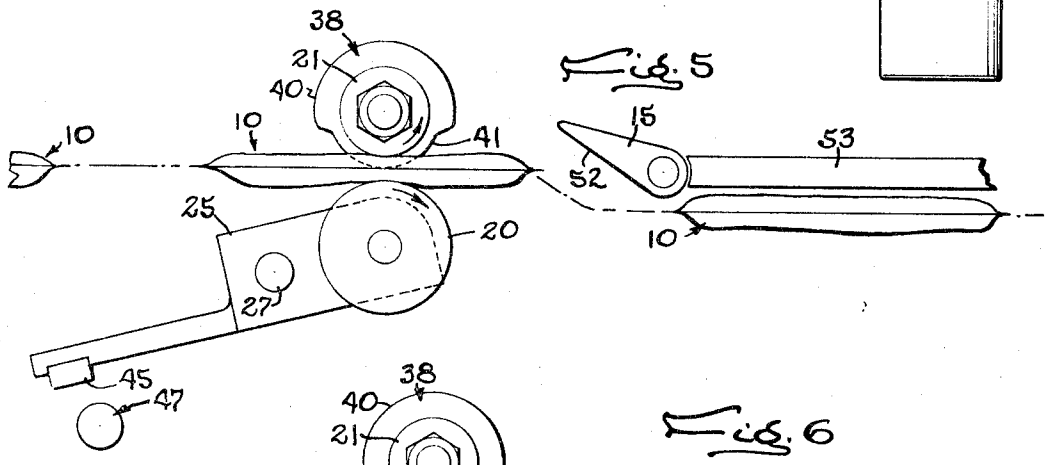
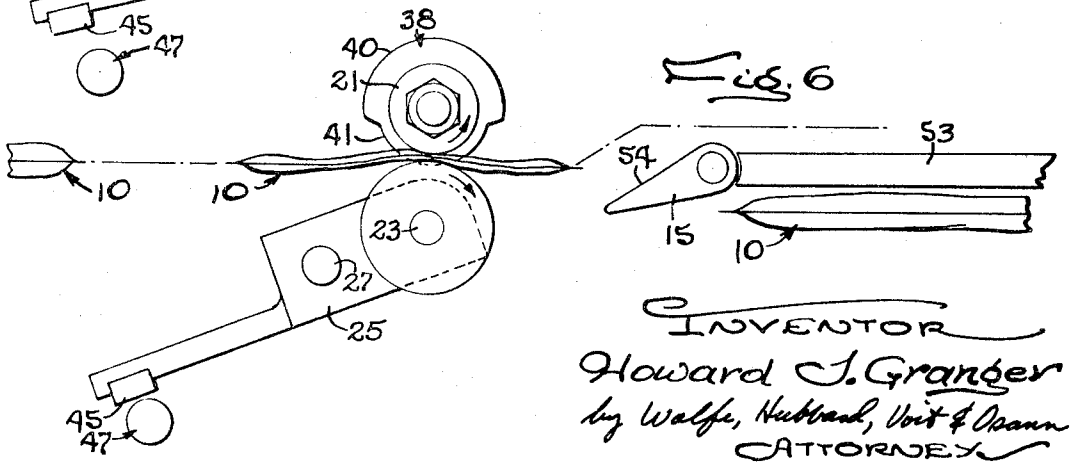


Fig. 6



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Fig. 7

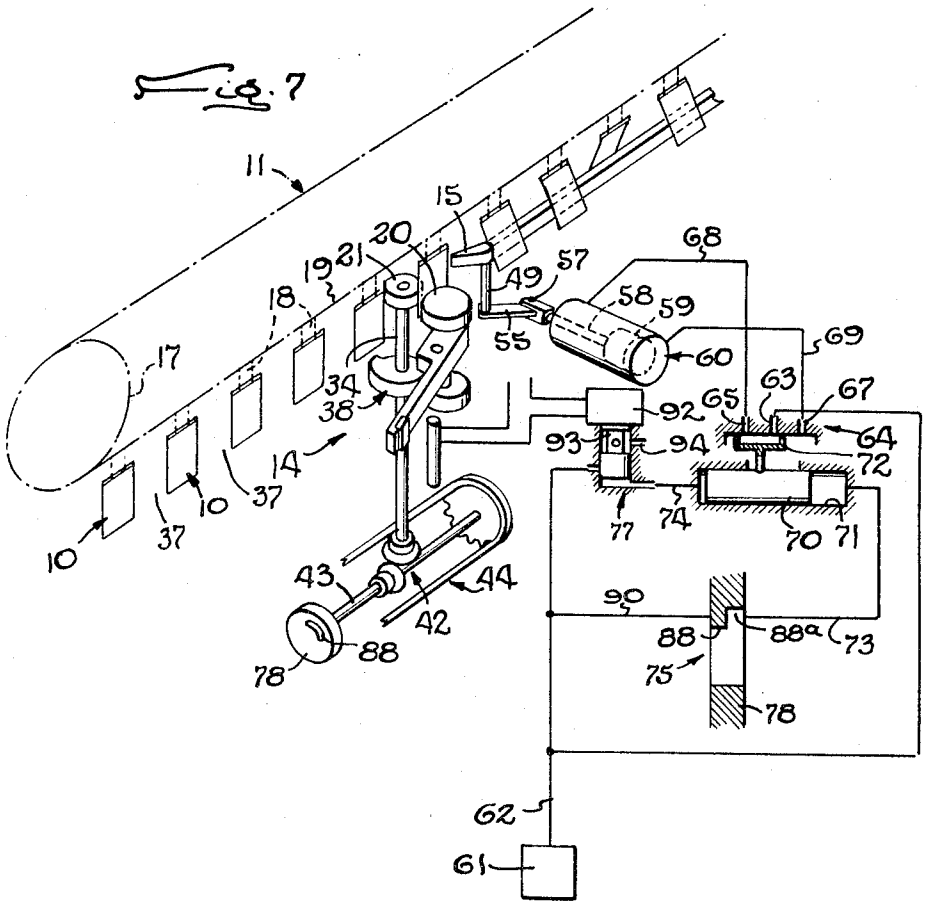


Fig. 8

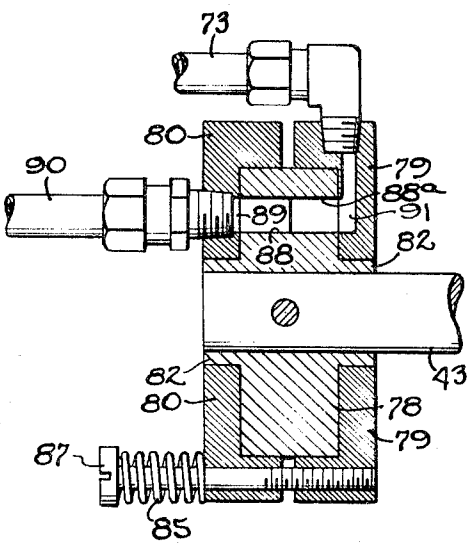
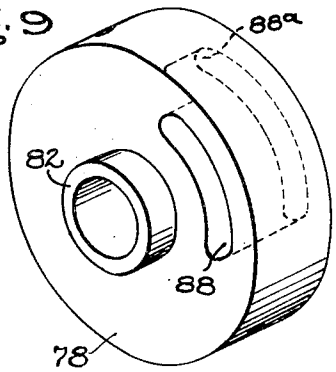


Fig. 9



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APPARATUS FOR DETECTING AND REJECTING IMPROPERLY FILLED PACKAGES

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Filed July 1, 1965, Ser. No. 468,893
12 Claims. (Cl. 209—74)

This invention relates to packaging machines and, more particularly, to an apparatus for use in high-speed automatic machinery for detecting the improper filling of flexible-walled packages in a succession or row of such packages and automatically separating the improperly filled packages from the others.

The general object of the present invention is to provide a new and improved apparatus of the foregoing character which is extremely simple in construction and operation and is adapted for the high-speed operation necessary in modern packaging machines.

A more detailed object is to use a simple roller for detecting underfilling of packages by feeling the sides of the packages and assuming a position corresponding to the thickness of the package.

Another object is to prevent false signaling of underfilled packages as a result of movement of the detecting roller into the gaps between adjacent packages in the row.

A further object is to prevent such false signaling in an extremely simple but effective manner.

Still another object is to separate underfilled packages from the row quickly and effectively with a high speed diverter of simple construction.

The invention also resides in the manner of operation of the diverter by the detector.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

FIGURE 1 is a fragmentary side elevational view of part of a machine embodying the novel features of the present invention.

FIG. 2 is a perspective view of a representative package.

FIG. 3 is a fragmentary cross-sectional view taken substantially along the line 3—3 of FIG. 1.

FIG. 4 is a fragmentary plan view of the parts shown in FIG. 1.

FIG. 5 is a view similar to part of FIG. 4 with parts in moved positions.

FIG. 6 is a view similar to FIG. 5 showing another condition of the parts.

FIG. 7 is a schematic perspective view of the apparatus together with a diagram of the pneumatic control circuit.

FIG. 8 is an enlarged view of a valve in FIG. 1 but shown in cross-section.

FIG. 9 is an enlarged perspective view of part of the valve shown in FIG. 8.

As shown in the drawings for purposes of illustration, the invention is embodied in an apparatus for detecting the underfilling of flexible-walled packages 10 advancing edge-to-edge in a row supported by a carrier 11 (FIG. 7), and sorting out or rejecting all those packages that have not been properly filled. Such apparatus is adapted for use with and forms a part of a high speed automatic machine (not shown) for forming, filling and closing the packages which eventually are collected automatically and prepared for shipment. In modern automatic machines of this type, packages are formed at rates on the order of 200 to 400 packages per minute.

The illustrative package 10 (see FIG. 2) is a generally flat rectangular pouch or bag comprising two sheets 12 of flexible packaging material disposed in opposed face-to-face relation and joined together along their margins by seals 13 along the top and sides, and usually by a fold integrally joining the sheets across the bottom of the pouch to completely enclose the packaged product. When the package is completed, the quantity of product therein causes outward bulging of the flexible sheets to an extent determined by the amount of product in the package. For various reasons, a small percentage of the pouches delivered to the carrier 11 by the package-forming portion of the machine in service use are underfilled or empty and thus are somewhat narrower in thickness than the properly filled pouches.

The present invention contemplates a new and improved apparatus for detecting the underfilling of the pounches and rejecting those that are underfilled, the apparatus being relatively simple in construction and operation as compared to prior devices for this purpose. To these ends, a novel detector 14 is disposed along the path of the pouches for feeling engagement with the sides of the passing packages to measure the thickness of the packages and produce a signal indicating each underfilled pouch, and a diverter 15 is positioned along the path beyond the detector and operated at high speed in response to such signals to separate each underfilled pouch quickly and simply from the advancing row of pouches.

As shown in FIG. 7, the carrier 11 is formed by an endless chain disposed in a vertical plane and trained around horizontally spaced sprocket wheels as indicated at 17 with a plurality of clips 18 of well known construction equally spaced along the chain to hang below the lower run 19 thereof. Each pouch discharged from the forming portion of the machine is gripped at its top in a clip at the left end of the carrier and carried edgewise to the right in a vertical plane along the path defined by the lower run of the chain.

The detector 14 comprises a roller 20 and a backing 21 disposed on opposite sides of the path of the pouches 10 for engagement with opposite sides of successive pouches as the latter move along their path, the roller being supported for movement toward and away from the backing and yieldably urged toward the backing to press each passing pouch against the backing and assume a position determined by the thickness of the pouch. In this manner, the roller senses and indicates the extent to which each pouch was filled with the packaged product. In this instance, the detecting roller 20 is supported for rotation about a vertical axis 22 on the upper end portion of a shaft 23 journaled in vertically spaced bearings 24 (FIG. 1) adjacent the right end (FIG. 4) of a rocker arm 25 pivoted intermediate its ends on a vertical pin 27 on the free end of a bar 28 overhanging the rocker. The bar 28 is supported at its other end on an upright bar 29 projecting upwardly from a horizontal plate 30 projecting across the pouch path beneath the latter and supported at one end on an upright post 31 (FIG. 1) and at the other end on a plate 32 (FIG. 4) in a plane paralleling the pouch path. A coiled contractile spring 33 is stretched between the bar 28 and the left end portion of the rocker to urge the latter counterclockwise about the axis defined by the pivot pin 27 and swing the roller 20 toward the backing 21.

Herein, the backing 21 is a second roller supported level with the detecting roller 20 on the upper end of an upright shaft 34 that is power rotated counterclockwise as viewed in FIGS. 4–6 to turn the backing roller at a peripheral speed the same as the speed of advance of the pouches. The shaft is journaled in bearings 35 in the plate 30 as shown in FIG. 1 with the periphery of the roller positioned to engage the adjacent sides of the passing pouches when the latter are vertically disposed.

It will be seen in FIG. 7 that adjacent pouches **10** on the carrier **11** are spaced apart so that there are substantial gaps **37** (FIG. 7) between the pouches. To prevent movement of the detecting roller **20** into these gaps, means are provided for holding the rollers apart and maintaining a minimum spacing between them except when a pouch is between the rollers. This is accomplished by a rotary cam **38** mounted on the power-rotated shaft **34** below the level of the pouches for engagement with a follower **39** in the form of a roller on the lower end of the shaft **23** carrying the detecting roller. The cam has an arcuate surface **40** extending part way around its periphery and disposed at a radius such that it holds the follower roller and the rocker **25** in the retracted positions shown in FIG. 4 when this surface is in engagement with the follower. The remainder of the periphery of the cam is cut away to form a recess **41** which permits the follower, and thus the rocker and the detecting roller, to move toward the backing into an extended position (FIG. 6) in which the spacing of the detecting and backing rollers is less than the desired minimum thickness of the pouches.

The arcuate extent or length of the cam surface **40** corresponds to the spacing of the adjacent edges of adjacent pouches, and the length of the recess **41** corresponds to the width of the pouches. With the shaft **34** rotating in timed relation with the advance of pouches, the cam holds the detecting roller **20** away from the backing roller **21** until the leading edge of a pouch enters between the rollers, then releases the detecting roller for movement toward the backing roller, and again takes over control of the detecting roller as the trailing edge of the pouch leaves the rollers. With properly filled pouches of substantial thickness, the detecting roller moves only to the position shown in FIG. 5. If the pouch is empty or has been underfilled, the roller moves closer to the backing as shown in FIG. 6. Operation of the cam in timed relation with the pouch movement is effected by driving the shaft **34** through right-angle gearing **42** (FIGS. 1 and 7) from a perpendicular shaft **43** having a chain-and-sprocket drive connection **44** with the main cycle shaft (not shown) which also drives the carrier **11**.

The motion of the detecting roller **20** and the accompanying motion of the rocker arm **25** are used to produce the signals for operating the diverter **15**. Herein, a magnet **45** is mounted adjacent the left end of the rocker to swing toward a proximity switch **47** as the detecting roller swings toward the backing. The spacing of the switch from the magnet when the roller is in engagement with a properly filled pouch **10** is sufficient to prevent actuation of the switch for operation of the diverter. Further swinging of the magnet toward the switch in response to engagement of the roller with an underfilled pouch, however, brings the magnet close enough to actuate the switch and operate the diverter. By careful selection and positioning of the switch and the magnet, the detection apparatus can be set up to produce an electrical signal in response to each pouch that is below a preselected minimum thickness.

As shown in FIGS. 1 and 4, the switch **47** is housed in a cylinder clamped in a hole through a split bar **48** projecting laterally from the side of the bar **29** and supporting the switch alongside the left end portion of the rocker **25**. The diverter **15** is simply a finger pivoted at one end on a vertical pin **49** preferably disposed in the path of the pouches with the free end portion of the finger extending upstream toward the detector **14** from the pivot and swingable laterally from side to side between the two positions illustrated in FIGS. 5 and 6. The pivot pin projects upwardly from a block **50** supported below the level of the lower edges of the pouches on an arm **51** welded to the frame plate **32** paralleling the pouch path.

In the normal position of the finger **15** shown in FIGS. 4, 5 and 7, the leading edges of pouches leaving the detector **14** engage the side **52** of the finger and are deflected laterally generally to the right in FIG. 7, bending

the pouches adjacent the clips **18** and offsetting the lower portions or bodies of the pouches to the right as the latter are drawn past the finger. An elongated guide bar **53** alined at its upstream end with the pivot pin **49** and extending downstream therefrom holds the pouch bodies in the laterally offset position as they slide along the bar.

When the diverter **15** is operated in response to a signal from the detector **14**, the finger swings counterclockwise (FIGS. 5 and 6) to the oppositely inclined position shown in FIG. 6 to position the opposite side **54** of the finger for engagement with the leading edge of the next passing pouch to deflect the body of the pouch in the opposite direction around the pivot and onto the opposite side of the guide bar **53**. Thus, the diverter simply, quickly and effectively sorts out the underfilled pouches and separates them from the properly filled pouches.

To swing the finger **15** back and forth in response to the signals produced by the switch **47**, a radial crank **55** (see FIG. 7) is fast on the lower end of the pivot pin **49** and pivotally connected at **57** to the outer end of a rod **58** carried by the piston **59** of a double-acting pneumatic cylinder **60** actuated by the signals produced by the switch. As shown in FIG. 7, air under pressure from a source **61** is supplied to a line **62** communicating with the inlet port **63** of a control valve **64** operable to connect the inlet alternately to two outlet ports **65** and **67** communicating respectively with lines **68** and **69** leading to opposite ends of the cylinder **60**. The control valve is of a well known type including a piston **70** reciprocable in a cylinder **71** and carrying a slide **72** which connects the inlet alternately with the two outlets in the two alternate positions of the piston. This piston is shifted back and forth within the valve cylinder by pressure air admitted into the opposite ends of the cylinder through lines **73** and **74** communicating with the source **61** through operating valves **75** and **77**.

The operating valve **75** controls the flow of air through the line **73** to the right end of the valve cylinder **71** to urge the valve piston **70** to the position shown in FIG. 7, and thus controls the admission of air into the rod end of the actuating cylinder **60** to swing the finger **15** into its normal position (FIGS. 4, 5 and 7). A shown in FIGS. 4, 8 and 9, this valve comprises a valve member in the form of a disk **78** pinned to the end of the driving shaft **43** and fitted between two oppositely opening cups **79, 80** having center holes **81** telescoped snugly over flanges **82** projecting from opposite sides of the disk **78**. The cup **79** on one side of the disk is secured by a bolt **83** (FIG. 4) to a frame plate **84** and the other cup **80** is frictionally pressed against the opposite side of the disk by springs **85** compressed between the cup and the heads of bolts **87** extending through the outer peripheral portion of the cup **80** and threaded into the fixed cup. The shanks of these bolts are spaced outwardly beyond the periphery of the disk.

With this arrangement, the disk **78** is rotated between the cups **79** and **80** by the shaft **43** in timed relation with the advance of the pouches **10**, making one revolution for each pouch passing through the detector **14**. Formed in the disk is an arcuate slot **88** that is radially spaced from the center thereof to revolve about the axis of the shaft **43** past a radially offset inlet port **89** in the cup **80** provided with pressure air through a line **90**. Angularly alined with this port is an outlet port **91** in the other disk **79** which receives air through the slot **88** once during each revolution of the disk. This port communicates through the line **73** with the right end of the control valve cylinder **71**. The rotation of the disk is timed with the advance of pouches to admit air to the line **73** and shift the piston **70** to the left, admitting air into the rod end of the actuating cylinder **60** to rotate the crank **55** clockwise in FIG. 7 and shift the finger **15** to its normal position. This is done as each pouch enters the detector **14**.

The proximity switch **47** is in the circuit of a solenoid **92** (FIG. 7) operable when energized to draw the plunger

93 of the operating valve 77 out of the blocking position shown in FIG. 7 thereby to admit air from the source 61 through the valve and into the left end of the control valve cylinder 71. This shifts the piston to the right to admit air into the head end of the actuating cylinder 60 and swing the crank 55 and the finger 15 counterclockwise (FIG. 7) to the reject position. Air is exhausted from the left end of the valve cylinder 71 through a passage in the plunger and an exhaust passage 94 (FIG. 7). The valve 77 opens when the disk 78 is in the condition shown in FIG. 7 with the port 89 and the line 90 closed by the disk. The port 91 and the line 73, however, communicate with the slot 88 through a notch 88[a] in the adjacent side of the disk at the trailing end of the slot thereby delaying closing of the port 91 and permitting air to exhaust from the right end of the cylinder 71 into the slot 88 and leak around the disk 78.

With the foregoing arrangement, the rotary valve 75 admits a charge of air into the right end of the control valve cylinder 71 as each pouch 10 approaches the rollers 20, 21, thereby admitting air to the rod end of the cylinder 60 and shifting the finger 15 to its normal position in FIG. 5 if the previous pouch was underfilled. Of course, if the previous pouch was properly filled, the finger already is in this position. Then, as the next pouch passes between the rollers, the cam 38 releases the follower 39 for movement of the detecting roller toward the backing roller. If this pouch is properly filled, the detecting roller is held away from the backing roller by the pouch and its contents, and the proximity switch 47 remains open. In passing the finger, the pouch engages the side 52 thereof and is cammed outwardly to the right (FIG. 7) to the position shown in full lines in FIG. 3.

If, on the other hand, the pouch between the rollers is underfilled and therefore thinner than the preselected minimum thickness, the spring 33 swings the detecting roller close enough to the backing roller for the magnet to actuate the switch and energize the solenoid 92 as soon as the cam surface 40 leaves the follower. The resulting movement of the plunger 93 opens the operating valve 77 to admit a charge of air into the left end of the control valve 64, shift the piston 70 therein to the right, and admit air into the head end of the cylinder 60 to swing the finger 15 to its reject position before the underfilled pouch reaches the finger.

Thus, the leading edge of the underfilled pouch 10 engages the side 54 of the finger 15 and is cammed to the left (FIG. 7) in passing the finger so that the body portion of the underfilled pouch is offset to the left and slides along the guide 53 shown in broken lines in FIG. 3. Prior to the entry of the next pouch between the rollers 20, 21, the operating valve 75 shifts the control valve piston 70 back to the left to return the finger to its normal position. Accordingly, the underfilled pouches are detected and separated from the normal pouch path with a relatively simple apparatus capable of effective operation at the high speeds necessary in modern machines.

I claim as my invention:

1. Apparatus for detecting the underfilling of flexible-walled pouches including, in combination, a carrier for supporting a succession of such pouches of predetermined width and advancing the same edgewise in spaced edge-to-edge relation along a predetermined path, a backing disposed on one side of said path and engageable with the adjacent sides of advancing pouches, a detecting roller disposed on the other side of said path and movable toward said backing to press each passing pouch against the backing and assume a position corresponding to the thickness of the pouch, means yieldably urging said roller toward said backing, a follower supported for rotation with said roller and spaced from said path, a rotary cam having a surface for engaging said follower and operable during such engagement to hold said roller a preselected minimum distance from said backing, said cam also having a recess for permitting movement of said roller toward said backing from said preselected minimum distance, means for rotating said cam and driving said carrier in timed relation with each other, the lengths of said surface and said recess being correlated with the width and spacing of said pouches to hold said roller away from said backing when there is no pouch between them and to release the roller when there is a pouch between them, and a device for sensing movement of said roller closer to said backing than said preselected minimum spacing.

2. Apparatus as defined in claim 1 in which said detecting roller and said follower are supported alongside said path on a rocker swingable toward and away from said path, said follower being level with said cam and said roller being level with the path of the pouches and with said backing.

3. Apparatus as defined in claim 2 in which said backing is another roller rotated with said cam at a peripheral speed the same as the speed of advance of said pouches.

4. Apparatus as defined in claim 2 in which said sensing device is a switch operated in response to swinging of said rocker toward said path.

5. Apparatus for detecting the underfilling of flexible-walled pouches including, in combination, a carrier for supporting a succession of such pouches and advancing the same edgewise in spaced edge-to-edge relation along a predetermined path, a backing roller and a detecting roller disposed on opposite sides of said path and supported for rolling engagement with opposite sides of each pouch moving along the path, said detecting roller being movable toward and away from said backing roller, means yieldably urging said detecting roller toward said backing roller to press passing pouches between said rollers whereby the detecting roller assumes a position corresponding to the thickness of the pouch between the rollers, a device for sensing the movement of said detecting roller closer to said backing roller than a preselected minimum spacing corresponding to a preselected minimum pouch thickness, a cam rotating in timed relation with the advance of pouches on said carrier and operable to prevent movement of said detecting roller closer to said backing roller than said preselected minimum spacing when there is no pouch between the rollers, and a diverter disposed along said path beyond said roller and controlled by said sensing device to separate underfilled packages from said succession.

6. Apparatus for detecting the underfilling of flexible-walled pouches including, in combination, a carrier for supporting a succession of such pouches and advancing the same edgewise in spaced edge-to-edge relation along a predetermined path, a backing and a roller disposed on opposite sides of said path and supported for engagement with opposite sides of each pouch moving along the path, said roller being supported for movement toward and away from said backing, means yieldably urging said roller toward said backing to press the roller against passing pouches whereby the roller assumes a position corresponding to the thickness of the pouch between the roller and the backing, a device for sensing the movement of the roller closer to said backing than a preselected minimum spacing corresponding to a preselected minimum pouch thickness, means for preventing movement of said roller closer to said backing than said preselected minimum spacing when there is no pouch between the roller and said backing, and a diverter disposed along said path beyond said roller and controlled by said sensing device to separate underfilled packages from said succession.

7. Apparatus as defined in claim 6 in which said movement preventing means comprise a cam rotating in timed relation with the advance of packages on said carrier, and a follower movable with said roller, said cam having a surface thereon intermittently engaging said follower to hold said roller away from said backing.

8. Apparatus for separating improperly filled packages from a succession of properly filled packages, said apparatus including, in combination, a carrier for gripping the tops of a succession of such pouches and carrying the same edgewise in spaced edge-to-edge relation along a predetermined path, a diverter disposed along said path and selectively movable between first and second positions to deflect the packages in different directions as they pass the diverter, a detector disposed along said path in advance of said diverter and operable to produce a signal in response to the passing of an improperly filled package, and means for shifting said diverter back and forth between said positions including an actuator, a control valve operable in response to pressure fluid introduced alternately into its opposite ends to operate said actuator back and forth, a first operating valve for introducing pressure fluid into one end of said control valve and shifting the diverter into said first position as each package approaches said detector, and a second operating valve operable in response to signals from said detector to shift said diverter into said second position before each improperly filled package reaches the diverter.

9. Apparatus as defined in claim **8** in which said first operating valve includes a rotary valve member turning in timed relation with the advance of said packages and delivering pressure fluid to said one end once during each revolution of said valve member.

10. Apparatus as defined in claim **9** in which said rotary valve member is a disk turning about a predetermined axis and formed with a slot therein radially spaced from said axis and disposed between inlet and outlet ports in said first operating valve once during each revolution of said disk.

11. Apparatus as defined in claim **10** further including means on said operating valve delaying closing of said outlet port by said disk after closing of said inlet port whereby exhaust fluid from said one control valve end may flow out through said outlet port after closing of said inlet port.

12. Apparatus as defined in claim **11** in which said ports are angularly alined and said delay means includes a recess adjacent the trailing side of said slot formed in the side of said disk adjacent said outlet port and communicating with said slot and said outlet port after said inlet port is closed.

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