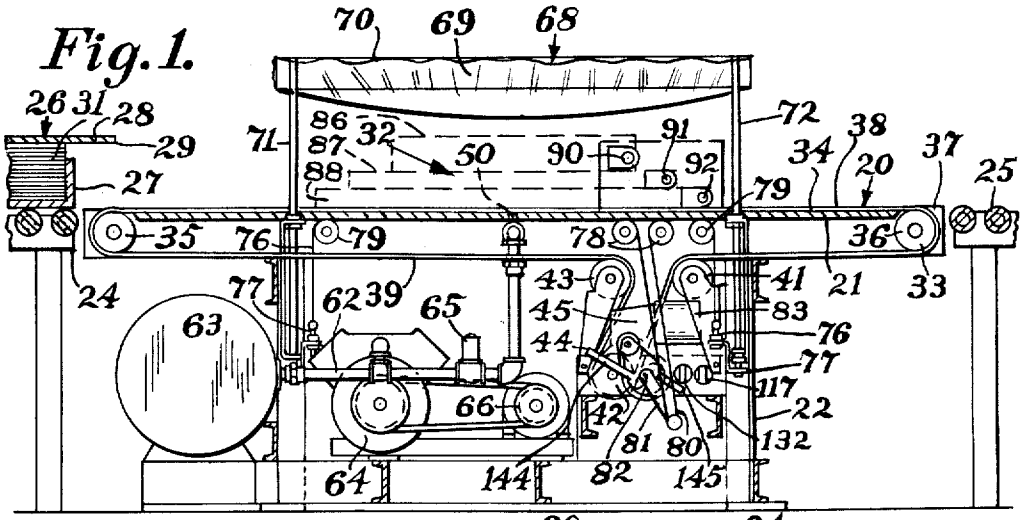
May 2, 1961 D. B. HOPKINSON 2,982,064

AUTOMATIC CARTON SEALING APPARATUS

Filed Oct. 14, 1959 2 Sheets-Sheet 1

Fig. 1.



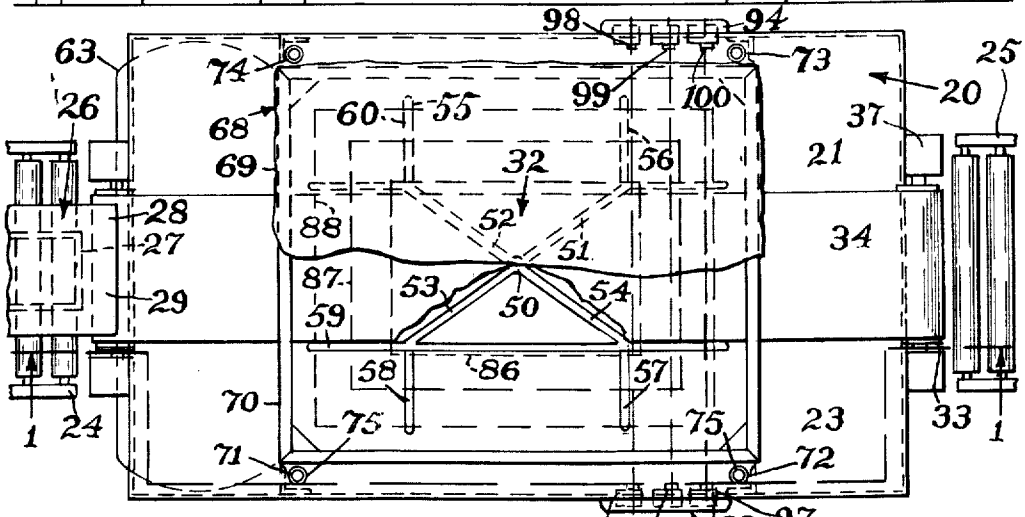


Fig. 2.

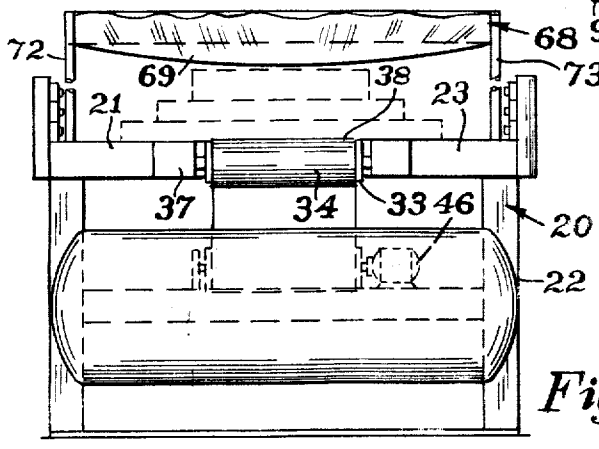


Fig. 3.

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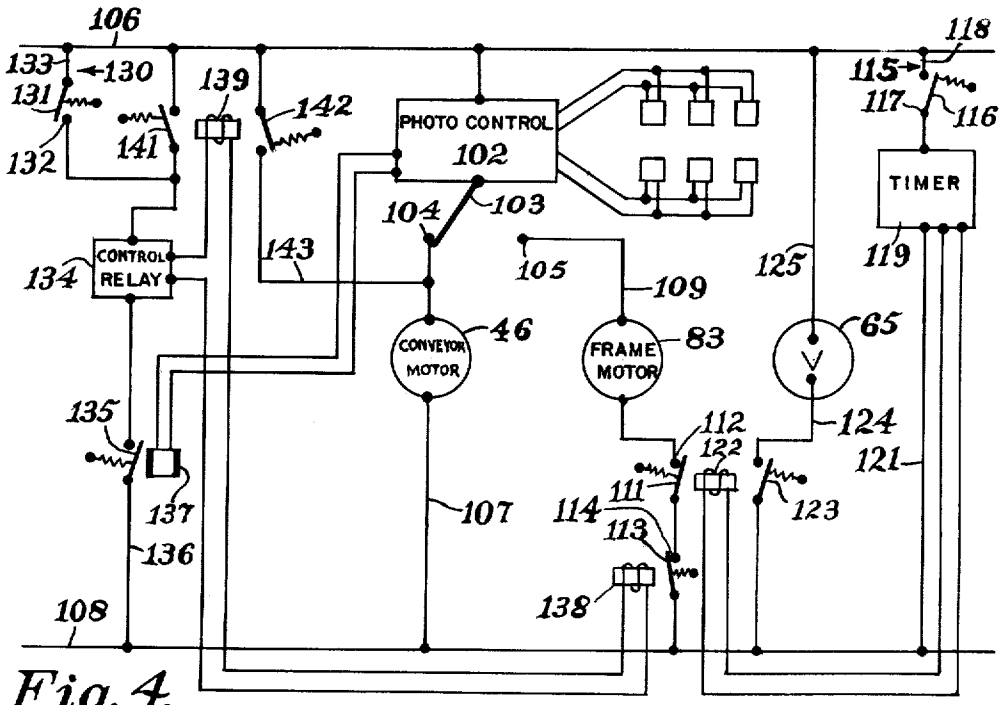


Fig. 4.

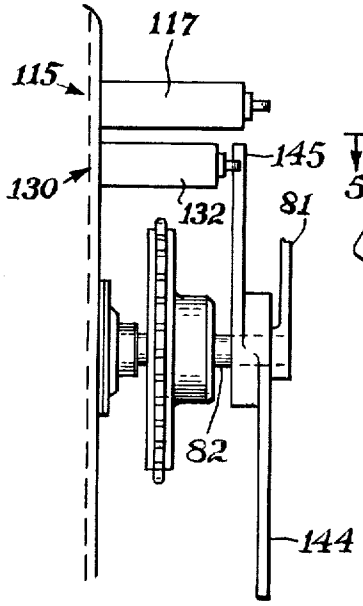


Fig. 5.

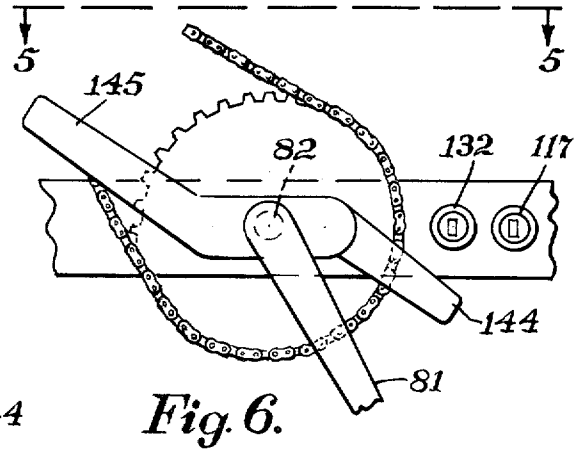


Fig. 6.

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AUTOMATIC CARTON SEALING APPARATUS

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Filed Oct. 14, 1959, Ser. No. 846,378

9 Claims. (Cl. 53—76)

This invention relates to a machine for tightly sealing large cartons such as are used to package reams of flat paper sheets or the like.

In the paper manufacturing art, the sheets of paper are usually stacked on pallets in untrimmed condition. Approximately a ream at a time is removed from the stack and passed through a trimming machine, of the guillotine knife type, wherein the four edges of the ream are accurately trimmed. The trimmed ream is then placed in the bottom portion of a paperboard carton, the upper portion of the carton placed over the lower portion and the two portions adhered to each other to tightly encase and seal the ream. It is essential that the ream of paper be so snugly fitted in the carton that there is no space for shifting of the sheets since the edges must be kept flush and the faces unwrinkled.

It has heretofore been proposed to accomplish the sealing of such cartons by vacuum means, the cartons being manually advanced to a sealing station, a flexible diaphragm lowered over the carton and air exhausted from under the diaphragm. By this means the side walls of the cover are forced to fold accurately around the top of the ream, no air space remains within the carton and the ream is hermetically enclosed in what amounts to a skin tight paperboard package. I am aware of a prior patent application, Serial No. 749,531, filed July 18, 1958, now U.S. Patent 2,932,927 to Segerstrom et al. of April 19, 1960, entitled "Carton Sealing Machine," and this application is intended to cover improvements made by me in such apparatus.

It is the object of this invention to provide vacuum carton sealing apparatus which is fully automatic in that the cartons are advanced on a power conveyor, automatically halted, automatically sealed and then automatically discharged from the apparatus.

Another object of the invention is to provide carton sealing apparatus of the vacuum diaphragm type wherein the diaphragm frame is lowered by its own weight only rather than under power. Thus there is no danger to the operator of having his hands or arms crushed by the frame.

A further object of the invention is to provide vacuum sealing apparatus which is fully automatic and which can automatically adapt itself to cartons of various sizes without requiring adjustment.

Still another object of the invention is to provide a vacuum sealing table having a novel pattern of air exhaust ports cooperable with an impervious, endless belt conveyor whereby the belt carries a carton between the ports without adversely masking the same or preventing air exhaustion.

A still further object of the invention is to provide carton sensing means, connected in series, each means being capable of sensing a carton of different dimensions and of halting the carton precisely in the centre of a vacuum sealing station or zone.

Other objects and advantages of the invention will be

apparent from the claims, the description of the drawings and from the drawings in which

Fig. 1 is a side elevational view of a machine constructed in accordance with the invention.

Fig. 2 is a plan view of the machine illustrated in Fig. 1.

Fig. 3 is an end view of the machine illustrated in Fig. 1 from the carton discharge end.

Fig. 4 is an electrical diagram of the apparatus of the invention.

Fig. 5 is a fragmentary, enlarged detail plan view of the limit switch mechanism, and

Fig. 6 is a side view of the device shown in Fig. 5.

As shown in the drawings, the improved vacuum carton sealer **20** of this invention includes the table **21**, having a base, or frame **22** and a horizontal upper face, or table top **23**. A carton conveyor **24** of a conventional type, is provided to feed unsealed cartons individually and successively onto the upper face **23** and a similar conveyor **25** is provided at the opposite end of the table to carry the sealed cartons to any desired destination. Each carton **26** includes a lower tray-like portion **27** and an upper portion **28** which may have downwardly prefolded but unsealed wall flaps or which may be a flat blank with precreased wall flaps **29**, the wall flaps having adhesive thereon ready for sealing to the lower portion.

The ream, or pile, **31** of paper sheets is preferably of greater height than the side walls of the lower portion **27** so that the upper portion or cover can be drawn down tightly therearound, all air expelled and the wall flaps of the upper and lower portions firmly adhered to each other. It will be understood that accuracy and perfect packaging are more desirable than high speed of operation for the reason that a paper trimmer must trim all four edges of a ream in successive steps whereby its production is relatively slow. Thus the sealer **20** can operate intermittently to advance an unsealed, filled carton across the upper face **23**, from the conveyor **24** to the sealing station, or zone, **32**, to then halt at station **32** for a period such as ten seconds while the carton is sealed and the adhesive dried, and to then advance the sealed carton out of station **32** across the upper face **23** to the conveyor **25**.

The cartons are advanced across the upper face **23** by a power operated conveyor **33** formed by an impervious flexible endless belt **34** trained around the end drums **35** and **36**. Drums **35** and **36** are journalled in frame pieces such as **37** of table **21**, the upper stretch **38** extending from end to end of the table and overlying a central, longitudinal strip of the upper face **23**. The lower stretch **39**, of belt **34**, is trained around an idler drum **41**, a drive drum **42** and a tension drum **43**, the drive drum **42** being connected by a suitable power train **44** to the reduction unit **45** and electric drive motor **46**.

The carton sealing station **32**, of table **21**, includes an air exhaust port **50**, in the centre of the table, four radially extending grooves **51**, **52**, **53** and **54** underlying the upper stretch **33** of belt **34** and four right angular grooves **55**, **56**, **57** and **58** each at the terminal end of one of the radial grooves. Each right angular groove such as **55** includes a leg **59** parallel to and alongside the belt **34** and another leg **60** which extends outwardly toward the side of table **21**. The pattern of the air exhaust grooves defines the sealing station **32**, and it will be apparent that the exhaustion of air from the central port **50** will tend to create a vacuum under any object resting on the portion of upper face **23** outlined by the grooves. The port **50** is connected by an air conduit **62** to a vacuum receiver tank **63** and to a vacuum pump **64**, there being a solenoid air valve **65** in conduit **62** for

controlling the exhaustion of air from port 50. The vacuum pump 64 is power operated by an electric motor 66, in a well known manner, to maintain the vacuum in tank 63 at a predetermined amount such as five (5) p.s.i. absolute or 20 inches Hg vacuum and the vacuum is adjustable from five to twenty inches of mercury.

Flexible, impervious diaphragm means 68 is provided in the form of the horizontally disposed blanket, or diaphragm, 69 draped across and supported from the rectangular frame 70 of rigid material such as wood or light metal. Diaphragm 69 may be of rubber, plastic or the like and the frame 70 is substantially co-extensive in area with the area of station 32 defined by the pattern of air exhaust ports, slots or grooves in the upper face 23. The frame 70 and diaphragm 69 are normally poised at a spaced distance above the upper face 23 by means of four guide rods 71, 72, 73 and 74 each at a corner of the frame and each slidable vertically in suitable holes, or sockets, such as at 75 in the table 21. The lower end of each of the guide rods is connected to a flexible strap such as 76, by a suitable bracket 77, each strap 76 passing over pulleys such as 78 and 79 and having its opposite end connected to the terminal end 80 of one of a pair of crank arms such as 81, each on an opposite side of the machine 20. The crank arms such as 81 are each mounted on a lateral shaft 82 which is rotatably driven by a suitable reduction unit and electric motor 83. For convenience I call the motor 83 the diaphragm motor and I call the motor 46 the conveyor motor. It should be noted that the frame 70 is raised by power but that it lowers by gravity only under the weight of the diaphragm, frame and rods, thereby avoiding any danger to the operator. When the arm 81 rotates clockwise from its uppermost position to its lowermost position it pulls downwardly on the four straps such as 76, thereby lifting the frame to its normal position. When arm 81 rotates back to its uppermost position, pull is released from the straps and the frame drops downwardly by gravity.

Multiple, electric, carton-sensing means 85 is provided for the purpose of halting the conveyor 33, with the carton carried thereon precisely and accurately in the centre of the sealing station 32, regardless of variation in the dimensions of the carton. In the machine illustrated, there are three sizes of carton customarily used, as indicated in dotted lines in Fig. 1 at 86, 87 and 88, and therefore three sensing units 90, 91 and 92 are shown. Carton sensing means 85 is mounted on table 21 proximate the delivery end of sealing station 32 and above the level of the upper face 23 of the table. A pair of upstanding framepieces 93 and 94 are fixed, each on an opposite side of table 21 and alongside the path of cartons advanced into station 32 by conveyor 33. Framepiece 93 carries three individual light sources 95, 96 and 97 while framepiece 94 carries three individual photo electric tubes, cells, transistors or other light sensitive devices 98, 99 and 100 opposite their respective light sources, whereby three separate light beams are simultaneously projected across the path of the leading walls of the cartons on conveyor 33.

Each individual carton sensing means, such as 95 and 98, 96 and 99 and 97 and 100 is staggered vertically and horizontally relative to the path of the cartons in spaced apart relation along an inclined plane so that the light beam of each means will be intercepted and broken by the leading wall of a particularly dimensioned carton such as 86, 87 or 88. The individual sensing means are connected to each other in series whereby individual and successive cartons, regardless of dimension will actuate the photo switch control means 102. Means 102 may be of the type designated "photo electric control type 20DJ1" manufactured by Photoswitch Inc., of Cambridge, Massachusetts, and shown diagrammatically in Fig. 4. The control means 102 automatically moves the armature 103 from terminal 104 to terminal 105 when the light beam of any one of the carton sensing means is intercepted. Normally the conveyor motor 46 is energized by a circuit including a source of electro motive force not shown, main conductor 106, photo control means 102, armature 103, terminal 104, conductor 107 and main conductor 108. This circuit is opened by the armature 103, in being moved to terminal 105 and a new circuit is closed including main conductor 106, photo control 102, armature 105, conductor 109, diaphragm frame motor 83, the armature 111 of switch 112, the armature 113 of switch 114 and main conductor 108. Thus the conveyor halts and the diaphragm drops by gravity onto the upper face 23 at the sealing station 32.

Upon arrival of the frame 70, on the upper face 23 of table 21, first limit means 115 is actuated, the means 115 including the armature 116 of limit switch 117, thereby completing a circuit including main conductor 106, conductor 118, armature 116, timer 119, conductor 121 and main conductor 108. Timer 119 may be of a type commercially available from the Industrial Timer Corporation of Newark, New Jersey, and upon actuation of the timer, relay 122 is energized to open switch 112 and close a switch 123. The diaphragm motor is thus deenergized while a circuit is completed including main conductors 106 and 108, solenoid valve 65, switch 123 and conductors 124 and 125. Valve 65, thereupon exhausts air from under diaphragm 69, to downfold and vacuum seal the carton at station 32, for the period set by the timer such as ten seconds. When timer 119 times out, relay 122 is deenergized to open switch 123 to valve 65 and again close switch 112 to the diaphragm frame motor 83, thereby energizing the motor and causing the frame and diaphragm to rise to their normal position poised above the upper face 23.

Second limit means 130 is provid d including the armature 131 of a switch 132 which is normally open but closed by the arrival of the diaphragm frame at its uppermost position. Switch 132 closes a circuit including main conductors 106 and 108, conductor 133, switch 132, a control relay 134, a switch 135 and conductor 136. The control relay 134 energizes a relay 138 which opens a switch 114 to the diaphragm frame motor 83 thereby stopping the same and energizes a relay 139 which closes a switch 141 for holding in relay 134 when the limit switch 132 opens and which relay also closes a switch 142 which energizes conveyor motor 46 through conductor 143 while bypassing photo control 102. The conveyor then moves the sealed carton to the delivery end of table 21, beyond the light beams of the photo switches. When all of the light beams of the series connected photo switches are restored, the photo control 102 moves armature 103 over to terminal 104 thereby permitting the conveyor to continue running and also opens switch 135 to drop out relay 134 and rest the system.

Switch 135 is opened by means of a relay 137 energized by photo control 102 when the arm 103 flips from terminal 105 back to terminal 104 thus indicating that the system is all clear and ready for receiving the next succeeding carton.

As shown in Figs. 5 and 6, I prefer to mount limit switches 117 and 132 at the side of table 21, proximate the shaft 82, for timed actuation in accordance with the rotation of shaft 82 and crank arm 81. A long arm 144 is fixed to shaft 82 to rotate therewith and to engage the switch 117 when the shaft 82 has permitted the frame to drop onto the upper face 23. A short arm 145 is also fixed to shaft 82 to rotate therewith and to engage the switch 132 when the shaft 82 has lifted the frame to its full raised position. The arms 144 and 145 rotate in different planes and the switches are similarly positioned so that each switch will be actuated only by its respective arm.

Arm 144 is set outboard from arm 145 about one quarter inch and strikes the roller on limit switch 117

while clearing the roller on limit switch 132. The arm 145 is shorter than arm 144 and strikes the roller on limit switch 132.

I claim:

1. In a carton sealer of the vacuum type, the combination of a table having a pattern of air exhaust ports in the upper face thereof outlining a carton sealing station; flexible, impervious diaphragm means, coextensive with the area of said station, vertically movable on said table and normally poised at a spaced distance above said upper face; a carton conveyor mounted on said table, said conveyor extending across said upper face from one end of said table to the other for advancing cartons up to, and away from, said sealing station; multiple, electric, carton-sensing means, mounted on said table alongside the path of a carton on said conveyor proximate one end of said sealing station, said sensing means being spaced apart and connected to each other in series for actuation by cartons of different dimensions; power operated means for raising said conveyor; power operated means for raising said diaphragm means; power operated air exhaust means for exhausting air from said ports; electric control means, responsive to actuation by any one of said sensing means, to halt said conveyor and lower said diaphragm means by its own weight only; first limit means, responsive to the arrival of said diaphragm means on the upper face of said table to actuate said air exhaust means for a predetermined period for vacuum sealing a carton at said sealing station and to then raise said diaphragm means and second limit means, responsive to the arrival of said diaphragm means at its raised position to restart said conveyor, to temporarily deactuate said sensing means and to then reactuate said sensing means.

2. A combination as specified in claim 1 wherein said carton conveyor is of less width than the width of the carton sealing station outlined by said exhaust ports and extends along a central strip thereof only.

3. A combination as specified in claim 1 wherein said diaphragm means includes a frame supported on rods slidably mounted in said table and flexible straps trained around pulleys connecting said rods to said power operated diaphragm raising means.

4. A combination as specified in claim 1 wherein said carton conveyor is an endless belt having an upper stretch overlying a central strip of the upper face of said table intermediate of said pattern of exhaust ports.

5. A combination as specified in claim 1 wherein said multiple, carton sensing means comprises at least three photo switches, spaced vertically and horizontally from each other in an inclined plane to establish at least three light beams of different heights for interception by the leading walls of cartons advanced by said conveyor.

6. A diaphragm type carton sealer comprising a table having power operated air exhaust means in the upper face thereof; power operated, vertically movable diaphragm means normally poised above the upper face of said table; power operated conveyor means for advancing cartons of different dimensions individually and successively across the upper face of said table and under said diaphragm means; a plurality of spaced photo cell units mounted above the level of the upper face of said table alongside the path of cartons advanced thereacross by said conveyor, said units being connected to each other in series and producing multiple light beams across said path, each beam for interception by the leading walls of one of said cartons of a particular dimension; means responsive to the interception of any one of said light beams by a carton for halting said conveyor means and lowering said diaphragm means over said carton; means responsive to the lowering of said diaphragm means for actuating said air exhaust means for a predetermined period and then raising said diaphragm means to its normal position and means responsive to the raising of said diaphragm means for restarting said conveyor means, temporarily deactuating said photo cell units and then reactuating the same for sensing the arrival of the next carton on said conveyor means.

7. A combination as specified in claim 6 wherein said air exhaust means in the upper face of said table includes a central exhaust outlet port, four grooves extending substantially radially outwardly from said port toward the corners of said table and four right angular grooves, each proximate a corner of said table and connected to the outer end of one of said radial grooves.

8. A combination as specified in claim 6 wherein said vertically movable diaphragm means includes a flexible, impervious diaphragm, a rectangular frame of rigid material supporting said diaphragm and frame guide rods slidably mounted in said table for retraction by the weight of said frame only.

9. Apparatus for sealing cartons of different dimensions, said apparatus comprising endless belt conveyor means for advancing cartons of predetermined different dimensions individually and successively along a straight, horizontal path through a carton sealing zone; at least three photo switches each mounted at a predetermined different horizontal and vertical position on said apparatus proximate the end of said carton sealing zone and above the level of said conveyor means, said units being connected to each other in series and producing at least three horizontally and vertically spaced light beams extending across the path of cartons carried by said conveyor means; electric control means responsive to the interception of any one of said light beams, by any carton of one of said predetermined different dimensions for deactuating said conveyor means with a carton precisely centered in said zone according to its dimensions and vacuum sealing means, in said zone, for sealing each said carton halted therein and then actuating said conveyor means to carry the sealed carton out of said zone.

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