United States Patent [19]

Darby, Jr. et al.

[11] **3,750,365**

[45] **Aug. 7, 1973**

[54] **METHOD AND APPARATUS FOR OPENING AND SEALING BAGS**

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[73] Assignee: **The Darby Manufacturing Corporation,** Dallas, Tex.

[22] Filed: **Sept. 10, 1970**

[21] Appl. No.: **71,010**

[52] **U.S. Cl.** **53/29,** 53/63, 53/190, 53/385, 53/386

[51] **Int. Cl.** **B65b 43/30**

[58] **Field of Search** 53/29, 183, 187, 53/189, 190, 386, 385, 63

[56] **References Cited**

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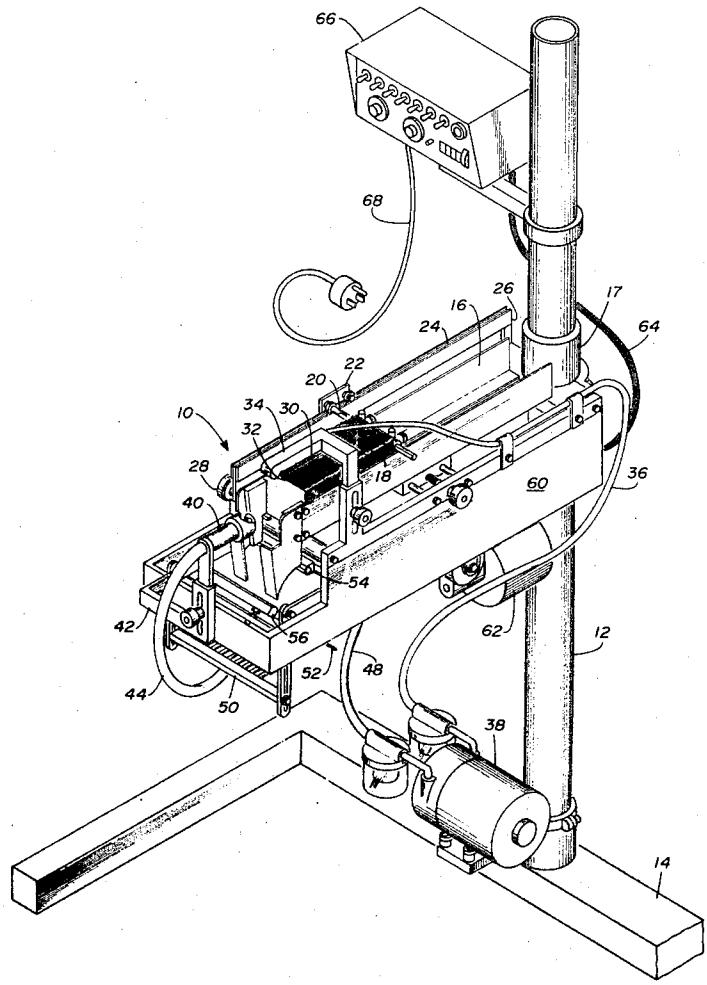
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[57] **ABSTRACT**

A magazine supports a horizontal stack of collapsed open-top flat bags. A suction head is reciprocable relative to the magazine and vacuum is applied thereto in order to open and remove the end bag from the magazine. The bag is withdrawn from the magazine and maintained in an opened position by the suction head to allow filling of the bag with a suitable material. Vacuum is released from the suction head after the bag is filled such that the filled bag falls by gravity into a gate located below the suction head. A sealing member moves against the top of the filled bag to seal the bag during which the gate opens to drop the filled and sealed bag, upon opening of the sealing member, onto a suitable conveyor.

19 Claims, 16 Drawing Figures



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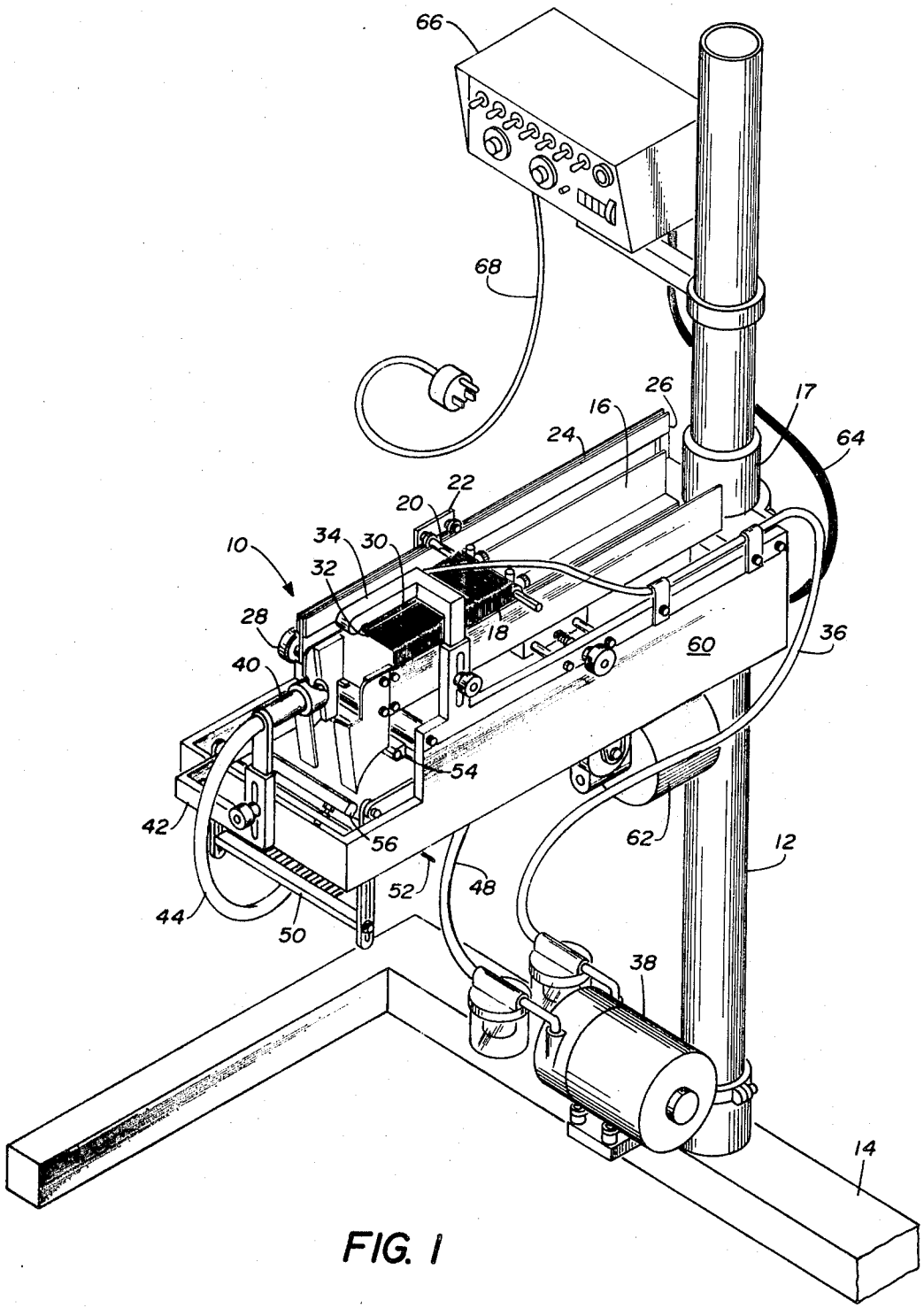


FIG. 1

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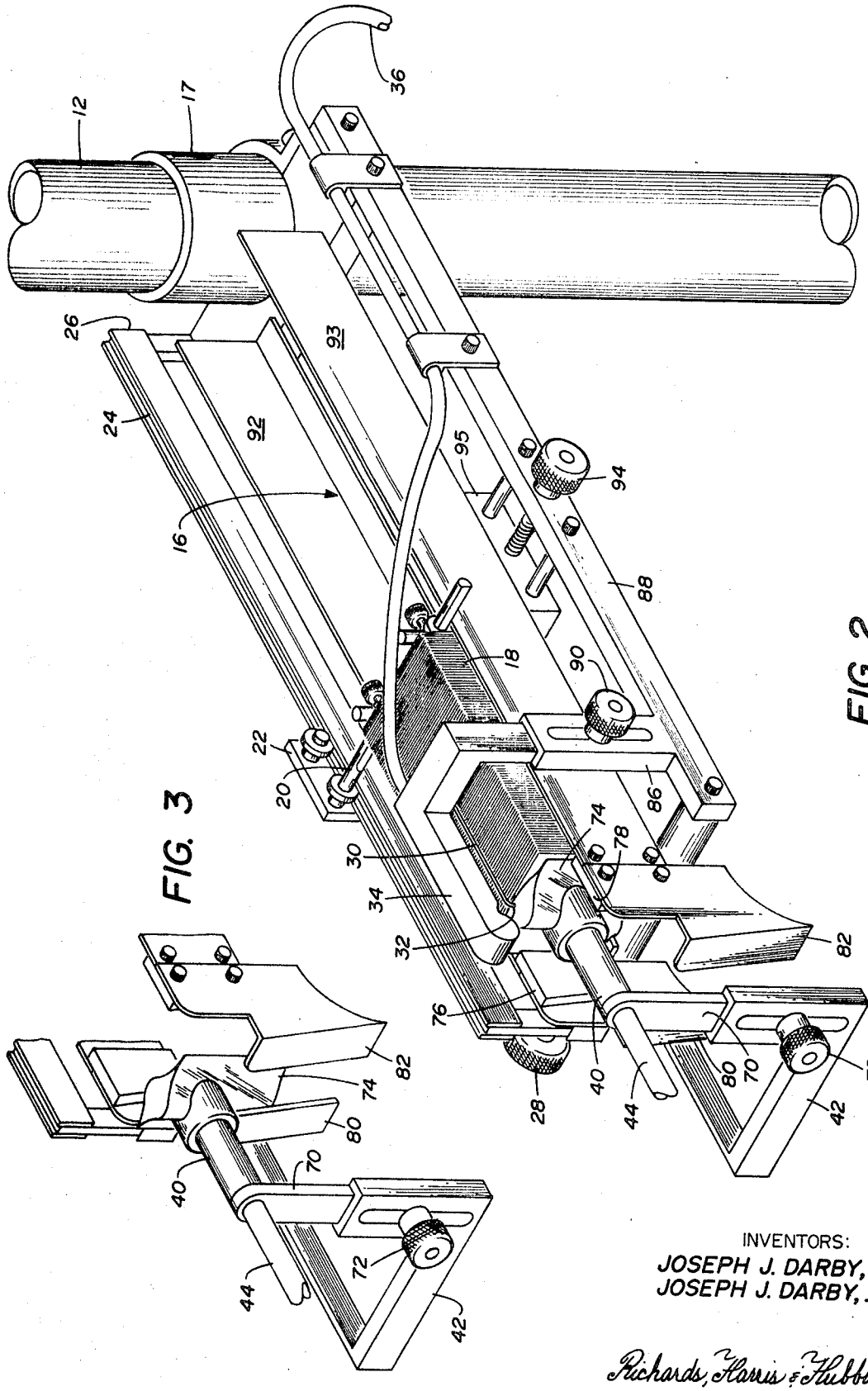


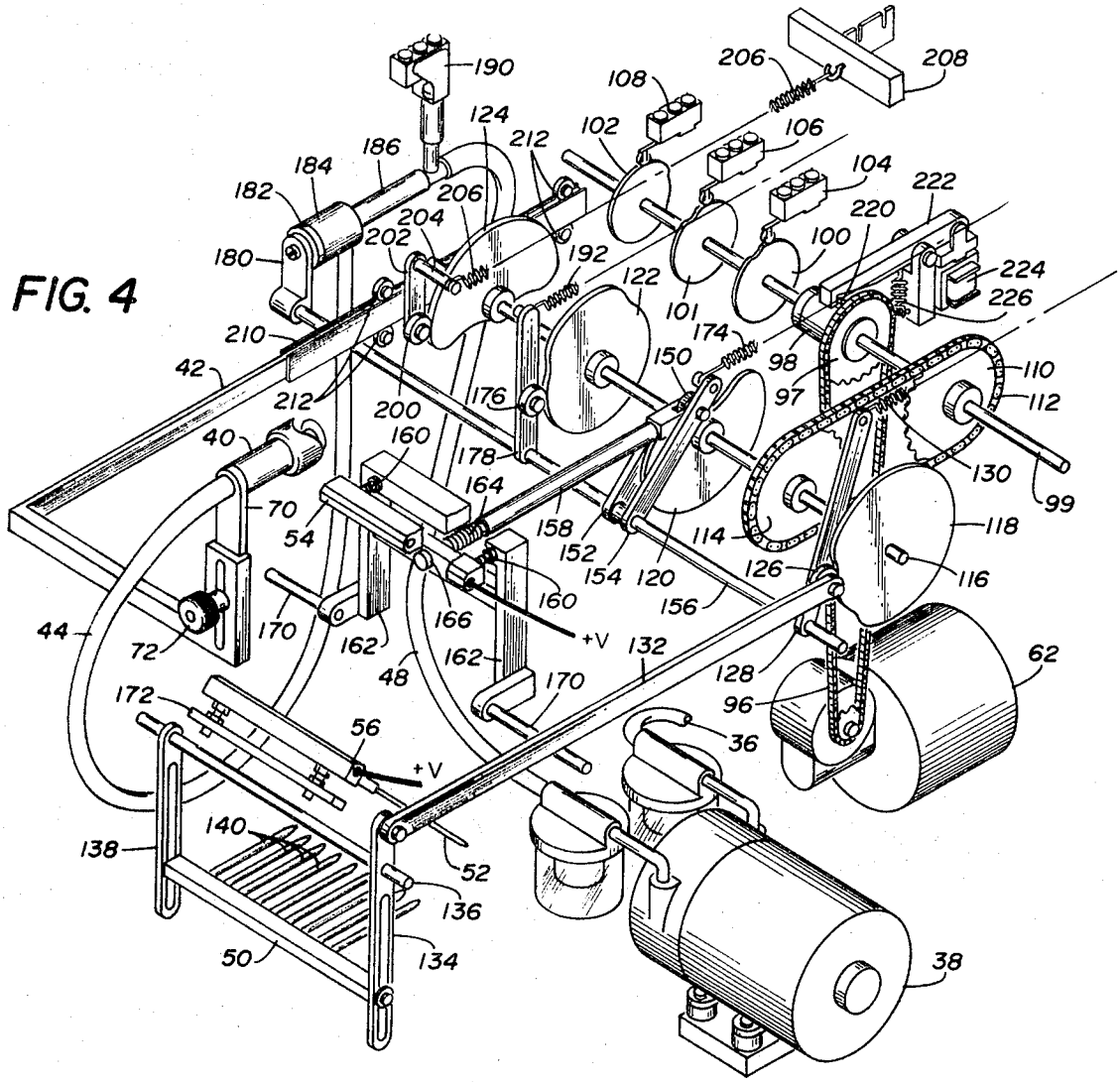
FIG. 2

FIG. 3

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FIG. 4



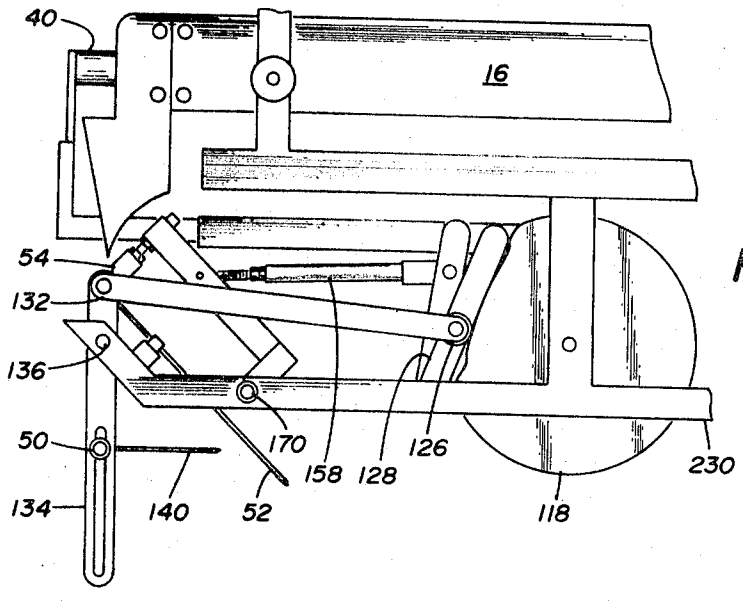


FIG. 5

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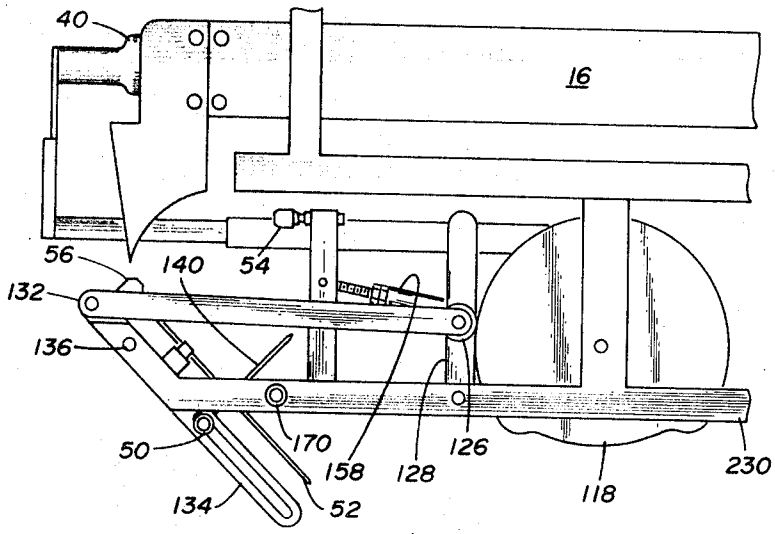


FIG. 6

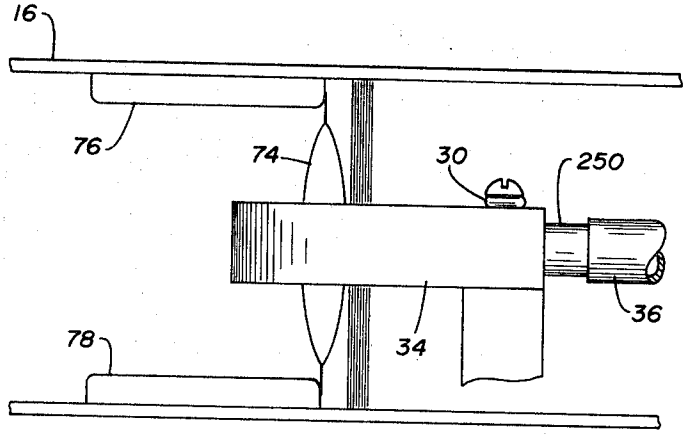


FIG. 8

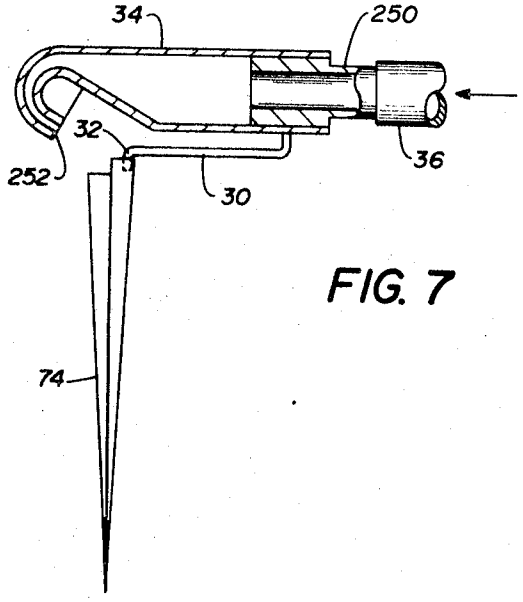


FIG. 7

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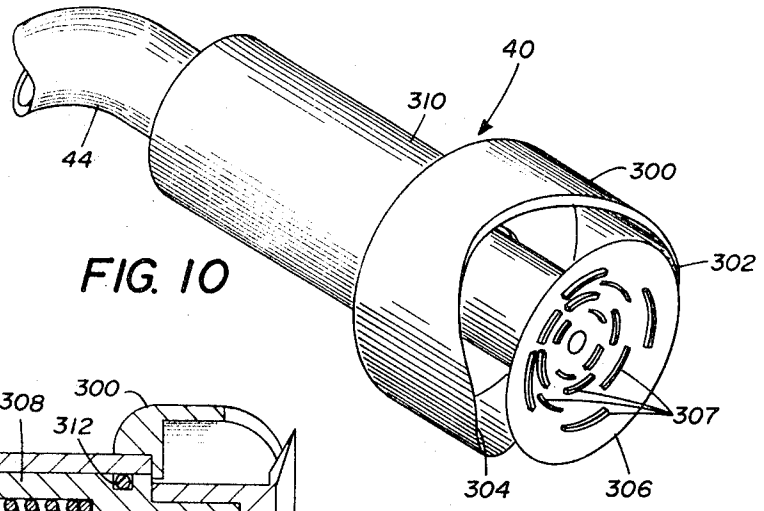


FIG. 10

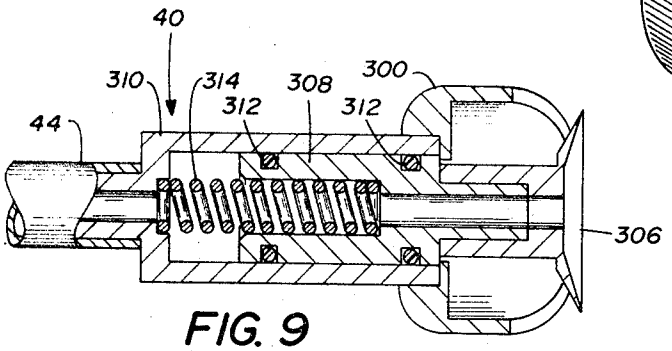


FIG. 9

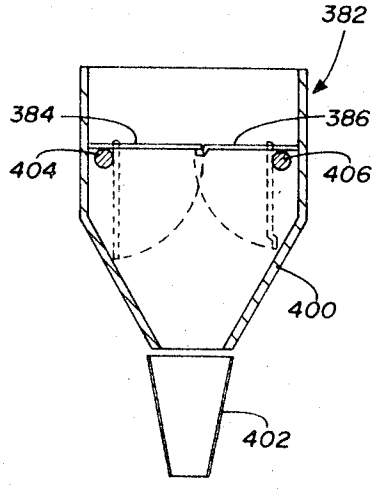


FIG. 12

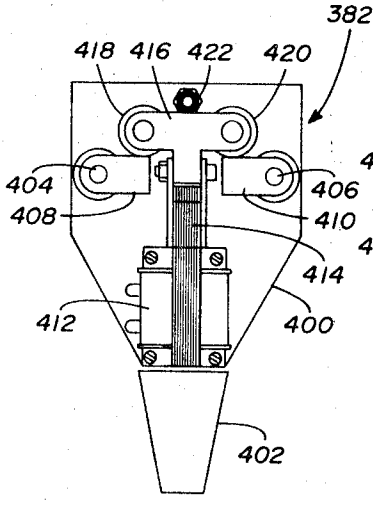


FIG. 13

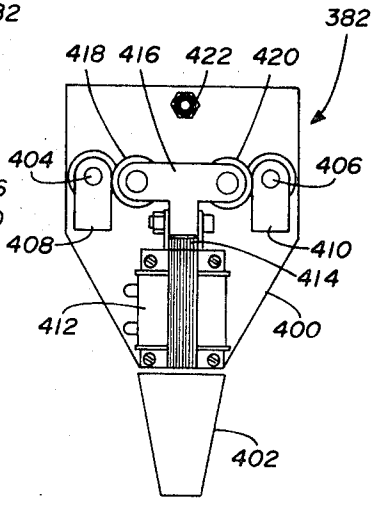


FIG. 14

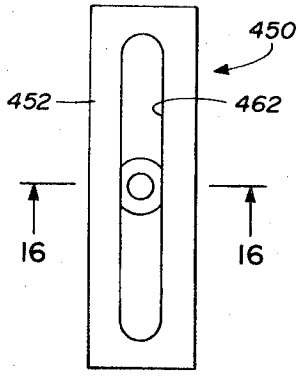


FIG. 15

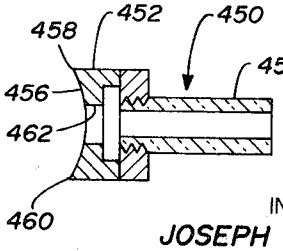


FIG. 16

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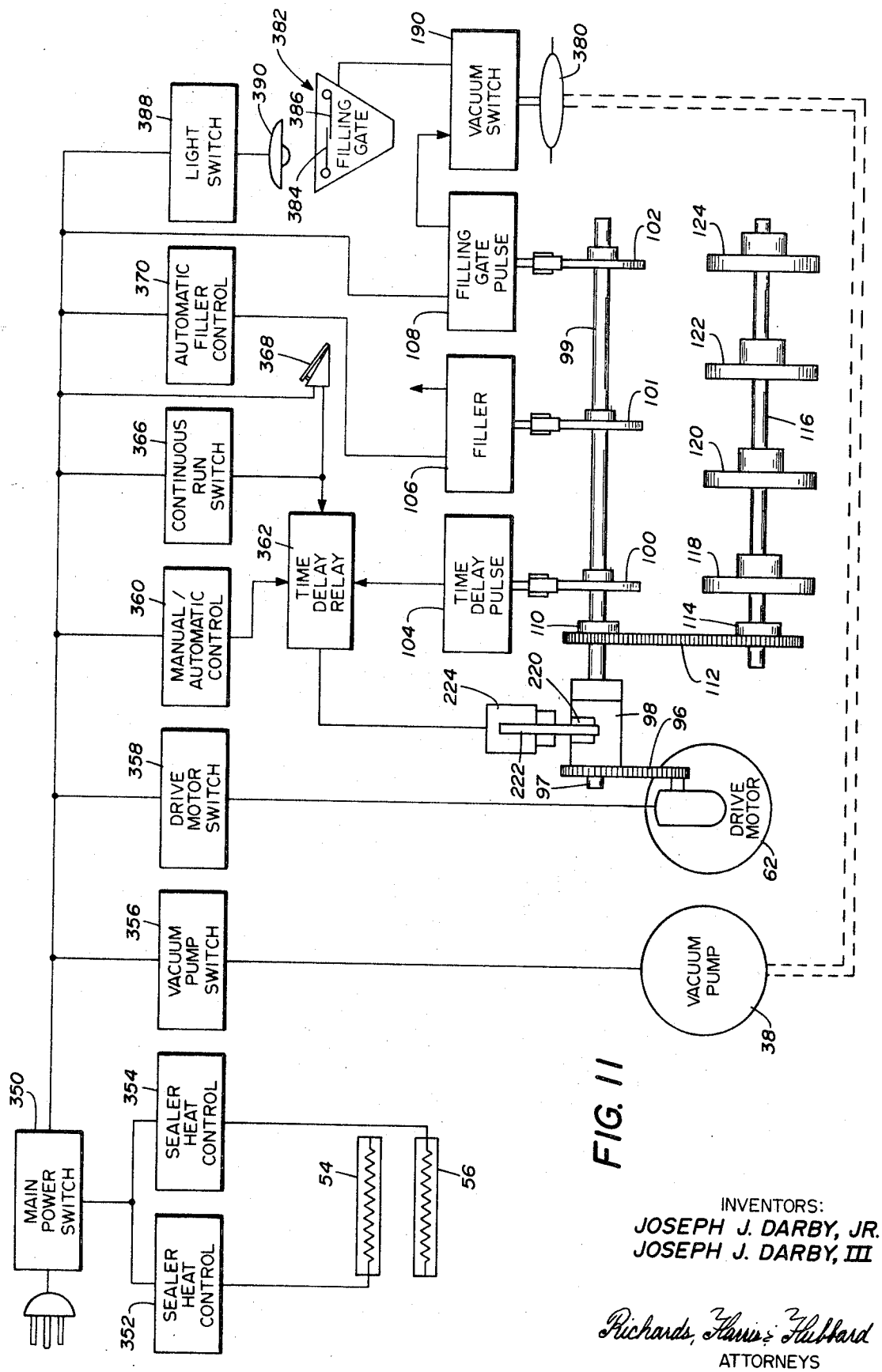


FIG. 11

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METHOD AND APPARATUS FOR OPENING AND SEALING BAGS

FIELD OF THE INVENTION

This invention relates to the automatic opening and sealing of bags, and more particularly relates to the automatic opening of a flat bag, maintaining the bag in an open position to enable filling thereof, sealing the filled bag and conveying the sealed bag to the next processing station.

THE PRIOR ART

A number of systems have heretofore been developed for removing a single bag from a stack of collapsed bags, opening the bag and filling the bag with a desired material or item. For example, the Thompson et al. U.S. Pat. Nos. 2,843,988 and the Bach 3,427,780 patents disclose systems wherein suction members move against a stack of collapsed bags and apply suction to the bags to facilitate removal thereof. The bags are then moved to a location where they are opened, filled and sealed. Additionally, other prior devices known generally as form, fill and seal machines operate to form a plurality of bags or pouches from web rolls of preprinted heat sealable material, and include stations for automatically opening, filling and sealing the pouches.

Such prior systems for opening and sealing bags have generally been complex and expensive, and are thus primarily useful in high volume and in long product run applications. However, many items are presently packaged in relatively small quantity and short run applications. For instance, relatively small quantities of hardward such as bolts, small toys, electronic components, and military and industrial repair parts are frequently packaged in different sizes and types of preformed bags. Due to the complexity and resulting expense of present bag opening and closing machines, most of such preformed bags are thus manually opened, the products or items inserted either manually or with an automatic dispenser, and the bags manually sealed. Such manual operations are time consuming, but have heretofore often been necessitated due to the expense and inflexibility of the larger and faster automatic systems. Moreover, many prior automatic bag opening and filling sytems have been primarily designed for operation upon certain types and sizes of bags and for certain limited products, and have not been able to properly open or handle different sizes of bags or relatively stiff preformed bags, such as barrier material pouches made according to military specifications.

A need has thus arisen for a relatively inexpensive, yet high speed machine which automatically opens a plurality of different types and sizes of preformed pouches, maintains the pouches open for filling, and which then automatically closes and seals the pouches.

SUMMARY OF THE INVENTION

In accordance with the present invention, a flat bag opening and closing machine includes a magazine for supporting a plurality of collapsed open-ended flat bags. A suction head has vacuum applied thereto and is movable relative to the magazine for opening and removing one of the bags at a time from the magazine. The suction head then maintains the bag in an open position to allow filling of the bag. Structure is provided to release the vacuum from the suction head such that the filled bag falls by gravity from the suction head. A gate beneath the suction head catches the filled bag and includes apparatus for sealing the open end of the filled bag.

In accordance with another aspect of the invention, a system is provided for opening and closing open-topped flat bags which includes a frame supporting a magazine which contains a plurality of collapsed open-topped flat bags. A suction head is reciprocated relative to the magazine for removing one of the bags at a time and for maintaining a bag open for filling during each cycle of operation. Structure is provided below the suction head and is operable in synchronism with the suction head for receiving the bags after being filled. The open top of the filled bag is then sealed during each cycle of operation of the system.

In accordance with another aspect of the invention, a suction head is reciprocated to and from a magazine containing a plurality of collapsed flat bags. A vacuum source is coupled to the suction head. Structure on the suction head contacts the side of a collapsed flat bag held within the magazine and vacuum is applied thereto such that the bag is removed from the magazine in an opened position.

In a more particular aspect of the invention, a magazine is provided to support a stack of collapsed open-top flat bags. An end of the magazine has an opening therein of a width less than the width of the collapsed bags. Structure maintains tension on the stack of bags, such that a collapsed bag is continuously held against an end of the magazine to extend across the opening therein. Structure is provided to contact the bag through the opening in the end of the magazine and for applying suction to one side of the bag to curve the side outwardly. The bag is then withdrawn through the end of the magazine, with the edges of the bag flexing to enable the withdrawal.

In accordance with a yet more specific aspect of the invention, a system for opening and closing the flat bag includes a magazine connected to a rigid frame for supporting a stack of collapsed flat bags. A plurality of cams are rotatably mounted along an axis along the frame. A motor rotates the cams around the axis. A first cam follower is operable by one of the cams to reciprocate a suction head relative to the magazine. A vacuum pump is connected to the suction head such that a bag is withdrawn from the magazine by the suction head during each reciprocation cycle. A second cam follower is operable by one of the cams to interrupt the application of vacuum to the suction head during each reciprocation cycle to thereby cause the release of the bag from the suction head. A third cam follower is operable by one of the cams to open and close a bag gate located below the suction head during each reciprocation cycle. A fourth cam follower is operable by one of the cams during each reciprocation cycle to reciprocate a sealing bar into and out of engagement with the top of a bag in the bag gate.

DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be made to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates a perspective view of the present bag opening and closing system;

FIG. 2 is a perspective view of the bag magazine and extraction portion of the system shown in FIG. 1;

FIG. 3 is a view of the suction head of the present invention holding a bag open for filling;

FIG. 4 is an exploded view of the cam operated actuating structure of the system shown in FIG. 1;

FIG. 5 is a side view of the portion of the system shown in FIG. 4 with the bag gate in the open position, the sealer bar in the closed position and the suction head advanced;

FIG. 6 is a side view of the system shown in FIG. 4 with the bag gate closed, the sealer bar open and the suction head retracted;

FIG. 7 is a sectional view of the air jet structure of the invention attached to the magazine;

FIG. 8 is a top view of the air jet structure shown in FIG. 7;

FIG. 9 shows the preferred embodiment of the suction head of the invention;

FIG. 10 is a perspective view of the suction head shown in FIG. 9;

FIG. 11 is a block diagram of the electrical system for operation of the system shown in FIG. 1;

FIG. 12 is a sectional view of a fill control mechanism for use with the present system;

FIG. 13 is a side view of the fill structure shown in FIG. 12 in the closed position;

FIG. 14 is a side view of the fill structure shown in FIG. 12 in an open position;

FIG. 15 is an end view of the alternate embodiment of a suction head for use with the present invention; and

FIG. 16 is a sectional view of the suction head shown in FIG. 15 taken generally along the section lines 16—16.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the present bag opening and closing system is identified generally by the numeral 10. The system includes a cylindrical support member 12 maintained in an upright position by a pedestal 14. A magazine 16 is supported at one end by a collar 17 on the support member 12 and is adapted to receive a plurality of collapsed flat bags 18. Due to the collar 17, the magazine 16 may be rotated about support member 12 to enable filling of the magazine. The bags 18 are arranged in a horizontal stack and tension is maintained against the end of the bags by a tensioning member 20. A roller carriage 22 supports the tensioning member 20 and includes rollers which move along a groove 24 formed within a rail 26. A spring member 28 is connected to the roller carriage 22 to continuously bias the tensioning member 20 against the stack of bags 18.

It will be understood that the term "bags" used in conjunction with the present invention includes all flexible receptacles which may be collapsed and maintained in a stacked configuration. However, in the preferred embodiment of the invention, the bags 18 comprise open-top, flat bags constructed from suitable material such as polyethylene or paper. In some instances, the bags may include foil or other barrier material linings required for certain military and food specifications. In many cases, the flat bags used with the present invention are relatively stiff and are thus not easily manipulated by conventional techniques.

A spring-like wire member 30 extends to the top of bags 18 and includes a downwardly extending tip 32 which tends to maintain the inner side of the bags away from the outer side of the bag so that a jet of air can enter the upper end of the bag. An air jet member 34 is connected through an air hose 36 to the output of an air pump 38. Compressed air is forced through the line 36 and angled downwardly from the air jet member 34 to initially open the end bag in the stack of bags 18 during each cycle of operation of the system.

A suction head 40 is connected to a rail 42 which is reciprocated to and from the end of the stack of bags 18. Vacuum is applied to the suction head 40 through a hose 44 in order that the end bag held within the magazine 16 may be opened and withdrawn, as will be subsequently described. Vacuum is applied through the hose 44 and through a hose 48 connected to the vacuum side of the vacuum pump 38. A suitable pump for use with the invention is the oiless vacuum pump manufactured and sold by the Gast Manufacturing Company, Model 0522–V103–G18D.

A movable gate member 50 is reciprocated into and out of engagement with a fixed gate member 52 during each cycle of operation of the present system, in order to catch a filled bag dropped from the suction head 40. As will be later described, a reciprocating heat sealing bar 54 moves against a fixed heat sealing bar 56 in order to heat seal the top of the filled bag caught by the gates 50 and 52. During sealing of the bag, the movable gate 50 moves to the illustrated position and the filled bag drops, upon release of the heat sealing bar 54, to a suitable conveying or stacking mechanism, not shown.

The actuating and cycling mechanism for the present invention are contained within the lower part of the system encompassed by case 60. An electrical motor 62 provides the power for operation of the system. Electricity for operation and control of the system is provided by an electrical cable 64 which is connected to control console 66 mounted upon the support member 12. Various on/off switches, speed controls and the like are mounted upon the control console 66 for operation and control of the system. Electrical power is supplied to the console 66 via an electrical cord 68 which may be connected to a conventional electrical supply.

FIG. 2 illustrates in greater detail the magazine and the reciprocable suction head assembly of the system shown in FIG. 1. The rail 42 is reciprocated along the side of the magazine 16 by a suitable timing cam, to be subsequently described. An extension member 70 is slidable in the end of the rail 42 and a knurled adjustment nut 72 enables vertical adjustment of the height of the extension member 70 to accommodate various sizes of bags. The suction head 40 is mounted on the end of the extension member 70 and vacuum is applied to the suction head 40 thorugh the hose 44 in the manner previously described. Air from the air jet member 34 causes the faces of the bag 74 on the end of the stack of bags 18 to become separated at the initiation of each cycle of operation of the system. The magazine 16 includes a pair of spaced apart rigid plates 76 and 78 which define an opening less than the width of the collapsed flat bags, in order to retain bags in magazine 16 and provide guides for the gravity fall of the filled bag.

The suction head 40 is moved through the opening defined by the spaced apart plates 76 and 78 in order

to apply suction to the outer side of the bag **74**. The inner side of the bag **74** is slightly higher than the outer side of the bag, and the inner side of the bag is held in place by the tip **32** of the wire member **30**. Due to the operation of the suction head **40** and the suction applied thereby, the outer side of the bag **74** curves substantially outwardly, thus causing the bag to open. As the suction head **40** then moves away from the magazine **16**, the bag **74** is carried through the opening defined by the plates **76** and **78** and is held opened in the position shown in FIG. **3**. In this position, the bag **74** is maintained in the open position without external assistance, for filling by the suction head **40**. The bag **74** may then be filled with any suitable material such as powder or with a single item such as a bolt, small toy, food products or the like. A pair of spaced apart guide members **80** and **82** are utilized to guide the filled bag **74** downwardly when the vacuum is released from the suction head **40**. The filled bag then falls into the closed gate members **50** and **52**, as will be subsequently described, where the open top of the bag **74** is sealed.

Referring again to FIG. **2**, it will be seen that the air jet nozzle **34** is slidably mounted in an extension **86** of a rail **88** which supports the entire magazine assembly. A knurled adjusting knob **90** enables the height of the air jet member **34** to be selectively adjusted to accommodate various sizes of bags. The magazine **16** is constructed from two generally L-shaped channel members **92** and **93** which are spaced apart a sufficient distance to accommodate the desired width of a particular bag. The distance between the channel members **92** and **93** may be adjusted by rotation of the adjustment knob **94** which is attached to an adjustment rod which is threadedly engaged with a right hand thread within a body **95** connected to the channel member **93**. The adjustment rod is also threadedly engaged with a left hand thread within a body (not shown) attached beneath channel member **92**. Due to the opposite direction of the threads on the adjustment rod, the channel members **92** and **93** move apart or together equally to maintain the bags centered to the various elements of the system. It will thus be seen that the magazine **16** is adjustable in width to accommodate various size bags, and that the air jet member **34** and the suction head member **40** are adjustable in height to accommodate various size bags to provide an extremely flexible system.

FIG. **4** is an exploded view of the timing and actuating mechanism of the system. Electrical motor **62** is connected to a suitable source of electrical power to drive a drive chain or a toothed belt **96** at a selected speed. A suitable motor for use with the present invention is a one-twelfth h.p. gear motor manufactured and sold by the Bodine Corporation. Motion from the drive chain **96** is transferred through a drive sprocket **97** and through a spring clutch **98** to a shaft **99** which is rotatably mounted in a frame, not shown. Microswitch actuating cams **100**, **101** and **102** are connected to shaft **99** for rotation thereby. Cam **100** conrols the operation of a microswitch **104**, cam **101** controls the operation of a microswitch **106** and cam **102** controls the operation of a microswitch **108**.

A sprocket **110** is connected to the shaft **99** and receives a suitable chain **112** for rotating cam drive sprocket **114**. Rotation of sprocket **114** causes counterclockwise rotation of a cam drive shaft **116**, which is rotatably journaled in the system frame, not shown.

A gate actuating cam **118**, a sealer bar actuating cam **120**, a vacuum valve actuating cam **122** and a suction head actuating cam **124** are spaced along the shaft **116** for rotation thereby. A cam follower **126** is connected to a cam follower support **128**, the cam follower **126** following the outline of cam **118** during rotation thereof. The upper part of the cam follower support **128** is connected to a spring **130** which is connected at the opposite end to the support frame of the system, not shown. A gate actuating link **132** is rotatably connected to the cam follower **126** for reciprocation in response to the rotation of the cam **118**. The opposite end of the link **132** is pivotally connected to the upper end of a gate actuating member **134**. Member **134** is connected to a pivot rod **136** which is pivotally mounted in the system frame, not shown.

A second gate actuating member **138** is also connected to the rod **136**, with the movable gate member **50** connected between the members **134** and **138**. Elongated slots are provided in each of the gate actuating members **134** and **138** to enable selective adjustment of the position of the movable gate member **50** for accommodation of various sizes of bags. Movable gate member **50** includes a plurality of spaced apart prongs **140** extending therefrom. As will be subsequently described, the fixed gate member **52** includes similar spaced apart prongs which mesh with prongs **140** as the gate actuating member **134** is pivoted about the rod **136**.

A cam follower **150** is supported between a pair of spaced apart cam follower supports **152** and **154** which are rotatably carried by a vacuum release rod **156** which is rotatably connected in the system frame, not shown. Additionally, the cam follower support **128** is rotatably connected at the lower end to the rod **156**. A sealer bar actuator rod **158** is connected at one end to the cam follower **150** and at the opposite end to the movable sealer bar **54**. Sealer bar **54** is connected through adjustable bolts **160** to a generally U-shaped support member **162**. Rod **158** includes a spring **164** at the end thereof which may be adjusted with the use of a nut **166** to provide an adjustable amount of pressure to the sealer bar. Sealer bar **54** includes a resistance heating element therein and electrical energy is applied thereto during operation of the system in order to heat the sealer bar **54**.

The U-shaped support **162** is connected by extension members to pivot rods **170** which are rotatably journaled in the frame of the system, not shown. The reciprocation of the actuating rod **158** due to the rotation of the cam **120** causes the sealer bar **54** to be pivoted about the rods **170** into and out of contact with the sealer bar **56**. Sealer bar **56** also includes resistance heating coils which supply heat upon the application of electrical power thereto. The heat sealer bar **56** is mounted by adjustable bolts to a support member **172** rigidly connected to the frame of the system.

A spring **174** is connected to the upper end of the cam support member **154**. The other end of the spring **174** is connected to the rigid frame of the system, not shown. A cam follower **176** is connected to a cam follower support **178**. The lower end of the support member **178** is rigidly connected to the rod **156**, so that movement of the support member **178** causes rotation of the rod **156**. The end of the rod **156** is connected to a valve support **180** which in turn supports a resilient circular valve **182** which is adapted to seal against the

open end of a cylindrical body **184**. Cylindrical body **184** is connected at one location to the hose **44** and at another location to a hose sleeve **186**. Sleeve **186** is connected to the vacuum hose **48**. When the valve **182** seals against the cylindrical body **184** in the illustrated position, vacuum may be transmitted through the hose **48**, through the sleeve **186** and through the hose **44** to the suction head **40**. When the rod **156** is rotated, the valve **182** is pivoted out of contact with the cylindrical body **184** and suction is released from hose **44** due to communication of the ambient atmosphere with the cylindrical body **184**.

A T-connector connects the hose **48** and the sleeve **186** to a switch **190**. A piston member, not shown, is responsive to the presence or absence of vacuum within the sleeve **186** in order to control the operating state of the switch **190**. A suitable piston actuated switch is manufactured and sold as a Type e J40–3634 Unit by United Electric Controls Company. As will be later described, the state of switch **190** is utilized to control the operation of a fill control device, such that no filling operation is attempted in case a bag is not held by the suction head **40**.

A spring **192** is connected at one end to the cam follower support **178** and at the other end to the rigid frame of the system, not shown. Rotation of the vacuum valve cam **122** thus controls the application of vacuum to the suction head **40**.

A cam follower **200** is mounted on a cam follower support **202** which includes a peg **204** connected to one end of spring **206**. The other end of spring **206** is connected to a support member **208** of the system frame. The cam follower support member **202** is connected to an elongated carriage member **210** which includes grooves in the upper and lower edges thereof. Rollers **212** are journaled in the rigid frame of the system, not shown, and fit within the grooves in the member **210** in order to enable sliding motion of the carriage member **210**. Rotation of the suction head actuating cam **124** thus causes reciprocation of the carriage member **210**. The rail **42** is rigidly connected to the carriage member **210**, such that the suction head **40** is reciprocated in synchronism with the rotation of the suction head cam **124**.

The clutch **98** is of the spring-type and may for instance comprise the Model D–93–5 clutch manufactured and sold by the Marquette Metal Products Company. A clutch pawl **220** extends from the clutch body. A clutch release member **222** includes a hook portion adapted to abut with the clutch pawl. A solenoid **224** may be energized to conrol the position of the clutch release member **222** between a raised and the illustrated lower position. A spring **226** applies a downward bias to the clutch release **222**. When the solenoid **224** is energized, the clutch release **222** is lifted and the clutch **98** is engaged, such that drive is transmitted from the motor **62** to the shaft **99** to operate the machine. When the solenoid is deenergized, the clutch release **222** is lowered to the illustrated position, thereby catching the clutch pawl **220** to declutch the motor **62** and to brake the system to a halt. Control of the solenoid **222** is provided by circuitry in a manner to be subsequently described.

FIGS. **5** and **6** illustrate a side view of the portion of the system shown in FIG. **4**, for illustration of the operation of the bag gate assembly. In FIGS. **5** and **6**, a frame **230** is illustrated for supporting the various portions of the assembly and for attachment to the outer casing of the system. For instance, the rod **136** is rotatably journaled in frame **230** and supports the gate actuating member **134** in the manner previously described. The gate actuating member **134** is pivotally connected to the gate actuating link **132**, which in turn is reciprocated in response to the action of cam **118** against the cam follower **126**. In FIG. **5**, cam **118** is positioned such that the line **132** causes the gate actuating member **134** to pivot to a near vertical position. This causes the prongs **140** of the movable gate **50** to be moved away from the spaced apart prongs of the fixed gate **52**. In this position, a filled bag which has been dropped from the suction head **40** and sealed by the sealing bars **54** and **56**, will be allowed to slide downwardly from the prongs of the fixed gate **52** into a suitable conveyor or packaging system, not shown, after release of the bag by the sealing bar **54**.

FIG. **6** illustrates the system of FIG. **5** after approximately 90° rotation of the cam **118**. The cam follower **126** thus causes the link **132** to pivot the gate actuating member **134** about rod **136**. The movement of the gate actuating member **134** moves the prongs **140** of the movable gate member **50** between the prongs of the fixed gate member **52**. The meshing of the prongs of the two gate members thus presents a barrier to catch a filled bag dropped from the suction head **40**. In FIG. **6**, the sealing bar **54** is illustrated in the retracted position to enable the filled bag to fall into place in the closed gate. FIG. **5** illustrates the sealing bar **54** positioned in contact with the fixed sealing bar **56** to apply heat and pressure to the top of the bag. After the sealing bar **54** is moved out of contact with the bag, the fihled and sealed bag slides down the prongs of the fixed gate member **52** to a suitable conveyor or packaging system as previously noted.

FIGS. **7** and **8** illustrate in greater detail the air nozzle assembly which is attached over the magazine **16**. FIG. **7** is a sectional view of the air jet member **34**, illustrating the connection of the hose **36** to an extension **250**. Air under pressure travels through an aperture in the extension **250** and through the gnerally rectangular portion of the air jet member **34**. The assembly terminates in an angled nozzle assembly **252** which directs a thin stream of pressurized air downwardly at an angle against the open top of a bag **74**. FIG. **8** illustrates a top view of the system which shows the initial opening of the bag **74** by the jet of air. It has been found that, due to the construction of flat bags, the stream of air must be angled downwardly in the manner shown for optimum operating results. In the preferred embodiment, it has been found that a stream of pressurized air of in the range of two atmospheres pressure and directed at an angle of approximately **30°** with respect to the horizontal provides optimum operating characteristics.

It is important that the stream of compressed air emitted from the nozzle assembly be of high velocity, sharply defined in shape without excessive turbulence or diffusion at its interface with ambient air, and of adequate volume. Also, the stream of air must be directed at the portion of the inner side of the bag which extends higher than the outer side, and oriented at an angle which will direct the entire stream of air into the bag when the bag is open, but which will allow a minimum amount of pressurized air to flow down the outer side of the bag when the bag is closed. These criteria are met by the present nozzle assembly **252** by gradual re-

duction of the cross-sectional area of the nozzle toward its outer tip, as best shown in FIG. 7, while leaving a straight portion angled at 30° to the horizontal, just behind the exit orifice.

FIG. 7 illustrates the operation of the tip 32 of the spring member 30 to hold the inner side of the bag 74 in position during approach by the suction head 40. Suction head 40 then further opens the bag 74 by applying suction to the outer side of the bag 74. As best shown in FIG. 8, the normal width of the collapsed bags in the magazine 16 may be seen to be wider than the opening defined between the plates 76 and 78. This normally retains the bags within the magazine prior to opening thereof.

FIGS. 9 and 10 illustrate in greater detail the construction of the suction head 40. A forming shroud member 300 comprises a generally cylindrical housing and includes inwardly curved portions in the top and bottom of the mouth thereof. The curved portions define curved projections 302 and 304. A resilient suction cup member 306 is mounted on a piston 308 slidable within a generally cylindrical housing 310 attached to the shroud 300. As best shown in FIG. 10, a plurality of semicircular segmental ridges 307 are formed about the interior face of the suction cup member 306 to provide additional vacuum surface area to the gripping force of the suction cup 306. O-rings 312 are disposed in the piston 308 to provide an air seal. The O-rings 312 and the piston 308 will generally be constructed from a plastic or other self-lubricating material. The present cylinder and piston configuration may be replaced by a suitable bellows or vacuum operated diaphragm in some instances. A spring 314 normally biases the piston 308 outwardly, such that the suction cup member 306 is normally maintained in the illustrated extended position.

In operation of the present opening system, air is supplied to air jet member 34 by compressing air drawn into the vacuum side of air pump 38 through suc tion head 40, and, when open, through air valve 182. The air is then transmitted from the pressure side of air pump 38 through hose 36 to the air jet member. When air valve 182 is closed and a bag is in place on suction head 40, the vacuum side of the air pump inlet is blocked from any supply of air to compress, and there is no appreciable amount of air coming through the air jet 34. When air valve 182 opens to release the bag held by suction head 40, air is admitted to the intake of the air pump, compressed, and blown out the air jet. Tip 32 of spring member 30 holds the inner side of the bag 74 slightly apart from the lower outer side. A small amount of air from the jet enters this opening, starting the bag to open. As the bag opens, the full stream of air enters the bag, generating considerable pressure inside the bag which forces the outer side to curve outward and the inner side to curve inward with enough force to move the horizontal stack of bags back into the magazine.

When air is free to enter suction head 40 through the hole in suction cup 306 and piston 308, spring bias 314 holds these members at the most extended position with respect to cylinder 310. This positions suction cup 306 well forward of projecting edges 302 and 304 on shroud 300. When the rotation of cam 124 has advanced suction head 40 to its most inward position, the resilient edges of suction cup 306 contact and conform to the curved side of bag 74, closing off air flow through the cup. The vacuum thus created within the system seals the bag tightly to the suction cup, and allows the ambient air pressure to overcome spring bias 314, forcing piston 308 back into the cylinder. This action pulls the bag out of the magazine, forcing the sealed vertical edges over the rounded corners to plates 76 and 78. Although air to the intake of the air pump has been shut off by sealing of the vacuum cup against the bag, air to prevent collapse of the bag due to backward bending of the sealed vertical edges is supplied by compressing the residual air in hoses 44 and 48. The bag is further opened by forcing it between plates 76 and 78. As the piston 308 approaches the end of its inward stroke, the side of the bag 74 contacts projections 302 and 304 on shroud 300. Suction cup 306 continues to be drawn into shroud 300, pulling the center of the bag with it and forming it to the inner edges of shroud 300 as shown in FIG. 3. It is important to note that the bag opening is performed entirely by the suction head and air jet, and does not depend on the reciprocating motion generated by cam 124.

When vacuum is released from the hose 44, the bag is released from the suction cup member 306 and the piston 308 is moved outwardly due to the bias of spring 314.

FIG. 11 is a schematic diagram of the electrical system of the invention. The system is adapted to be plugged into a conventional wall plug and electrical power is supplied through a main power switch 350 and through heat sealer controls 352 and 354, which are mounted on console 66, to the resistance heaters within the heat sealer bars 54 and 56. If desired, the heat sealer controls may alternately switch electrical power into and out of the heat sealing bars 54 and 56, or a continuous supply of electricity may be supplied to the bars for continuous heating.

The controls used for control of the sealer bar heaters are of the stepless or infinite type which include a thermostatic switch and a small electric heater to heat the thermostat. When the switch is in a conducting state, current flows to the sealer bars and to the internal heater. The temperature rise thus produced in the thermostat causes it to open, interrupting the flow of current in both the heater and the sealer bars. This allows the thermostat to cool to a point at which it again closes the circuit, and the cycle repeats. Cycling frequency is several times per minute. The control knob sets the point in temperature at which the thermostatic switch opens, and thereby the heating time required to reach the set temperature. This may be varied from 5 to 90 percent of each cycle, with additional positions provided on the control for continuous conduction (useful in pre-heating the sealing bars to operating temperature) and an off position. A silicon controlled rectifier type control, such as used in light dimmers, may also be used, or alternatively any of the readily available automatic temperature controls.

A vacuum pump switch 356 is mounted upon the console 66 of the system shown in FIG. 1 and is selectively operable to supply electrical energy for operation of the vacuum pump 38. A drive motor switch 358 is mounted on the console 66 and is operable to supply electrical energy for operation of the drive motor 62. Motor 62 operates through the clutch 98 to rotate the shaft 99 and the cam drive shaft 116 in the manner previously described. The position of the clutch and of the various cams of the system have been slightly rear-

ranged in this diagram for ease of illustration. Electrical energy is applied through manual/automatic control device **360** to a time delay relay **362.** The manual-/automatic control device **360** comprises a double throw toggle switch. In manual position, the circuits are so connected that each time the foot switch is depressed, the solenoid **224** is energized and clutch release **222** is actuated allowing the machine to cycle. A hand switch, proximity switch or photoelectric actuated switch may be substituted for the foot switch so that the cycle can be initiated by the motion of dropping the material to be filled. When switch **360** is in automatic position, time delay relay **362** is inserted into the circuit in series with a foot switch **368,** converting it from an actuating switch to an over ride or "deadman" switch. In normal operation,the operator keeps foot switch **368** depressed at all times, but should it be necessary to have more time for filling a bag or other reason for delay, the machine will hold the bag open in filling position until the foot switch is again depressed.

Relay **362** may be adjustable to provide a variable time delay for the filling operating of the system. After a predetermined time delay, the relay **362** applies a control signal to the solenoid **224** for control of the clutch release member **222** in the manner previously described. The timing cam **100** provides control to the microswitch **104** which generates a time delay pulse to the time delay relay **362.** The notch in timing cam **100** closes microswitch **104** approximately 5° before the release pawl **200** on clutch **98** reaches engagement position with clutch release **222.** This pulse initiates the time delay cycle in relay **362,** causing it to interrupt the supply of current to solenoid **224,** thus releasing clutch release **222** so that it engages clutch pawl **220** and interrupts the mechanical cycle with the opened bag in the filling position. After the preset time delay interval has passed, during which time the bag has been filled, the time delay relay reverts to its normal position, reenergizing solenoid **224** thus actuating clutch release **222** and clutch **98** for another mechanical cycle. A continuous run switch **366** is mounted on the console **66** to enable continuous running of the system, if desired.

Switches **366** and **368** are connected between the source of electrical power and the time delay relay **362.** Electrical power is also applied through an automatic filler control switch **370** mounted on the console **66** which supplies energy to an exterior filler control microswitch **106.** Microswitch **106** is controlled by rotation of the timing cam **101.** In response to rotation of the timing cam **101,** the microswitch **106** applies electrical pulses to an exterior filler machine of conventional nature which then operates in synchronism with the present system to deposit measured quantities of material into the bags opened by the system. Electrical energy is also applied to the filling gate pulse microswitch **108** which is operable by the timing cam **102** to generate electrical signals which are applied through the vacuum switch **190** (FIG. 4). Vacuum switch **190** is controlled in response to the presence of vacuum in lines **44** and **48,** as represented by the diagrammatic diaphragm control **380.** When vacuum is present in the lines, the vacuum switch passes the electrical signals from the gate pulse microswitch **108** to a filling gate device **382.**

Filling gate device includes flaps **384** and **386** which are then controlled to allow filling of an open bag if vacuum is present, or to prevent the passage of material to the present system if sufficient vacuum is not detected by the vacuum switch **190.** A light switch **388** is located on a console **66** to energize a light bulb **390** to yield light for the operator'work table.

FIGS. **12–14** illustrate in greater detail the filling control device **382.** The device **382** is adapted to be disposed over the suction head **40** when the suction head **40** is in the position illustrated in FIG. **3.** A conventional filling machine or an operator's work table is thus located above the filling gate device **382** to periodically drop a measured amount of granular material or selected items into the open top of the filler gate device **382.**

While the present filling control device **382** may be used with an automatic filling machine, the primary use of the device is for manual filling operations. The filling control device permits an operator to devote the total opening cycle time to gathering the product and placing it in the device. Cam **102** is oriented so that it causes a pulse to be sent through microswitch **108** to open the flaps **384** and **386** at the earliest possible time the bag is in position to receive the product. The duration of the pulse is as short as gravity drop time of the product will allow. This results in the shortest possible time used in filling, thus more packages per minute. More rapid counting, grouping, or other product manipulation is possible because the operator is relieved of the necessity of concentrating on coordination of insertion with the arrival of the bag in filling position. Under good conditions, bag filling time can be as little as 10 percent of bag opening and sealing time, thus giving operating rates as high as 65 per minute.

As shown in FIG. **12,** when the flaps **384** and **386** are in the horizontal position, the material dispensed by the conventional filling machine is not allowed to drop into the open bag supported by the suction head **40.** When the flaps **384** and **386** are in the dotted line position shown in FIG. **12,** the filling gate device is in the open position and the material deposed from the conventional filling machine is allowed to pass through the hopper **400** and through a funnel **402** into the open bag held by the suction head. Filling gate device **382** thus prevents depositing of filler material into the system when the bag is not held in the correct position due to a malfunction of the machine.

Flap **384** is connected to a pivot pin **404** and flap **386** is connected to a pivot pin **406.** As best shown in FIG. **13,** an end of pivot pin **404** is connected to an extension **408,** while pivot pin **406** is connected to an extension **410.** A solenoid **412** is attached to the side of the hopper **400** and is controlled by electrical signals from the vacuum switch **190** and to the filling gate pulse microswitch in series with the solenoid to move the solenoid plunger **414** between the extended position shown in FIG. **13** and the retracted position shown in FIG. **14.** A cam support **416** is attached to the end of the solenoid plunger **414** and includes a pair of roller cams **418** and **420** thereon. A rubber bumper **422** is mounted on the side of the hopper **400** such that the cam support **416** abuts thereagainst in the extended position of the solenoid plunger **414.**

When the solenoid **412** is not energized, the solenoid plunger **414** is in the extended position and the cam support **416** abuts the rubber bumper **422.** The extensions **408** and **410** are thus in generally horizontal positions and the flaps **384** and **386** are in the closed position shown in FIG. **12.** When the solenoid **412** is ener-

gized, the solenoid plunger 414 is moved to the retracted position and the cams 418 and 420 bear against the extension members 408 and 410 to rotate the pivot pins 404 and 406. This causes the flaps 384 and 386 to be pivoted downwardly to the dotted line position shown in FIG. 12 to thereby open the filling gate device to allow filling of a bag held by the suction head 40. Torsion springs, not shown, are mounted on shafts 404 and 406 for return of the flaps to the closed position.

While the preferred embodiment of the suction head has been illustrated in FIGS. 9 and 10, FIGS. 15 and 16 illustrate an alternate embodiment of a suction head 450, which is primarily useful for operation on lightweight pouches or bags. The suction head is formed from an elongated rectangular metal housing 452 which includes at the rear end thereof a threadedly connected extension 454 for connection to the vacuum hose 44. The front face of the housing 452 has a concave surface 456 formed thereon in order to shape the face of the flat bag when suction is applied to the bag. A pair of edge projections 458 and 460 initially contact the sides of the bag and vacuum is then applied between the projections through an elongated slot 462 formed in the front of the housing 452. The suction head 450,in combination with the magazine of the present system, thus is able to form certain flat bags into an open position and to maintain the bag in an open position for filling, without the requirement of additional support of the bag.

In operation of the present system, the main power switch 350, the vacuum pump switch 356 and the drive motor switch 358 (FIG. 11) are turned on by the operator to energize the system. The desired control switches 360, 366 or 368 are then energized to initiate operation of the system. The relay 362 is normally closed and thus the closing of the desired switch, such as the foot switch 368, energizes the solenoid 224 to lift up the clutch release member 222. The clutch 98 is released such that power from the motor 62 may be applied through chain 96 to the shaft 99 and through the chain 112 to the drive sprocket 114 in order to drive the drive shaft 116, as best shown in FIG. 4. The cams 118, 120, 122 and 124 are thus rotated in a counterclockwise manner from the position illustrated in FIG. 4.

The stack of bags 18 are maintained in the position shown in FIG. 2 due to the tensioning member 20. While clutch release member 222 holds the clutch 98 in a disengaged state, the sealer bar 54 is in an open position as shown in FIG. 4, and the movable gate memer 50 is in the open position shown in FIG.5. Suction head 40 is fully extended in the bag filling position shown in FIG. 4. Air valve 182 is closed against valve body 184. The cycle is initiated by the release of clutch 98 which causes cam shaft 116 to rotate in a counterclockwise direction. This rotation causes the rise on cam 118 to move movable gate 50 towards the closed position. Simultaneously cam 122 causes air valve 182 to open. Vacuum decay and the gravity drop time of bag allow gate to close completely before arrival of bag in actual operation. Suction head 40 remains fully extended due to dwell of cam 124, and sealer bar 54 remains open due to the dwell of cam 120 to allow time for the bag to drop.

After approximately 90° of rotation, the action of cam 122 causes air valve 182 to close, and sealer bar 54 starts to close due to action of cam 120. When sealer bar 54 is fully closed against sealer bar 56, cam 118 causes movable gate 50 to open. Suction head 40 now moves rapidly toward the end bag in the magazine 16, the bag having been partially opened by a blast of compressed air from air jet member 34 as shown in FIGS. 7 and 8. Suction cup 306 contacts the side of bag 74, applying suction thereto. As the suction cup seals to the bag, vacuum is built up within cylinder 310, causing piston 308 to retract, drawing the side of the bag out of magazine 16 and into shroud 300 forming a fully opened bag. Suction head 40 now moves outward to the filling position due to action of cam 124, and sealing bar 54 simultaneously opens.

At approximately 5° before the clutch release pawl 220 reaches the hook on clutch release 222, timing cam 101 closes microswitch 106, sending an electrical impulse to initiate operation of a conventional filling machine. Additionally, timing cam 102 closes microswitch 108, sending an electrical impulse to open filling gate device 382; and timing cam 100 momentarily closes microswitch 104 to send a pulse to initiate the timing cycle in time delay relay 362. This action in the time delay relay interrupts current to solenoid 224, dropping clutch release 222 into position to engage clutch pawl 220. This engages clutch 98 so that drive from motor 62 is disconnected from the system, stopping rotative motion of cam shaft 116 with suction head 40 in the bag filling position shown in FIG. 3. The time delay may be adjusted by a control on console 66 to enable variations between the filling periods, such as from one-tenth second to 10 seconds, depending upon the type of material to be deposited in the open bag and depending on the type of filling machine utilized. This provides a great deal of flexibility for the present system.

If within any time delay period the operator sees that the filling operation cannot be completed, releasing the foot switch will override the time delay and hold the bag in open position until the operation can be completed. After occurrence of the time delay, the relay closes and electrical power is supplied to the soleniod 224 in order to release the clutch release member 222. Drive from the motor 62 is again then applied to the system to initiate a new cycle of operation to the system.

Rotation of cam shaft 116 causes movable gate member 50 to close, and vacuum valve 182 is pivoted away from valve body 184 to release the vacuum from suction head 40. This release of vacuum in suction head 40 and thus in suction cup 306 releases the filled bag which falls by gravity down the guide members 80 and 82 to the gate. The spring 314 (FIG. 9) forces the suction cup member 306 outwardly so that it again is in position to contact the end bag in magazine 16.

In place of the time delay mechanism, an impulse from an automatic filling machine or from a product drop sensing device could be used to initiate a new cycle.

The movable gate 50 has in the meantime been moved by cam 118 to the closed position shown in FIG. 6 to catch the filled bag. The sealer bar actuating cam 120 then causes the movable sealer bar 54 to pivot and to contact with the top of the filled bag held by the closed gate. The top of the bag is then held tightly between the sealer bars 54 and 56 and heat is applied thereto due to the resistance heaters within the sealer bars. Additionally, pressure, as determined by the

spring **164**, is applied to the top of the bags to provide a hermetic seal thereto.

An important aspect of the present invention is that during the sealing operation above described, cam **122** begins to close the valve **182** against the cylinder **184** to again supply vacuum within the suction head **40**. Additionally, the suction head **40** is operated by cam **124** to again move toward the magazine **16**. The suction head then moves against the next bag held within the magazine and opens the bag in the manner previously described. After the suction head **40** then withdraws the next opened bag from the stack of bags **18**, the sealer bar **54** is retracted to allow the sealed package to fall. The movable gate member **50** has previously moved to its open position during the sealing stage to let the now sealed and filled bag fall to a suitable conveyor or packaging system. Thus, the present system is able to simultaneously operate upon two bags at a time, one of the bags being withdrawn for the filling operation while the previously filled bag is sealed. This simultaneous and synchronous operation of the present system enables faster operation than most prior devices.

The foot switch **368** may be released at any time in order to stop the operation of the machine at the end of a cycle for adjustments such as refilling of the magazine or the like. The filling gate device **382** prevents the depositing of material or items into the machine in the case of a malfunction of the machine. The present machine operates automatically without the requirement of manual intervention by the operator, thus allowing complete freedom of the operator's hands for filling operations. The pouches held by the system may be filled with products manually or automatically from conventional synchronized automatic fillers in the manner previously described. The rate of production of the present machine will often equal and exceed many form, fill and seal machines, and has the flexibility of being adaptable to relatively low volume operations wherein the packaged items are required to be changed, or wherein different sized bags are required to be utilized. When automatic filler machines are utilized, a single operator can often attend several machines feeding a common output conveyor.

The present machine is easily adapted by an operator to handle a large number of different size bags, with little loss of efficiency. A single product may thus be packaged in a variety of different packages with little time loss for changeover, such that different brand names, advertising specialties, dealer imprients, change in stock numbers on multiple use parts and the like may be accomplished. Stiff, hard to open military specification bags and pouches may be handled by the present machine at the same speed as lighter weight commercial bags.

Whereas the present invention has been described with respect to use of rotating mechanical cams for actuation of the various operations of the system, it will be understood that variations utilizing stepped output motors and associated logic control circuitry may also be utilized to control the operations of the system. Also, hydraulic and pneumatic actuating devices may be used to provide reciprocation of certain of the elements of the system. Fluidic units may additionally be used to provide the sequencing and delay functions for the system.

Whereas the present invention has been descried with respect to specific embodiments thereof, it will be understood that various changes and modifications will be suggested to one skilled in the art, and it is intended to encompass such changes and modifications as fall within the scope of the appended claims.

What is claimed is:

1. A flat bag opening and closing machine comprising:

a magazine for supporting a plurality of collapsed open-ended flat bags,

a single suction head assembly having vacuum applied thereto for being moved against one side of the bag at the end of said magainze for opening and removing said bag from said magazine, said suction head assembly maintaining suction on one side of said bag to hold said bag in an open position to allow filling of said bag,

means for releasing the vacuum from said suction head assembly such that the filled bag falls by gravity therefrom, and

means beneath said suction head and operable in synchronism with said suction head assembly for catching the filled bag and for sealing the open-end of the filled bag, said means operable after sealing said bag to drop said bag to a collection location.

2. The machine defined in claim **1** wherein a filled bag is sealed synchronously with the removal of an opened bag from said magazine.

3. The machine defined in claim **1** wherein said suction head comprises:

a forming shroud member having spaced apart curved portions, and

means for applying vacuum to a suction cup slidable in said shroud member to cause a side of a bag to be urged against said curved portions to thereby hold said bag in an open configuration for filling.

4. The machine defined in claim **3** and further comprising:

a spring biased member mounted in said shroud member for exerting outward bias against said suction cup.

5. The machine defined in claim **1** wherein said means for catching comprises:

a fixed gate member, and

a movable gate member operable in synchronism with said suction head to alternatively open and close with said fixed gate member.

6. The machine defined in claim **1** wherein said means for sealing comprises:

a movable heat sealing member connected to receive electrical voltage,

means operable in synchronism with said suction head for moving said heat sealing member against the top of a bag held by said catching means, and

a stationary heat sealing member mounted on said catching means for applying heat to a bag in conjunction with said movable heat sealing member.

7. In a bag opening and closing system, the combination comprising:

means for opening a flat bag and for supporting the opened bag for filling,

a fixed gate member including spaced apart prongs disposed beneath the supporting means,

a movable gate member operable in synchronism with said opening means for opening and closing against said fixed gate member, said movable gate member including spaced apart prongs which mesh with said prongs of said fixed gate member upon

closing to catch and support the bottom of a filled bag, and

heat sealing means movable in synchronism with said movable gate member for engaging the top of a filled bag supported at the bottom by said gate members.

8. The system of claim **7** and further comprising:

filler control means disposed over said means for opening and synchronized with the opening of the bags for controlling the deposit of material into the opened bags.

9. The system of claim **8** wherein said filler control means prevents the deposit of material when a bag is not withdrawn through said opening by said suction applying means.

10. The system of claim **9** wherein said filler control means comprises:

a hopper for receiving material,

gate flaps rotatable to move from an open to a closed position, and

cam means operable in response to an electrical impulse for rotating said gate flaps.

11. The system of claim **10** and further comprising:

solenoid means for moving said cam means.

12. A system for opening and closing flat bags comprising:

a frame,

a magazine connected to said frame for supporting a stack of collapsed flat bags,

a plurality of cams rotatably mounted along an axis on said frame,

motor means for rotating said cams around said axis,

a first cam follower operable by one of said cams to reciprocate a suction head relative to said magazine,

vacuum generating means connected to said suction head such that a bag is withdrawn from said magazine by said suction head suring each reciprocation cycle,

a second cam follower operable by one of said cams to interrupt the application of vacuum to said suction head during each reciprocation cycle to thereby cause the release of a bag from said suction head,

a third cam follower operable by one of said cams to open and close a bag gate located below said suction head during each reciprocation cycle, and

a fourth cam follower operable by one of said cams during each reciprocation cycle to reciprocate a sealing bar into and out of engagement with the top of a bag held by said bag gate.

13. The system of claim **12** and further comprising:

a timing cam rotated by said motor means,

switch means operable in response to said timing cam, and

clutch means connected between said motor means and said plurality of cams and operable in dependence upon said switch means for terminating operation of said system for a predetermined time to enable loading of an opened bag.

14. The system of claim **12** and further comprising:

means operable in response to the interruption of vacuum to said suction head for control of a filling device.

15. The system of claim **12** wherein said bag gate is variable in size to accommodate various bag sizes for sealing thereof.

16. The system of claim **12** and further comprising:

air jet means mounted on said magazine for directing a stream of air against the upper part of bags to facilitate the opening thereof.

17. The method of filling flat bags comprising:

maintaining a plurality of open top collapsed flat bags in a stacked horizontal configuration,

applying suction to one side of a bag on the end of the stacked configuration to cause said bag to open,

withdrawing the opened bag from the stacked configuration,

maintaining the opened bag in a position for filling by application of vaccum to a single side of the bag,

dropping the filled bag to a vertical sealing position,

sealing the top of the filled bag while supporting the bottom of the bag, and

dropping the sealed bag to a collection location.

18. The method of claim **17** and further comprising:

maintaining the bag on the end of said stacked configuration in place by a retaining member, and

applying a jet of pressurized air into the bag to open the bag.

19. The method of claim **17** wherein said steps of withdrawing an opened bag and sealing the top of a filled bag are performed generally simultaneously on two different bags.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,750,365 Dated August 7, 1973

Inventor(s) Joseph J. Darby, Jr. and Joseph J. Darby, III

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, lines 33-34, "hardward" should be --hardware--.
Col. 4, line 57, "thorugh" should be --through--.
Col. 8, line 9, "line" should be --link--;
line 34, "fihled" should be --filled--;
line 42, "gnerally" should be --generally.
Col. 9, line 39, "suc tion" should be --suction--.
Col. 11, line 22, "operating" should be --operation--;
line 30, "200" should be --220--.
Col. 12, line 4, "operator'" should be --operator's--.
Col. 13, line 49, "memer" should be --member--.
Col. 14, line 24, "engages" should be --disengages--.
Col. 15, line 49, "imprients" should be --imprints--;
line 67, "descried" should be --described--.
Col. 16, line 12, "magainze" should be --magazine--.
Col. 17, line 38, "suring" should be --during--.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents