ABSTRACT: An evacuating and heat-sealing machine for thermoplastic bags has a controller and power-driving mechanism including a plurality of commonly driven cams, a first cam causing withdrawal of a bag-evacuating nozzle, a second cam applying a pressure bar to the bag to be sealed, a third cam providing means for varying the length of the heater period, and a fourth cam controlling the length of the sealing period. All of the cams are driven simultaneously to provide parallel operation of sealing machine functions.
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EVACUATING AND SEALING MACHINE FOR PLASTIC BAGS

This invention relates to a machine for evacuating and heat-sealing thermoplastic bags, and in particular to improved mechanism for controlling the operations of such a machine.

In the past, evacuating and heat-sealing machines have usually had large and cumbersome mechanisms for controlling the evacuating and heat-sealing functions of the machine, with the source of vacuum often being used as a motive means for performing these functions, thereby requiring vacuumtight, clumpy bellows structures. Other controllers utilize external timing devices and electrical switches, with associated complex circuitry serially operated in sequence as the evacuating, heating, and sealing functions are performed.

It is, therefore, an object of the invention to provide an efficient, portable, simple and semiautomatic machine for rapidly and sequentially evacuating and sealing previously filled plastic bags.

It is another object of the invention to provide an improved, cam-operated controller for sequentially controlling the evacuating and heat-sealing operation of the machine including the varying of the length of the heat-sealing period, and the driving in synchronization of a nozzle for evacuating the bag along a bar for applying pressure to the end of the bag to be closed during the heat-sealing.

In accordance with the present invention, an evacuating and heat-sealing machine for thermoplastic bags is provided which has movable, resilient gripping means for holding a bag in vacuumproof condition, in communication with an evacuating nozzle while air is being withdrawn therefrom. A plurality of commonly driven cam means are also provided, which, when actuated at the end of a selected evacuating period, causes withdrawal of the nozzle from the evacuated bag, the application of a pressure bar along a selected heat-sealing line, the defining of the length of the sealing period, and the initiating and varying of the length of the heating period. The latter means includes a switch for energizing and deenergizing the heater movable with respect to the surface area of a cam face having a selected configuration, such that the actuating period of the switch may be varied by movement of the switch.

The novel features of the invention together with other objects and advantages thereof will become apparent from the following description of a preferred embodiment of the invention illustrated in the accompanying drawings, in which:

FIG. 1 is a plan view of the evacuating and heat-sealing machine according to the invention;
FIG. 2 is a side elevation with parts removed, taken on the line 2-2 of FIG. 1;
FIG. 3 is a front elevation, taken on the line 3-3 of FIG. 1, with parts broken away to show the cam operated controller;
FIG. 4 is a sectional view with parts removed taken on the line 4-4 of FIG. 1, to show the nozzle actuating means;
FIG. 5 is a side elevation with parts removed, taken on the line 5-5 of FIG. 1;
FIG. 6 is a sectional view with parts removed, taken on the line 6-6 of FIG. 3 to show the profile of the pressure bar cam and its associated cam follower;
FIG. 7 is a sectional view with parts broken away, taken along the line 7-7 of FIG. 3 to show the profile of the heating period control cam and the mechanism for moving the heater control switch;
FIG. 8 is a schematic wiring diagram of the electrical control circuit of the present invention; and
FIG. 9 is a fragmentary, enlarged front elevation with parts broken away to show the tensioning means for the heater ribbon.

Referring to FIGS. 1 and 2 of the drawings, the mechanism of the present invention includes generally a baseplate 10 on the front of which is mounted a projecting shelf 12 which serves to support packaged products while the products are being vacuumized and sealed. A cover (not shown) over the entire mechanism is, of course, provided. The products to be sealed are enclosed in an open-ended bag formed from thermoplastic material, so that the application of pressure will secure the plasticized parts to each other.

The end of a bag to be sealed in placed beneath a gripper bar 14 and a pressure-sealing bar 16. Gripper bar 14 has a pair of side arms 18 extending rearwardly and attached to bearings 20 which are positioned for free rotation on a main shaft 22. Shaft 22 is rotatably supported by bearing blocks 24, mounted on base plate 10 and lined with a suitable antifriction bearing Lin. Gripper bar 14 also has a longitudinal channel 28 which retains a bar of resilient material 30, such as foam rubber. Positioned directly beneath gripper bar 14 is a pad 32 formed from a strip of like resilient material mounted on shelf 12. During the evacuating step, a bag being evacuated is held in position beneath gripper bar 14, the resilient bar 30 and pad 32 serving to provide a good seal to prevent leakage and wrinkling during the evacuating step. Each side arm 18 is pivotally secured to a respective plunger 34 of a pair of solenoids 36 by means of pivot pins 38. When solenoids 36 are energized, gripper bar 14 is pulled downwardly against pad 32 to hold the open end of a bag to be sealed therebetween.

An evacuating member indicated generally as 40, has a forwardly extending, broad and flat nozzle 42 terminating in a silt orifice 44 (FIG. 3). It is adapted to be retracted from a first extended position between gripper bar 14 and pad 32 where it protrudes beyond the outer face of resilient bar 30 and into the interior of a bag to be sealed, to a second position where it is sufficiently withdrawn to allow the downward path of sealing bar 16. Nozzle 42 is attached to an axially movable shaft 46 by means of sleeve 48 which also has a fluid-conducting passageway therein to communicate with nozzle 42 and a base plate line 50. Shaft 46 is mounted for axial movement in a pair of bearing brackets 52 which have suitable low-friction sleeve bearings 54 inserted therein.

A reciprocating motion for effecting nozzle withdrawal and advancement is imparted by a cam 56 of actuating arm 56, cam follower 58 and cam 60. As shown more clearly in FIGS. 3 and 4, actuating arm 56 has one end pivotally mounted by screw 62 to a post 64 which in turn is secured to a support plate 66, fastened to baseplate 10. The other end of actuating arm 56 passes through a slot 68 in shaft 46 and is loosely coupled thereto by a transversely disposed pivot pin 70 which passes through shaft 46 and a slot 72 in actuating arm 56. Cam follower 58 is secured to actuating arm 56 and is urged against the outer, peripheral profile of cam 60 by spring 74, fastened to actuating arm 56 and bearing support 2.

Cam 60 is mounted on a shaft 76 and is adapted to be rotatably driven by a motor 78 through a conventional reduction gear box 79. Drive shaft 76 is supported by support plates 56 and 80. Cam 60 has a notch 82 which engages cam follower 58 when motor 78 is in a deenergized condition at the beginning of an evacuating cycle. It will be seen that when cam follower 58 is nested in notch 82, nozzle 42 will be in its furthest extended position to protrude beyond gripper bar 14. Because of the steepness of the sides of slot 82, rotation of cam 60 immediately causes actuating arm 56 to move shaft 46 rearwardly and retract nozzle 42.

Hose 50 is connected to a double solenoid valve generally indicated as 84 which has two inputs, either of which may be placed in communication with hose 50 by sequential operation of an associated solenoid 86 or 88. One inlet to valve 84 is connected to a vacuum pump 90 by means of a fluid-conducting hose 92. The other inlet to valve 84 may be connected to a source of suitable gas under pressure, such as nitrogen, by means of fluid-conducting hose 94, to serve as a gas flush after the air in a bag to be sealed has been evacuated. Thus, when solenoid 86 is operated, nozzle 42 is placed in communication with vacuum pump 90 to draw a vacuum therethrough. Likewise when solenoid 88 is energized, nozzle 42, by action of valve 84, is connected to an external source of pressurized gas.

Pressure sealing bar 16 overlies a strip heater unit generally indicated as 96 and is supported by a pair of side arms 98 ex-
tending rearwardly and secured to a pair of collars 100 which, in turn, are secured attached to shaft 22. Rotation of shaft 22 therefore causes pressure bar 16 to descend, downwardly towards heater unit 96. Pressure bar 16 has a longitudinally extending channel 102 into which is inserted a pad 104 formed from resilient material such as silicone rubber. Pad 104 is adapted to press the open end of a bag to be sealed firmly against heater unit 96. When pressure bar 16 is in a down position.

Pressure bar 16 has an actuating arm 106 extending rearwardly and secured fastened to main drive shaft 22 by means of a collar 107. Actuating arm 106 has a cam follower 108 (FIG. 3) supported between a pair of blocks 110, 112 which in turn are mounted to actuating arm 106. Cam follower 108 engages the peripheral cam profile surface of a cam 114, mounted on shaft 76, and is driven by motor 78. As will be seen in FIG. 6, cam 114 has a notch 116 in which cam follower 108 dwells when motor 78 is deenergized and pressure bar 16 is in an up-position. One side of notch 116 has a rather steep contour, thereby causing pressure bar 16 to almost immediately descend its full length of travel and press against the open mouth of the bag to be sealed when motor 78 is energized. Cam 100 and 114 are radially displaced with respect to each other on shaft 76 such that notch 116 is sufficiently to clear pressure bar 16 as it descends towards heating unit 96. Shaft 22, when not being rotated by action of cam 114 and cam follower 108, is maintained in a rest position by means of a spring 118 fastened between a pin 120 affixed to base 10 and a pin 122 secured to shaft 22.

Referring now to FIGS. 1 and 9, heating unit 96 has a base bar 124 spaced from baseplate 10 by spacer bars 126 and held in longitudinal alignment with pressure bar 16 by means of guide blocks 128, 130 fastened to baseplate 10. Overlaying the upper sealing surface of bar 124 and electrically insulated therefrom by a base layer of suitable insulating material 136, is a resistance heater ribbon 138 which may be formed from nichrome. The ends of heater ribbon 138 are cramped in terminals 139 which are secured by nuts 132 to respective pivot posts 140, formed from an insulating material, and pivoted in slots 142, disposed in each end of heater bar 124, by means of pivot pins 144. Springs 146 are inserted laterally in each of bar 124 and press against an associated post 148 to apply tension to ribbon 138 and compensate for expansion and contraction thereof.

In order to prevent a plastic bag being sealed from sticking to heater ribbon 138, a strip of nonstick material such as Teflon impregnated fiber cloth 148 is provided, which overlies ribbon 138 and is held tightly thereover by metal strips 150, longitudinally disposed along each side of heater bar 124.

An important feature of the present invention is the provision of novel electromechanical means for adjusting the length of the heating period with respect to the total time that pressure bar 16 is in its downward position and applying pressure against a bag being sealed. With certain thermoplastic bag materials such as nylon, it is important that a cooling time be provided after the heat has been removed, during which time pressure is applied to the seal as it cools. To accomplish this without the use of an external timing device, a cam 152 mounted on shaft 76 and driven by motor 78 is provided, which has in abutting relationship with a face 154 during a portion of its period of rotation, a spring-pressed ball 156 of an actuator 158 for a snap switch 160. Pressure on ball 156, when it engages face 154, forces pushbutton 162 to close the contacts of a conventional snap switch 160. By means of an electrical circuit described in more detail below, switch 160, when closed, allows electrical energy to be applied to heater ribbon 138 through a step-down transformer 163.

Referring now to FIG. 10, a circuit diagram 166 is shown of the electrical control circuitry of an external timing device (not shown) such as a conventional, electromechanical, synchronous clock motor-driven timer indicated schematically as 204. When holding relay 196 is energized, gas solenoid 88 is also energized and vacuum solenoid 86 is at the same time deenergized, thereby switching the inlet of vacuum valve 84 from evacuating line 92 to gas flush line 94 to apply positive gas pressure thereon.

When timer motor 204B has run a selected timing period is sufficient to fill the previously evacuated bag with an inert gas, contacts 206 associated with timer 204B are actuated and
closed to apply energy to drive motor 78 through a one revolution switch 208 (FIG. 1 and 7). The switch is secured to support plate 168 and is a normally closed snap switch operated by a cam bar 210 mounted on shaft 76. Thus, when motor 78 rotates shaft 76, cam bar 210 moves away from the actuator of switch 208, allowing it to close and provide a holding circuit for drive motor 70 until the shaft has completed one revolution. At that time, switch 208 is again opened by bar 210, stopping drive motor 70 and completing the sealing cycle.

When drive motor 70 is energized, cams 114 and 60 begin to rotate and cause pressure bar 16 to descend immediately towards sealing unit 96 and apply pressure to a bag to be sealed, while at the same time, the nozzle 42 is retracted by rotation of cam 60. Cam 152 also begins to rotate, causing switch 160 to close and apply energy to heating element 138 for a preselected period of time depending upon the location of switch 160 with respect to cam face 154. During this period, heat is applied to a bag to be sealed. At the end of this interval, the desired cooling period commences and lasts until the revolution of cam 210 is completed. Switch contacts 208 again open to stop drive motor 78, at which time pressure bar 16 rises to its dwell position, and foot switch 42 advances to its protruded position ready to receive another bag.

It will be noted that because of the holding circuit through the contacts of switch 208, the foot switch may be released after it has been pressed to its second position and motor 78 has been energized, thereby allowing gripper bar 14 to return to its elevated or dwell position.

If the gas flushing step is not desired, it may be eliminated by actuating manually operated switch 194 to close contacts 201 and 203. The circuit arrangement is then such that vacuum solenoid 86 will remain energized throughout the evacuated and heat-sealing cycle, that is, when foot switch 189 is in both its first and second positions. However, timer motor 204 will not operate when foot switch 189 is in its second position since contacts 200 are then open and holding relay 196 remain deenergized at that time. Instead, energy is applied to drive motor 70 through contacts 198 and 201, now closed, thereby allowing the pressurizing, nozzle retracting and heat-sealing step to function as described previously.

What we claim is:

1. In a vacuumizing and heat-sealing machine for plastic bags, the combination comprising a retractable, fluid-conducting nozzle communicable with the interior of a bag to be sealed, a pair of resilient gripper bars, one of said bars being stationary, means for moving the other of said gripper bars into clamping relation with said stationary bar to clamp in fluidlight relation the unshealed ends of an open-ended plastic bag around said nozzle to withdraw air from the bag through said nozzle, a stationary heat-sealing bar having electrical heating means extending longitudinally along said bar, a movable pressure bar disposed substantially parallel and adjacent to said gripper bars, and driving means for moving said pressure bar into sealing contact with said bag and said heat-sealing bar and withdrawing said nozzle in synchronism therewith from between said gripper bars to avoid contact with said pressure and heat-sealing bars, said driving means including a plurality of cams arranged on a common shaft, means for selectively rotating said shaft, first mechanical coupling means operatively associated with a first of said cams for effecting reciprocal movement of said nozzle, second mechanical coupling means operatively associated with a second of said cams and said pressure bar for raising and lowering said pressure bar in synchronism with the movement of said first cam to prevent said bar from contacting said nozzle, and further including timing means having movable switch means operatively associated with a third of said cams and in circuit with said heating means to control energization of said heating means for a predetermined first period of time while said pressure bar is in sealing contact with said bar and deenergization of said heating means at the end of said first timing period while maintaining said pressure bar in sealing contact with said bar and said heat-sealing bar for a second period of time to allow the sealed bag to cool under pressure.

2. The invention defined in claim 1 wherein said movable switch has an actuator adjacent a face of said third cam and is operable to actuate said switch when in contact with said cam face, and including means for movably positioning said switch with respect to said cam face to vary the length of the relative path of travel of said actuator over said cam face when said common shaft is rotated, thereby varying the length of time that said heating means is energized.

3. The invention defined in claim 1 including a second switch for controlling the operation of said driving means, and a fourth cam on said common shaft for operating said switch and stopping said driving means after each cycle of operation.

4. The invention defined in claim 1 wherein said movable gripper bar is pivotally connected by a mechanical linkage to at least one electrical solenoid, and further including a control circuit having a two-position control switch, said control switch being effective when in a first position to energize said solenoid and move said bar into clamping relation with said stationary gripper bar and effective when said control switch is in a second position to energize said driving means while maintaining said solenoid in an energized condition.

5. The invention defined in claim 4 including electrically operated valve means for placing said fluid-conducting nozzle in communication with said air withdrawing means or with a second source of fluid, said control switch being operative in said first position to actuate said valve means to place said fluid-conducting nozzle in communication with said air-withdrawing means and operative in said second position to temporarily disable said driving means and actuate said valve means to place said fluid-conducting nozzle in communication with said second source of fluid for a predetermined period of time, and means operative at the end of said predetermined period of time to actuate said driving means.

6. In a vacuumizing and heat-sealing machine for plastic bags, the combination comprising a movable pressure bar positioned above a bag to be sealed and operative when lowered to hold the open mouth of a bag in sealing contact with heat-sealing means to heat-seal the bag, a shaft mounted in rearwardly spaced parallel relation with said pressure bar, said shaft having forwardly projecting arms secured and carrying said pressure bar, a second pair of stationary arms for holding and supporting said arms mounted on said second shaft, means for selectively rotating said second shaft, a first cam follower secured to one of said arms and engaging one of said arms to rotate said first shaft and lower and raise said pressure bar when said second shaft is rotated, a fluid-conducting nozzle communicable with the interior of a bag to be sealed and protruding beyond said pressure bar and into the interior of a bag when said pressure bar is in a raised position, a pair of gripper bars extending parallel to and in front of said pressure bar, one of said bars being stationary, means for moving the other of said gripper bars into clamping relation with said stationary bar to clamp in fluidlight relation the unshealed ends of said bag around said nozzle, means mounting said nozzle for reciprocating movement from said protruded position to a withdrawn position clearing said pressure bar and said gripper bars, said nozzle having a second cam follower engaging a second one of said arms and operative to effect said reciprocal movement of said nozzle when said second shaft is rotated, means connected to said nozzle for withdrawing air from a bag to be sealed, heat-sealing means including a stationary heat-sealing bar and electrical heating means extending longitudinally along said bar, said heat-sealing bar being positioned beneath said pressure bar, a third one of said arms having a movable switch with a switch actuator adjacent a face thereof and operative to actuate said switch when said switch actuator in contact with said cam face, said switch being connected in circuit with said heat-sealing means to control the energization thereof, and means for movably positioning said switch with respect to said cam face to vary the length of the relative path of travel of said actuator over said cam face when said com-

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mon shaft is rotated to vary the length of time that said heating means is energized.
7 The invention defined in claim 6 wherein said movable gripper bar has rearwardly projecting arms rotatably mounted on said first shaft and carried thereby, and means for lowering said movable gripper bar, independent of the movement of said first shaft, into clamping engagement with said stationary bar.