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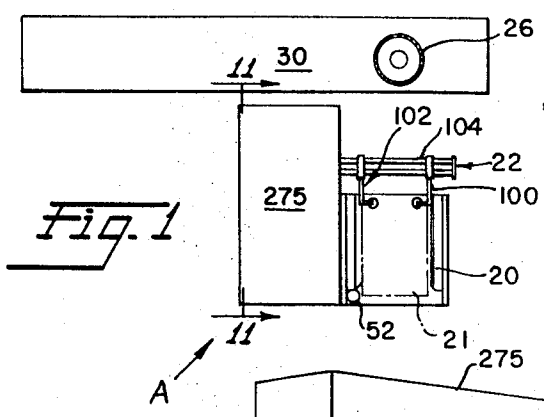


Fig. 1

Fig. 2

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Fig. 3

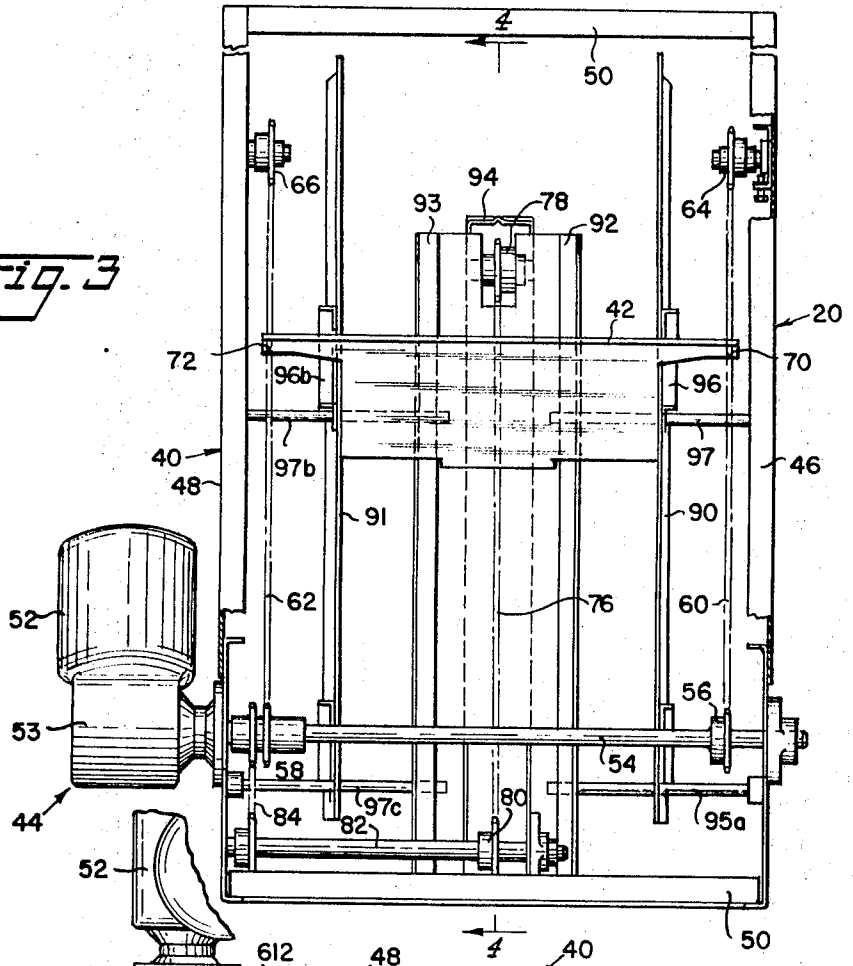


Fig. 6

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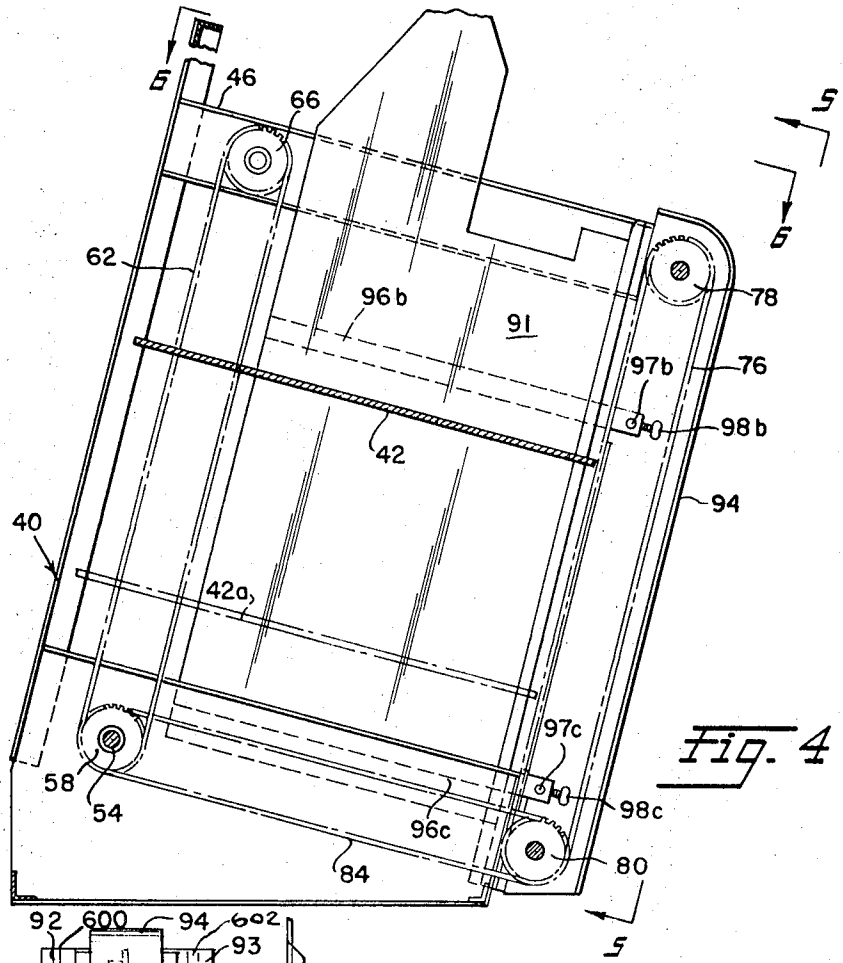


Fig. 4

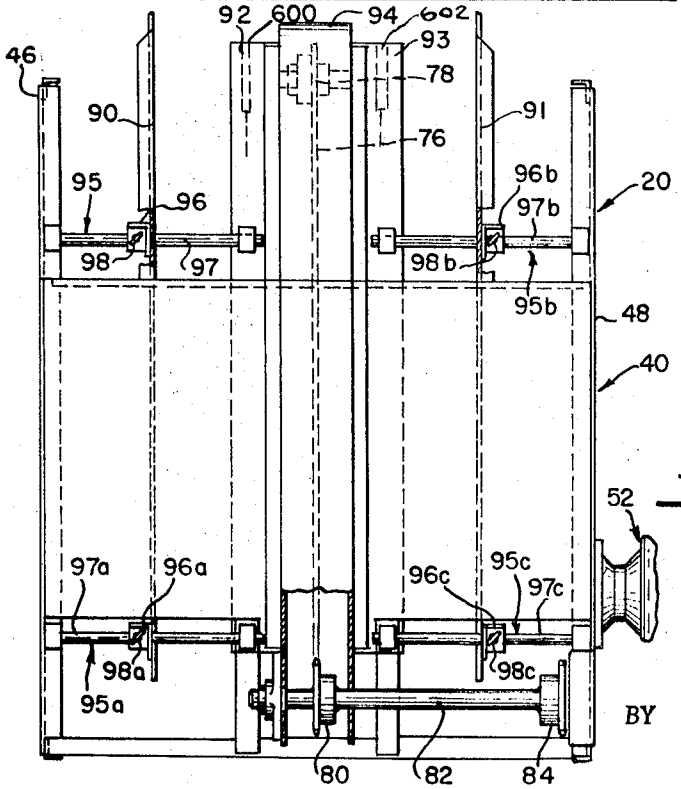


Fig. 5

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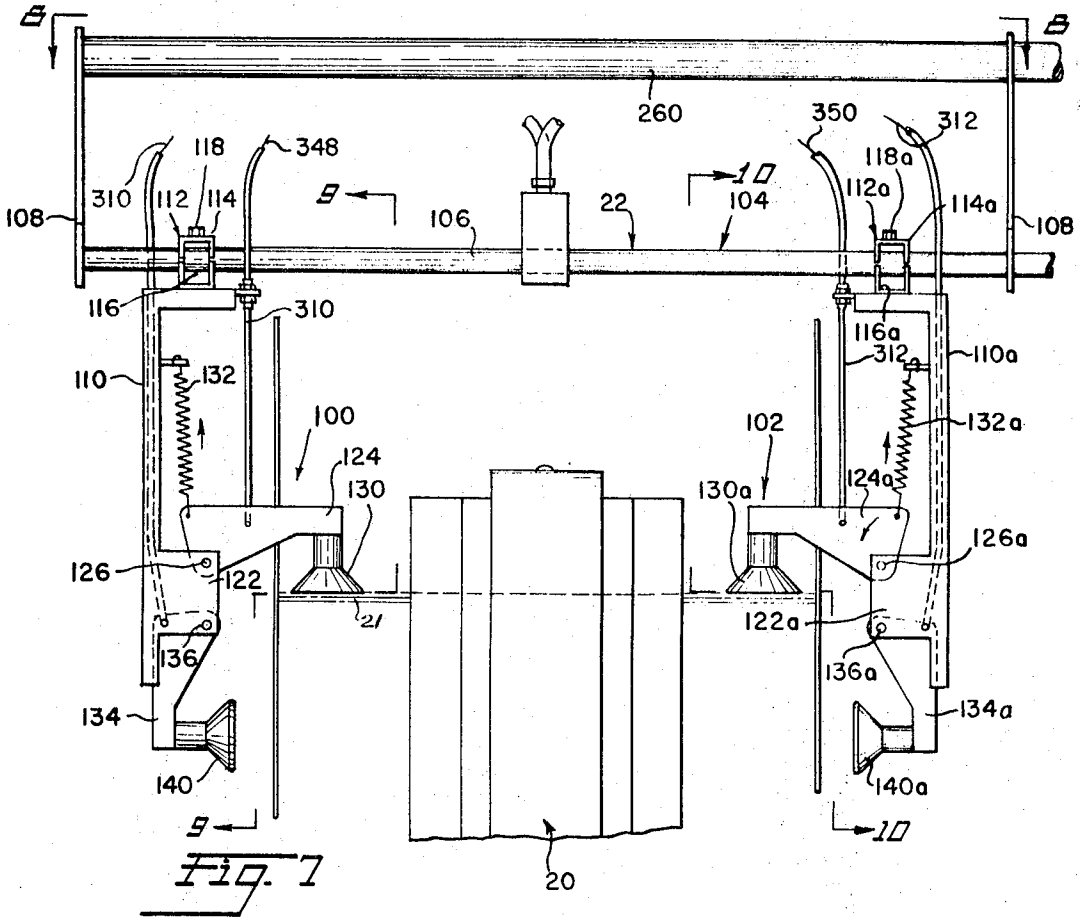


Fig. 7

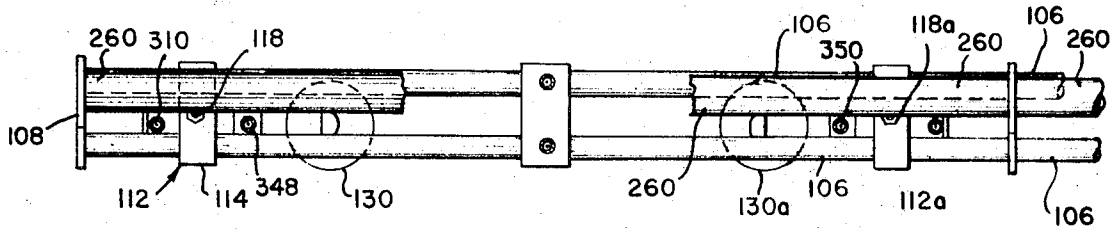


Fig. 8

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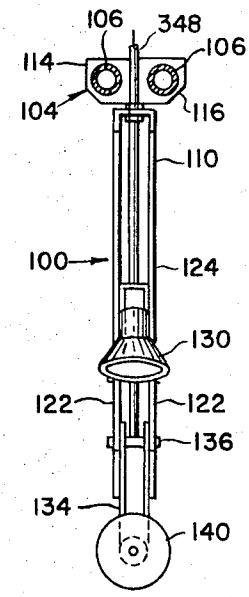


Fig. 9

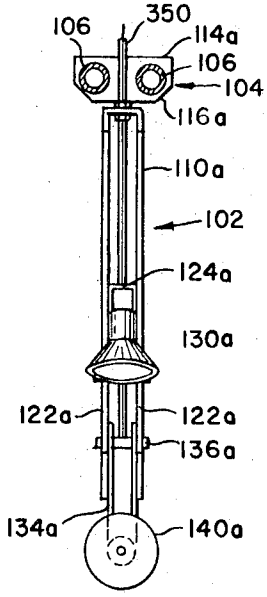


Fig. 10

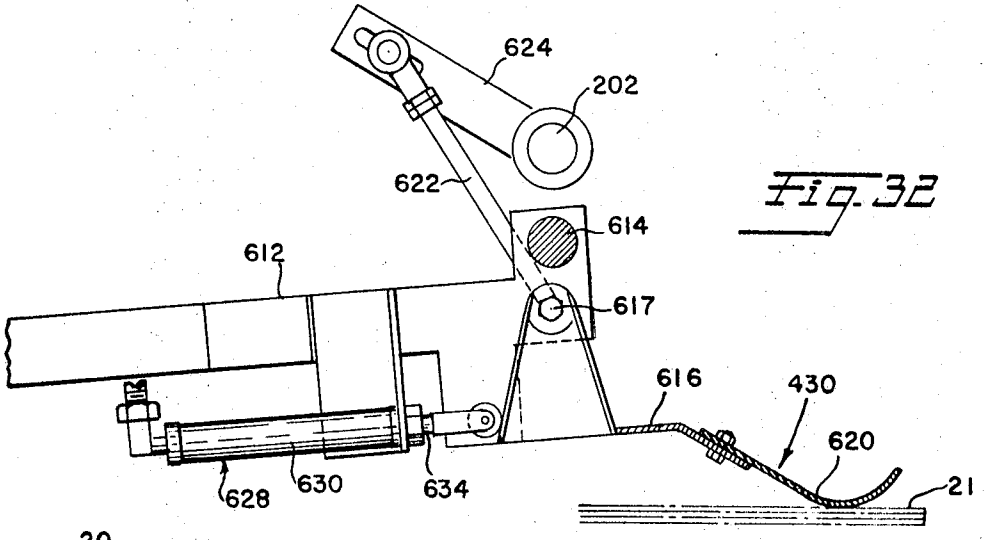


Fig. 32

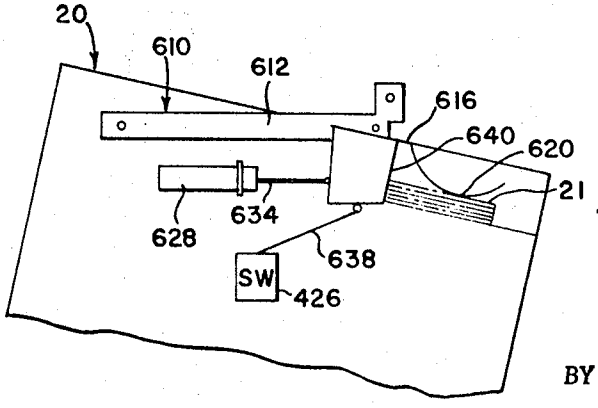


Fig. 33

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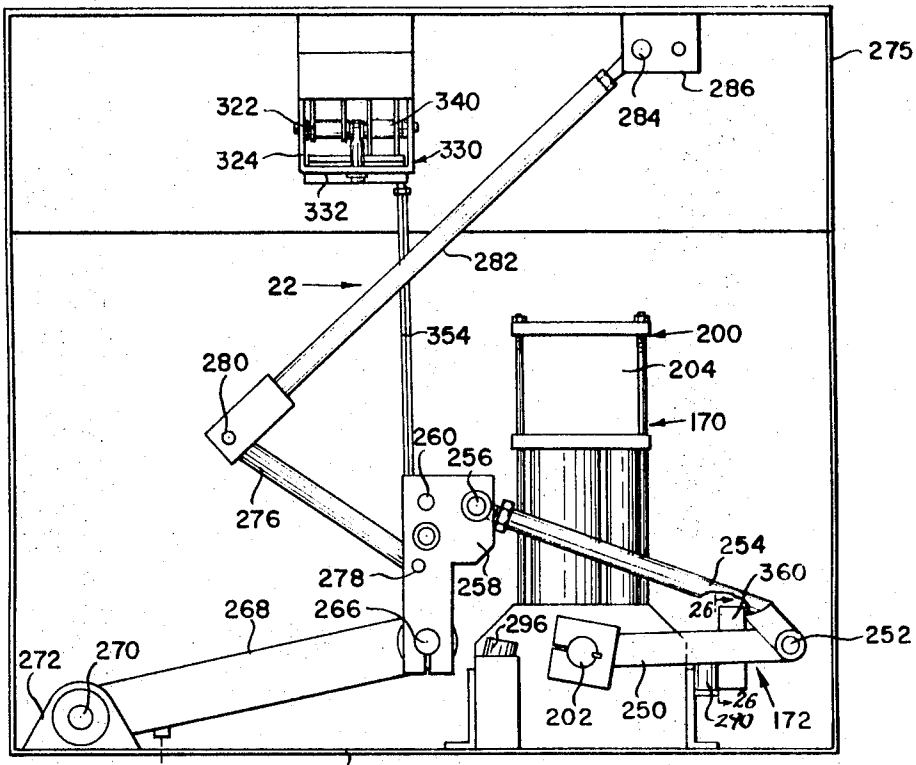


Fig. 11

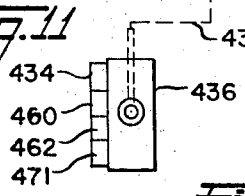


Fig. 21

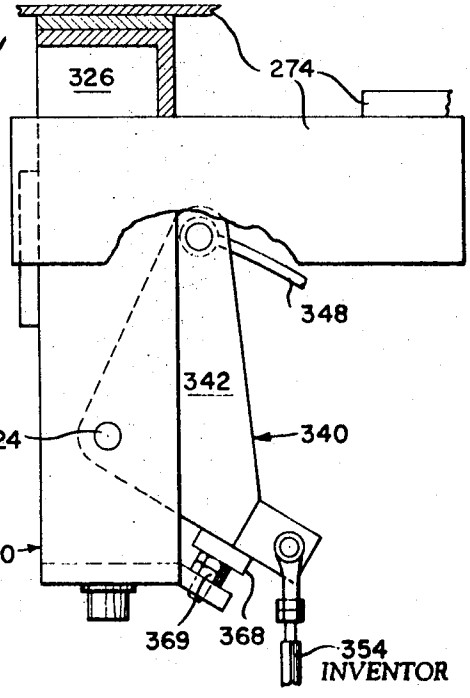
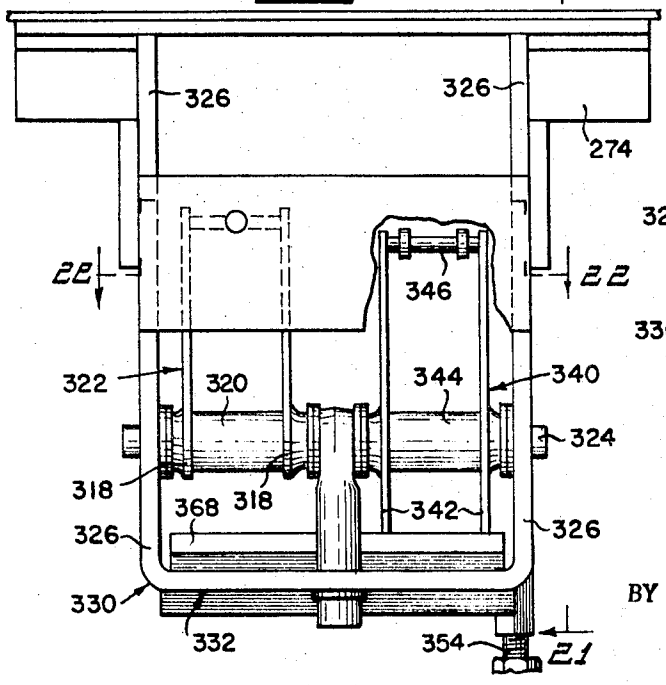


Fig. 20



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Fig. 12

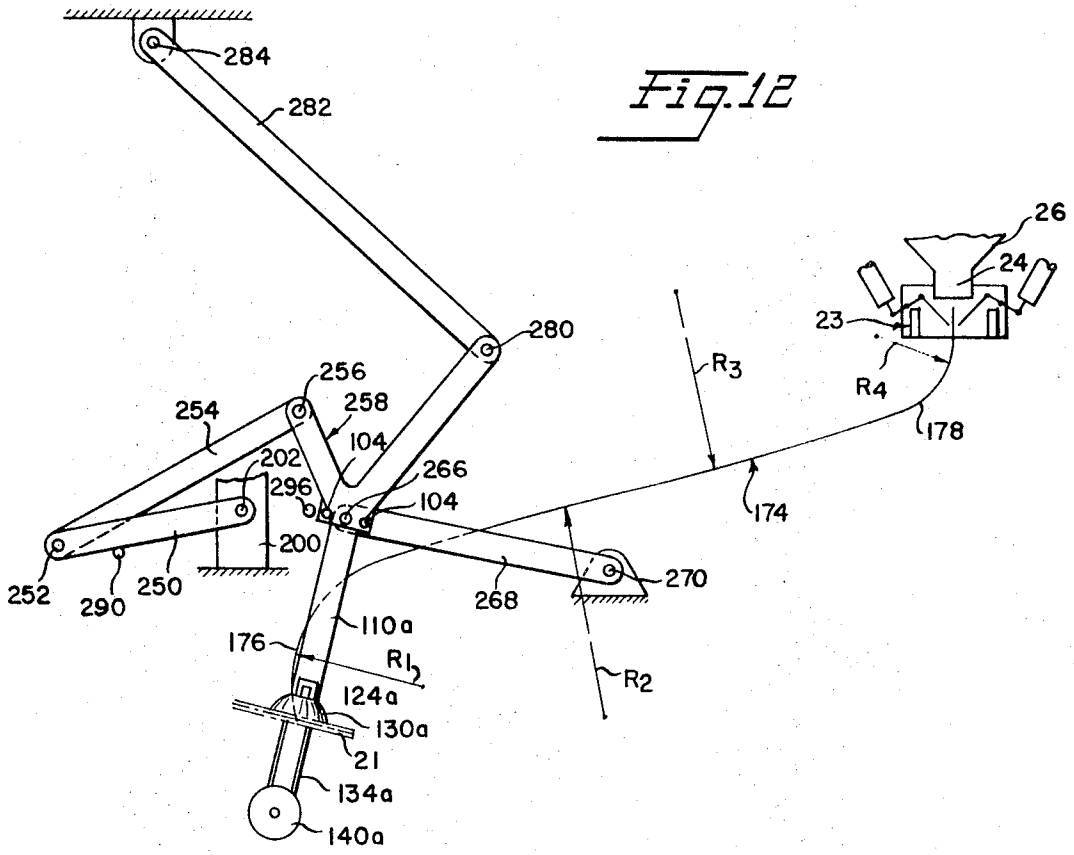
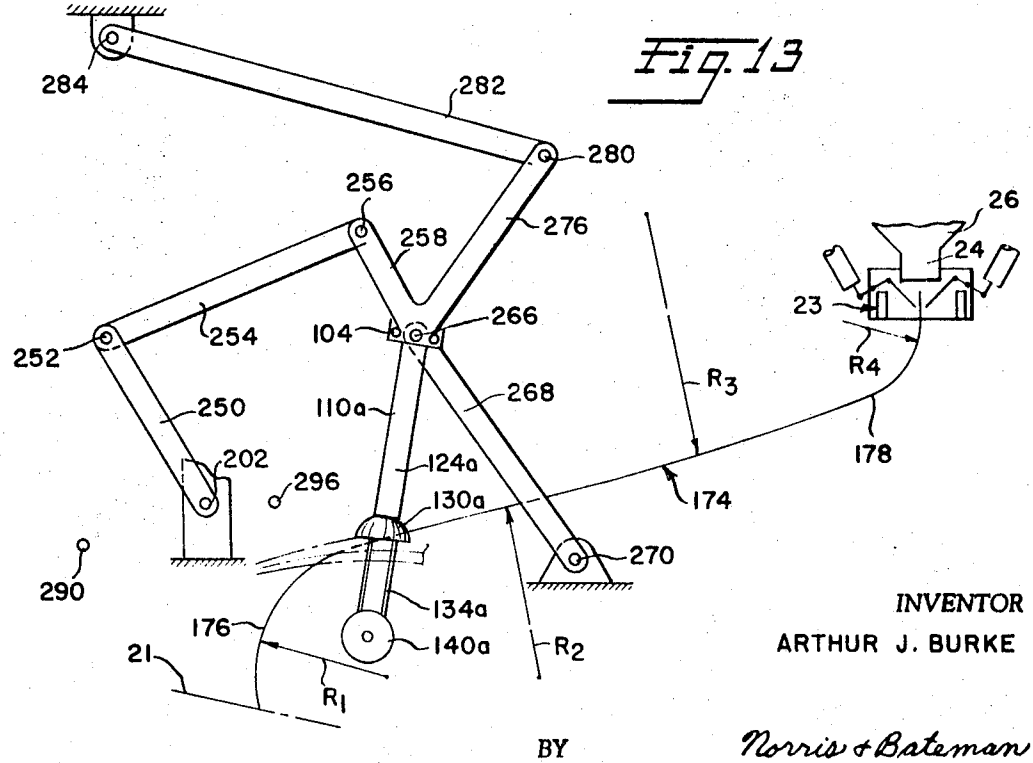


Fig. 13



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Fig. 14

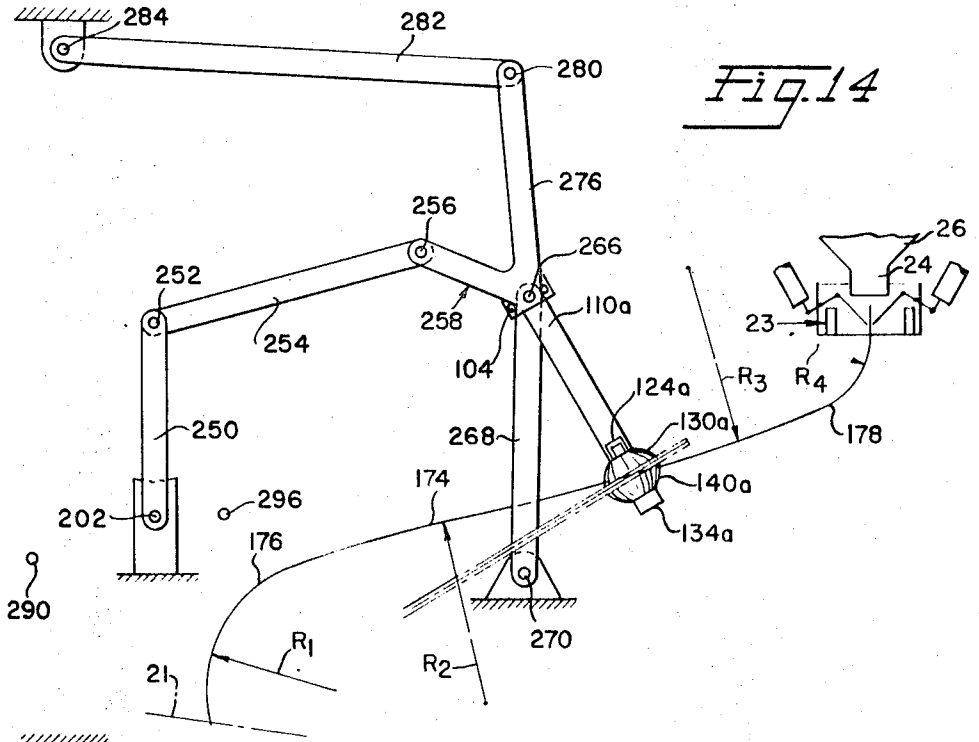
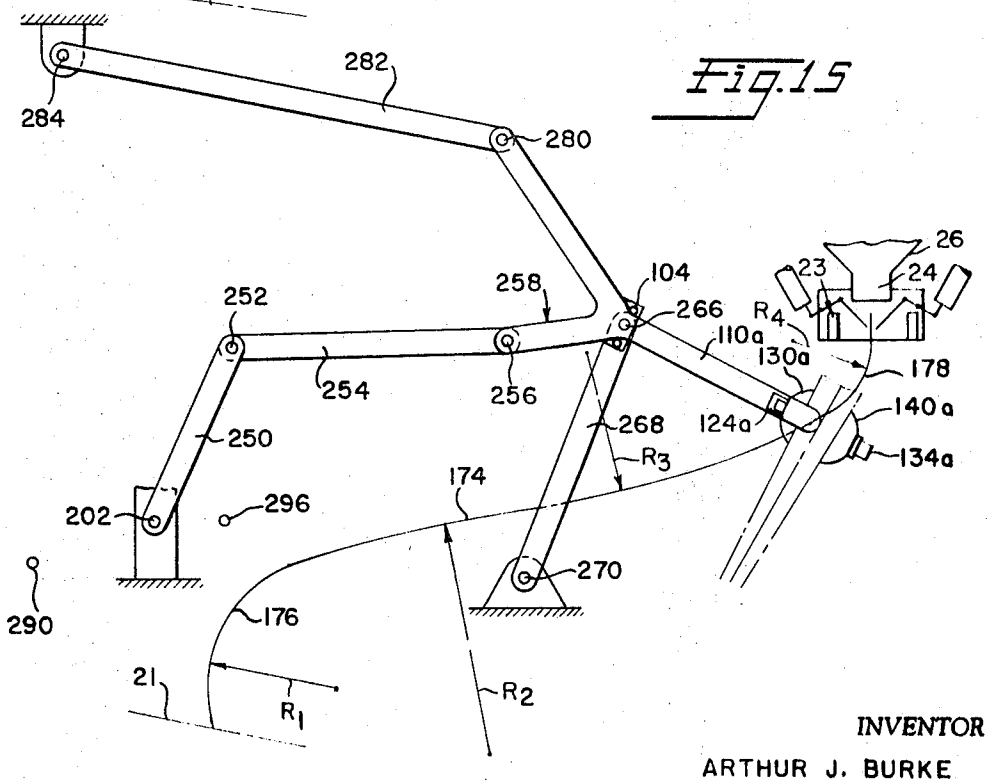


Fig. 15



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Fig. 16

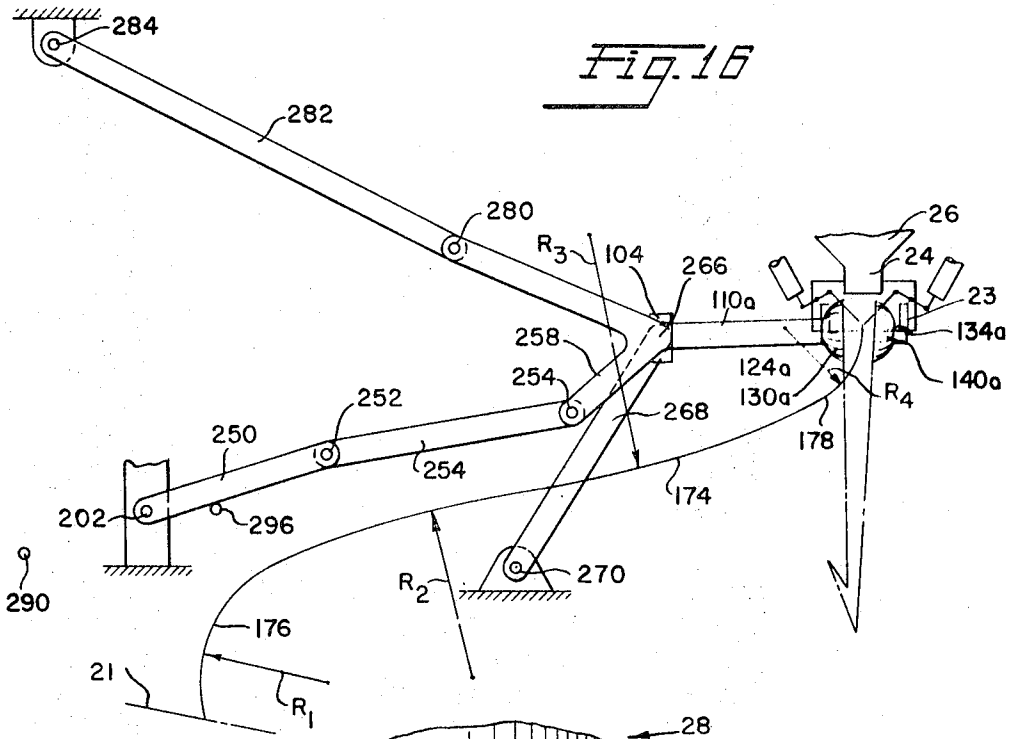
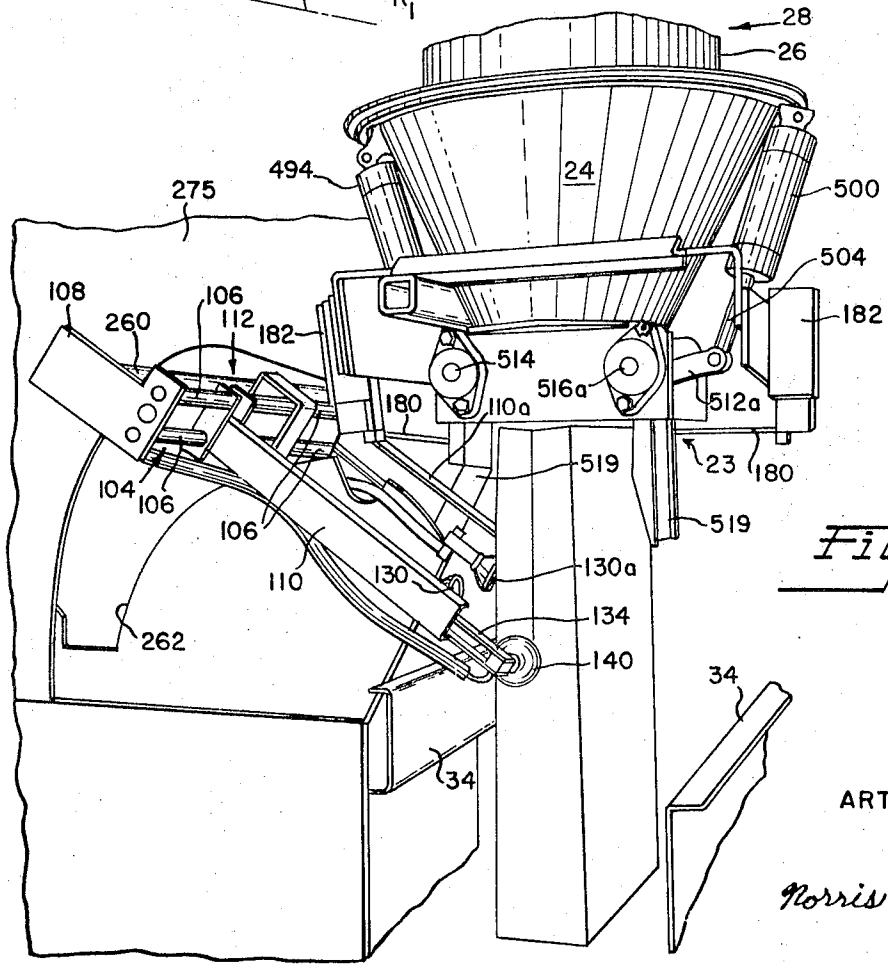


Fig. 17



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Norris & Bateman

ATTORNEYS

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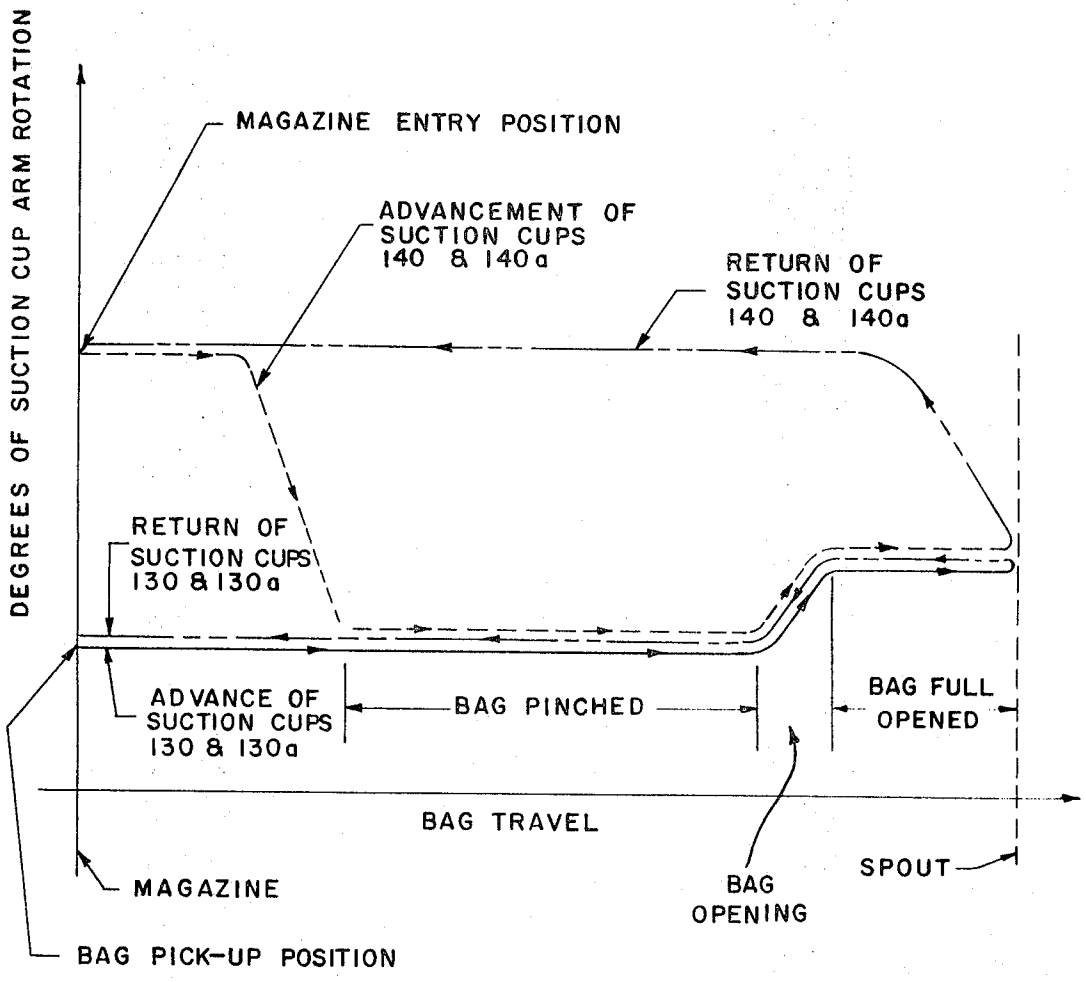


Fig. 1B

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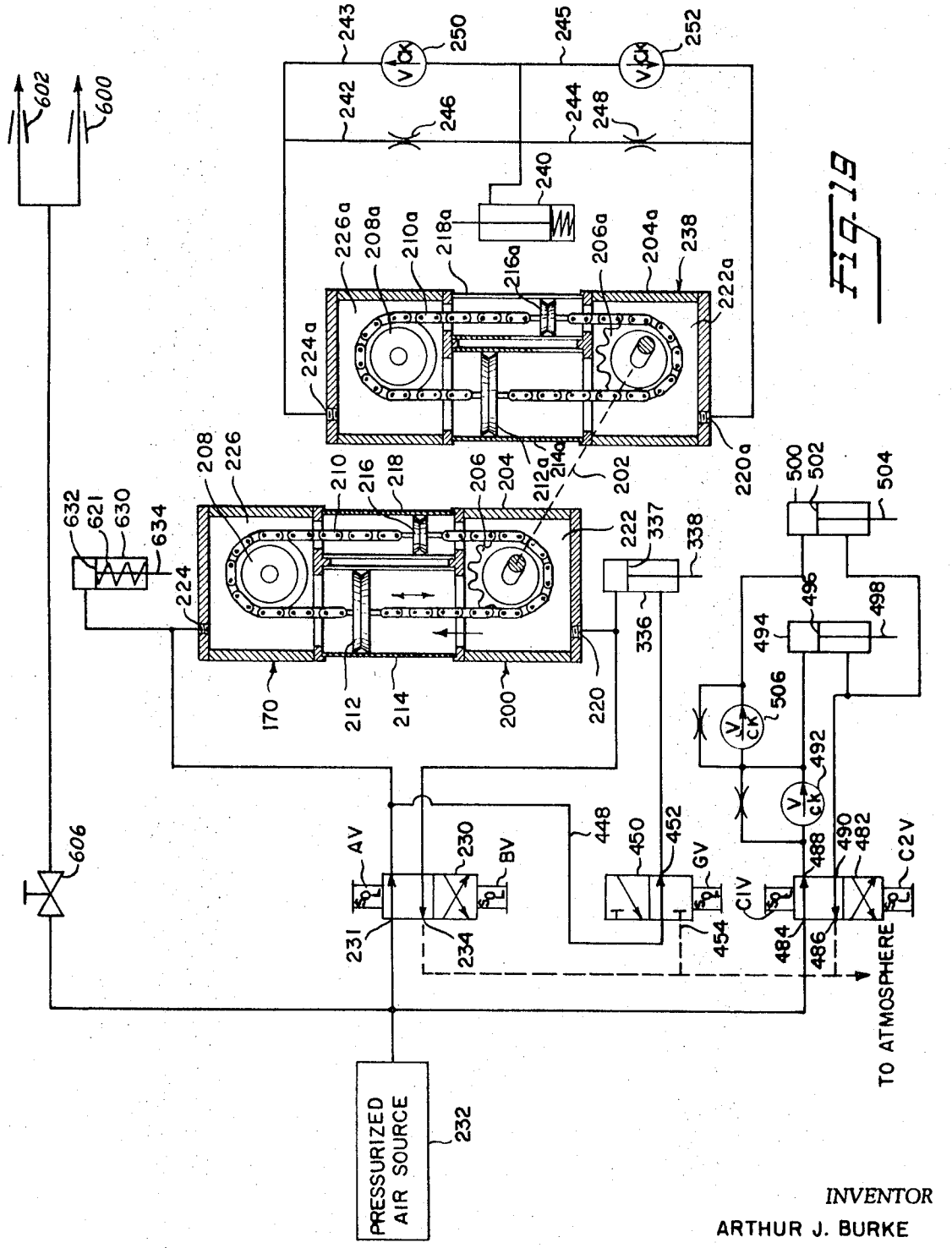


FIG. 19

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Fig. 22

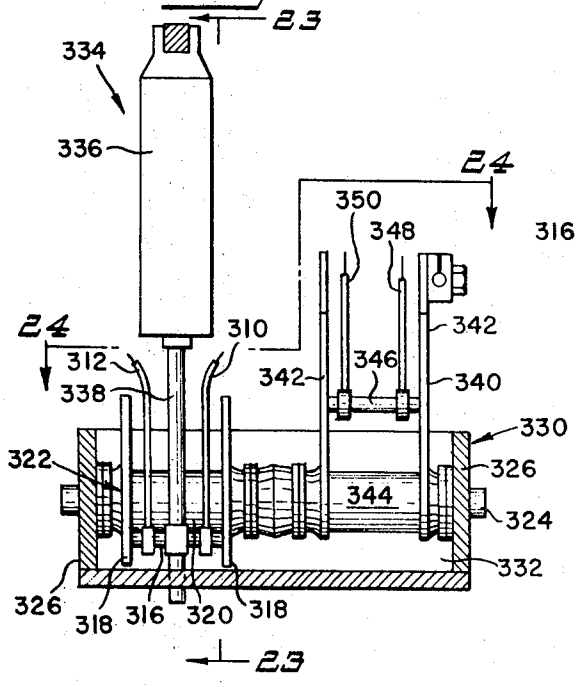


Fig. 23

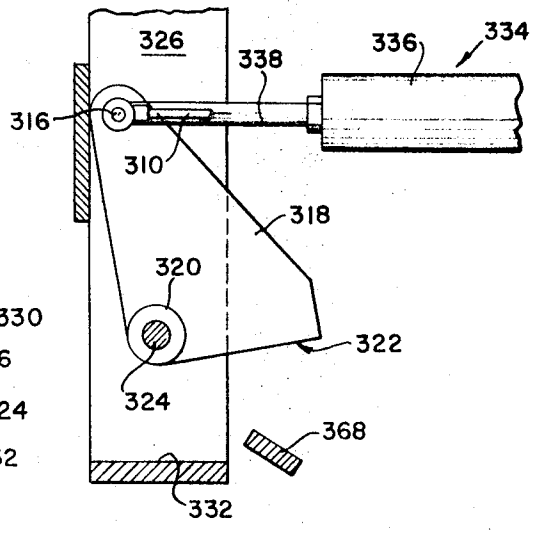
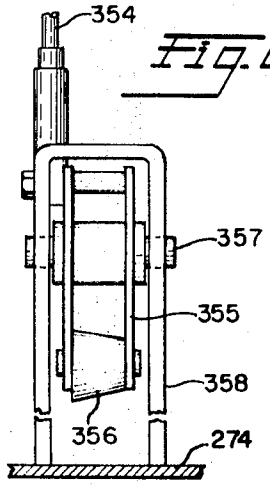


Fig. 25



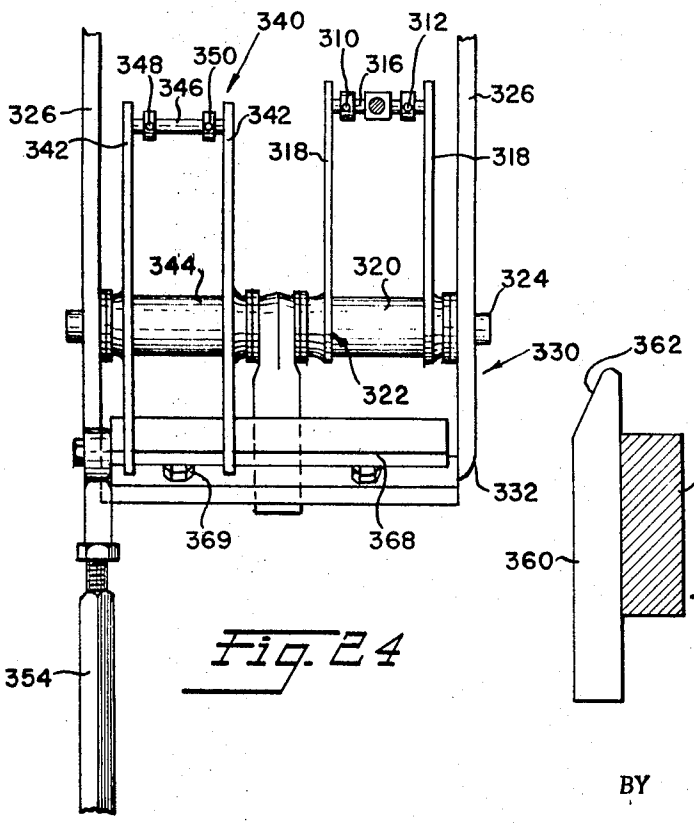


Fig. 24

Fig. 26

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ATTORNEYS

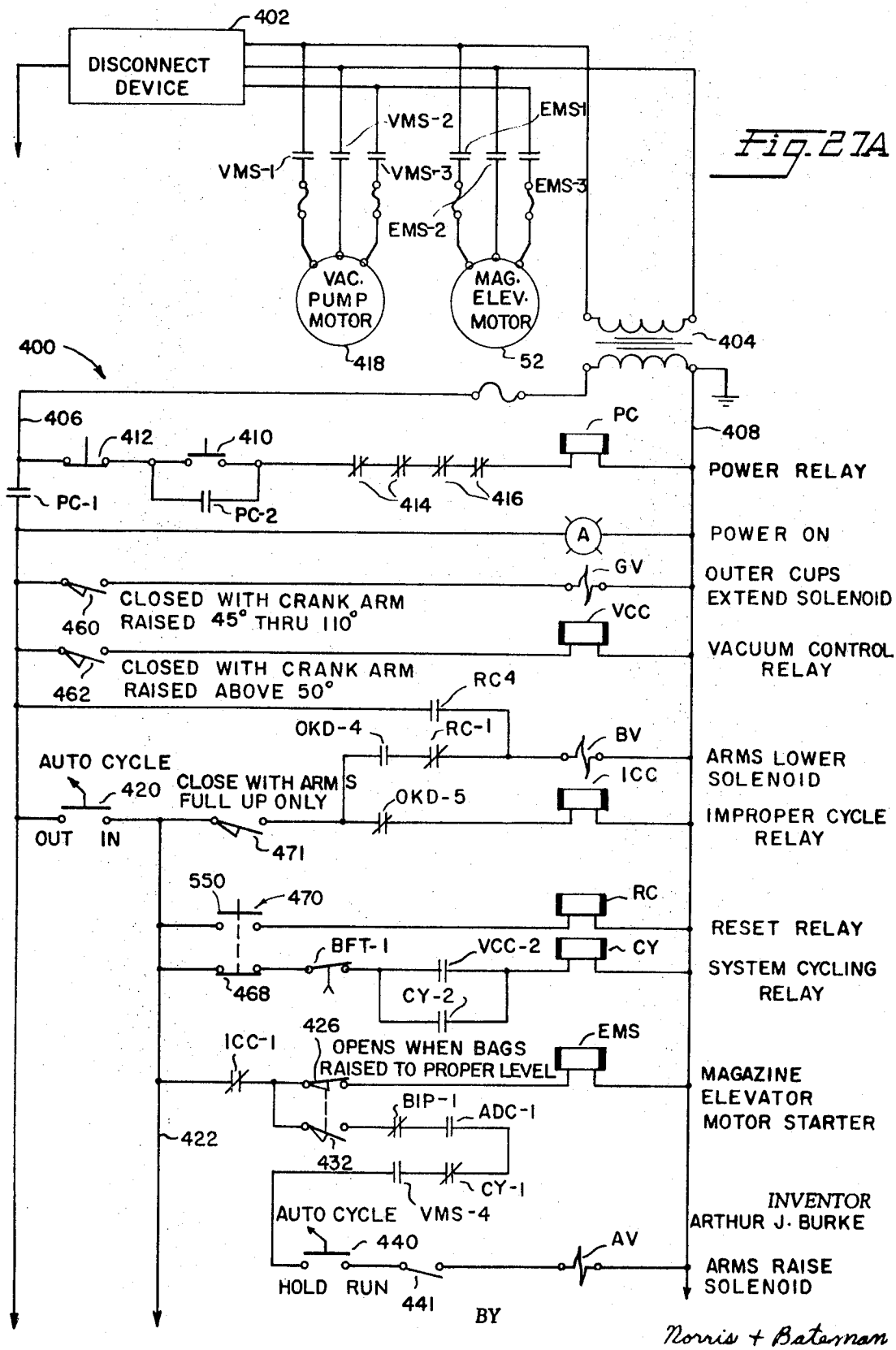


Fig. 27A

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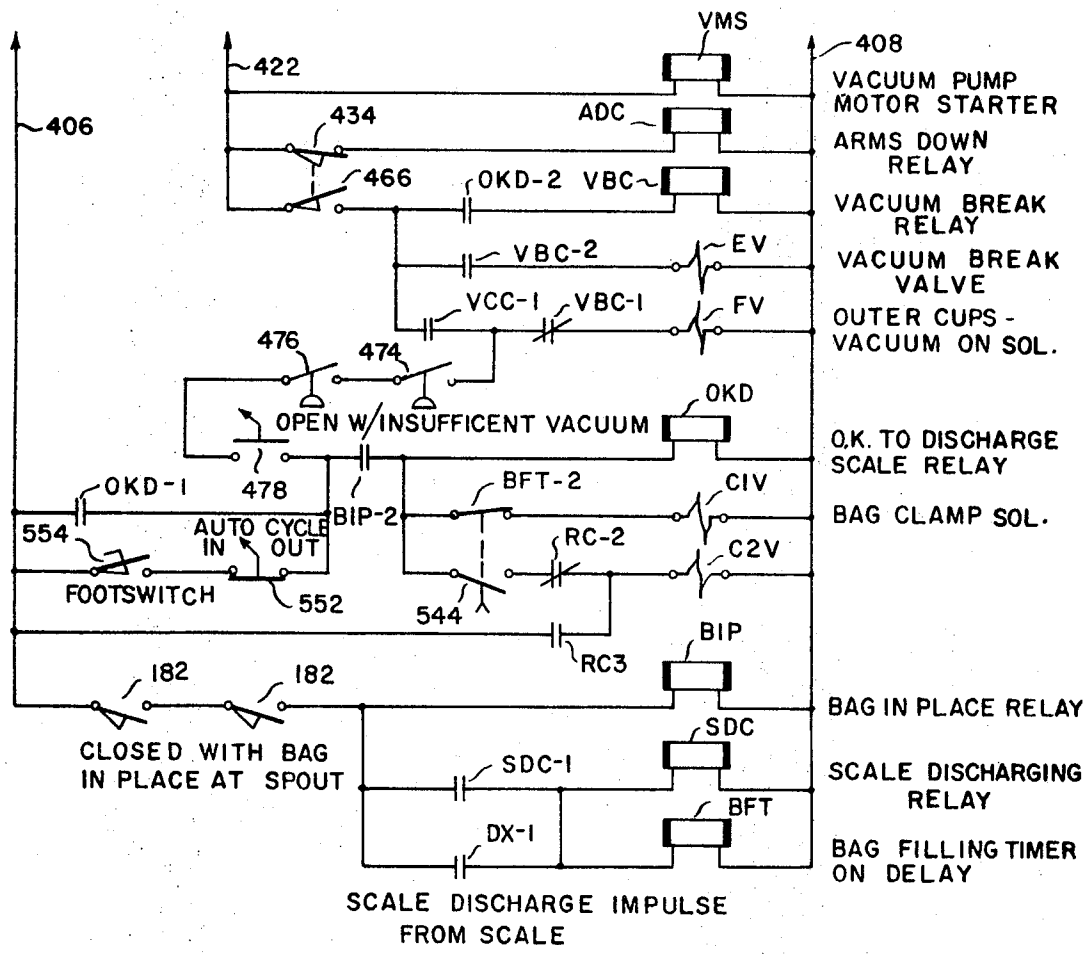


Fig. 27B

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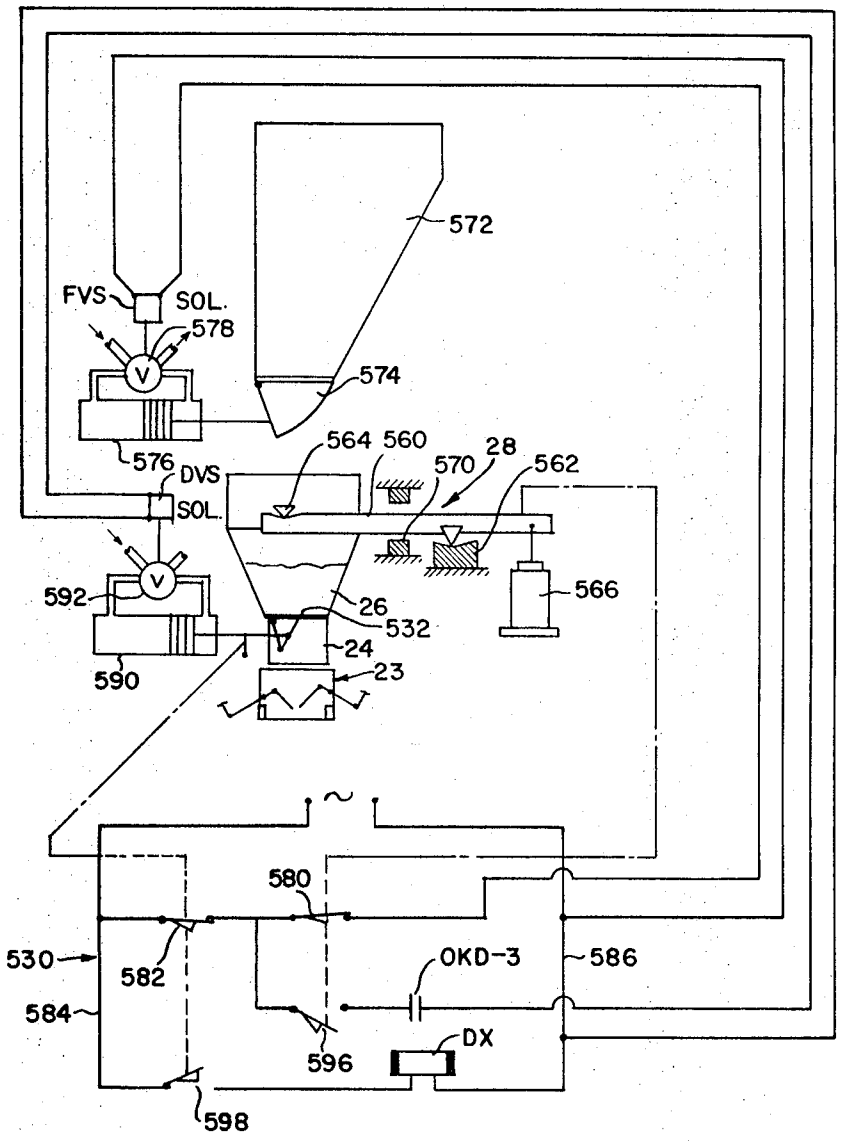


Fig. 27C

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ATTORNEYS

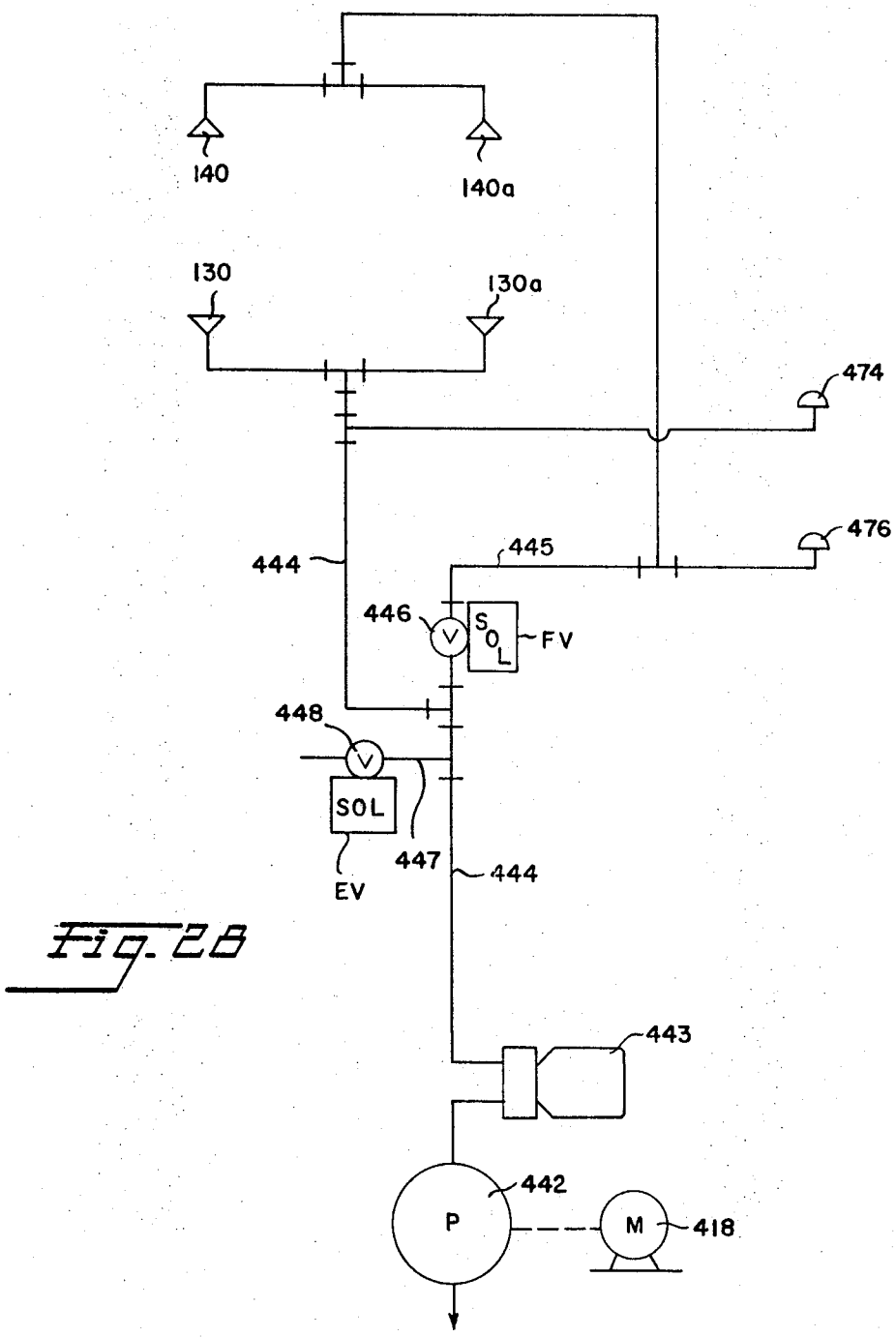


Fig. 28

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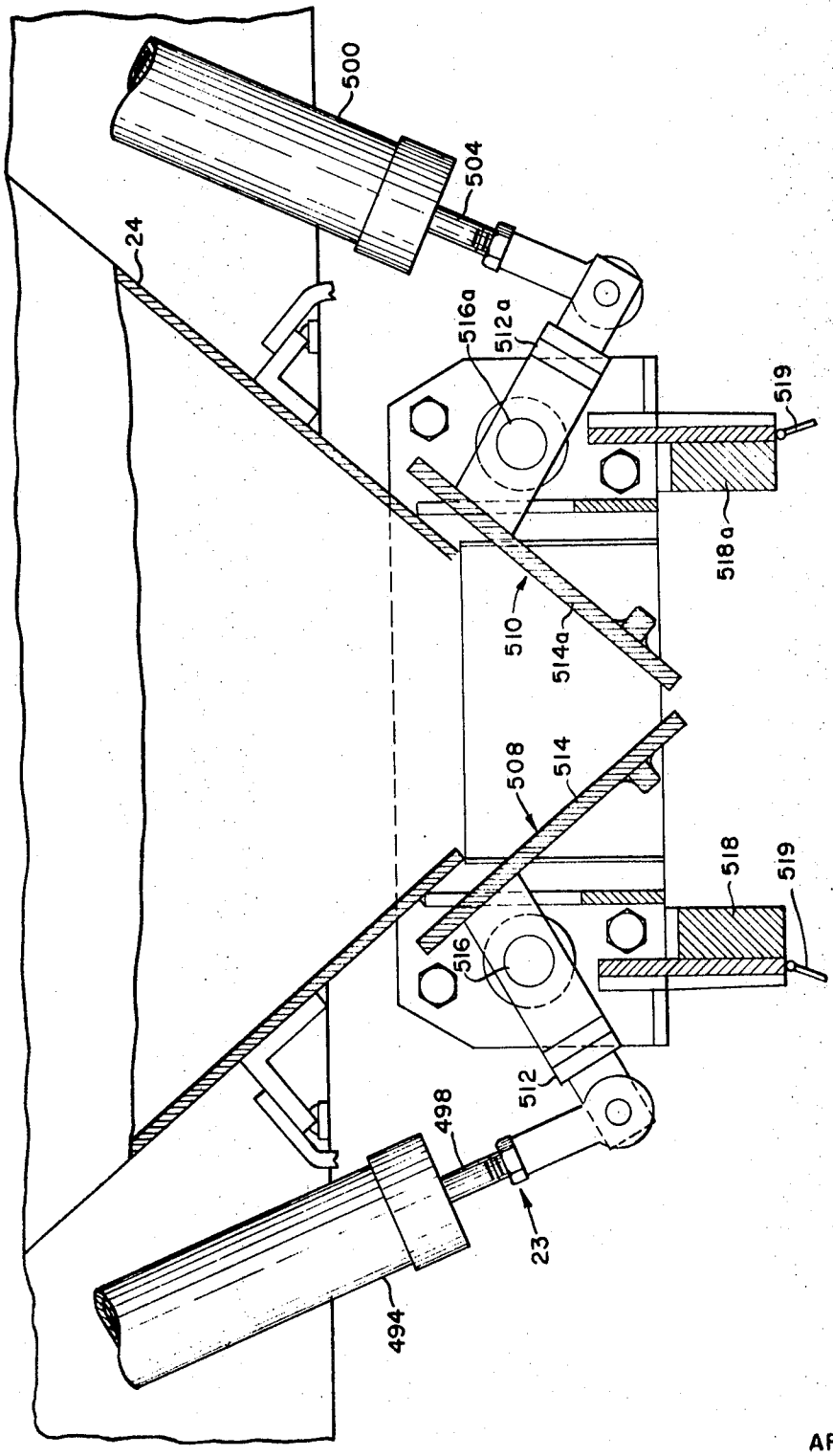


Fig. 29

INVENTOR
ARTHUR J. BURKE

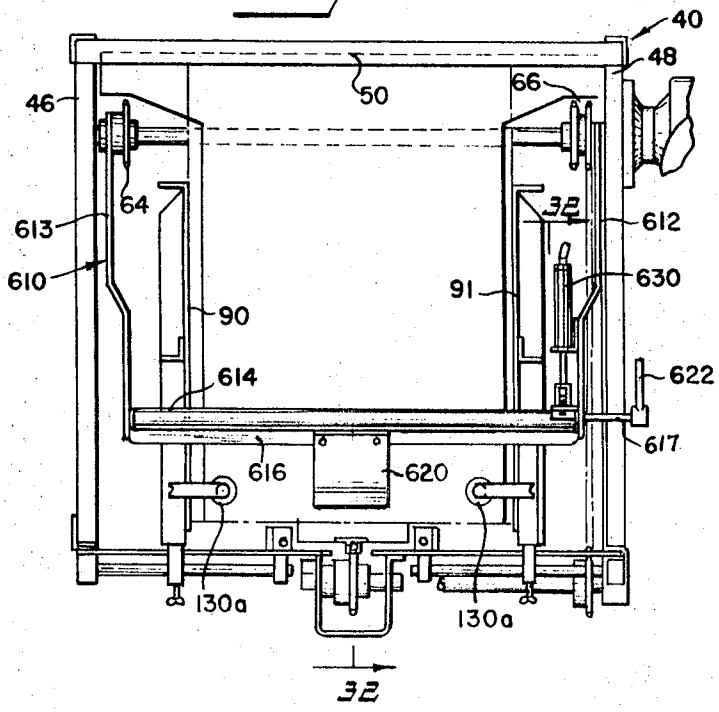
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Fig. 30



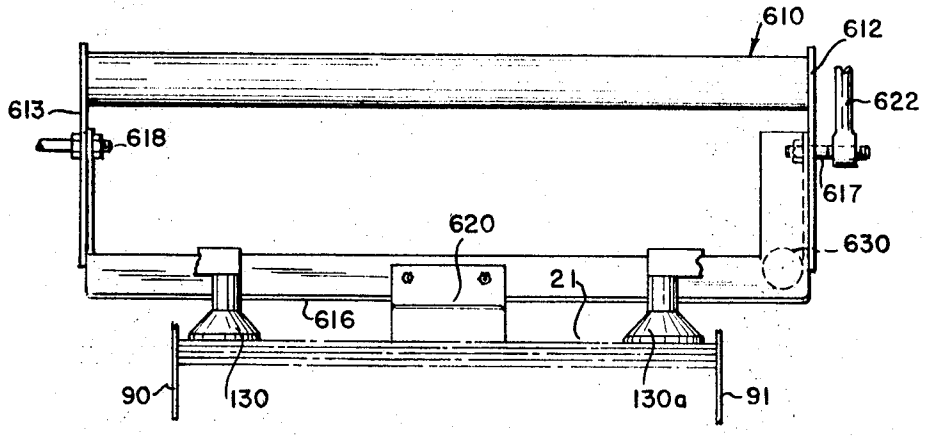


Fig. 31

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ATTORNEYS

United States Patent Office 3,619,981 Patented Nov. 16, 1971

3,619,981

BAG PLACER

Arthur J. Burke, Oakland, N.J., and Rudolf Keller, New York, N.Y., assignors to Howe Richardson Scale Company, Clifton, N.J.

Filed Dec. 16, 1968, Ser. No. 783,786
Int. Cl. B65b 43/30
U.S. Cl. 53—190 16 Claims

ABSTRACT OF THE DISCLOSURE

A bag placer for automatically picking up a bag from a stack in a magazine, opening it and placing it on a bag holder or the spout of a supply hopper receiving material to be delivered to the bag. The apparatus for effecting the magazine-to-bag holder transfer and for opening the bag comprises a suction cup assembly which is dispalced back and forth between the magazine and the bag holder by a motor driven motion transmitting linkage mechanism. This linkage mechanism is constructed to displace the suction cup assembly along a motion path aproaching the configuration of an S and is defined by two oppositely curved portions which are smoothly joined together by a single point or region of inflexion. The linkage mechanism further translates uniform rotary motion of a power output member to accelerate the bag as it is transferred from the magazine to the bag holder along the S-shaped motion path.

FIELD OF INVENTION

This invention relates to apparatus for picking up a bag from a stack in a magazine, for opening the bag and for placing it on or presenting it to a spout or the bag holder of a hopper or other receptacle containing material to be delivered to the bag. Such machines are commonly referred to as bag placers, bag hangers or bag feeders. The term "spout" is used herein to designate the lower end of the supply hopper. In some cases the bag is placed directly on the spout and held in place theeron by a suitable bag holder or clamping device. In other cases the bag holder is at the lower end of the spout so that the bag will, in effect, be suspended from the bottom of the spout. The phrase "suspending the bag from the spout" is used herein to designate either of the cases mentioned above.

BACKGROUND OF THE INVENTION

In automatic bag placing and filling machines of the type with which this invention is concerned, a magazine for storing a stack of empty bags is spaced from the spout of a supply hopper containing material for filling the bags. Usually the magazine is horizontally spaced from the general region of the hopper and below the level of the spout which is vertically located at the bottom of the hopper to provide the necessary space for transferring the bag from the magazine to the spout.

Probably the most common form of bag transferring mechanism in use in industry today is the type which swings the bag about a fixed center and, consequently, along an arcuate path of uniform radius. With such transfer mechanisms the level at which the bag is disposed in the magazine is determined by the horizontal spacing between the magazine and the vertical axis of the spout. For relatively long bags, on the order of 20 inches and more, the horizontal distance between a horizontal stack of bags in the magazine and the spout is required to be relatively large to enable the bag to be clear of the magazine when it is placed on the spout. As a result, the vertical spacing between the bag in the magazine and the bottom of the spout will be equally as great. The head room occupied by the bag placing and filling equipment will therefore be considerable.

SUMMARY AND OBJECTS OF INVENTION

This invention differs over the foregoing type of bag transfer mechanism and other forms of previously proposed bag placers by providing a bag transfer linkage mechanisms which picks up a bag from a generally horizontal stack in the magazine and which transfers it to the spout along a path having a smoothly curved configuration approaching the shape of an S which is turned generally 60 degrees from its normal, upstanding orientation depending upon the inclination of the bags stacked in the magazine. More specifically, the path along which the bag is advanced from the magazine to the spout is defined by two continuously and oppositely curved sections which are smoothly joined together by a single inflexion.

The first curved section extending from the magazine has in effect a progressively increasing radius such that the bag will initially be lifted from the stack generally upwardly and then advanced more horizontally. The second curved section has a progressively decreasing radius extending from the first curved section to the spout. From the point of inflexion, therefore, the motion of the bag will first be along the straighter portion of the second curved section and then will swing upwardly to the spout where the radius diminishes so that the motion of the bag at the end of the second curved section will be essentially vertical. Thus the value of the second derivative of the bag motion curve, which is described by the gripped bag portions as they move from the magazine to the spout, continuously decreases to zero at the point of inflexion and then continuously increases from the point of inflexion to the end of the curve at the spout.

The foregoing S-shaped motion path allows the spout to be spaced from the magazine at a considerably horizontal distance while at the same time enabling the vertical distance between the spout and magazine levels to be minimized. As a result, the head room occupied by the equipment is correspondingly reduced as compared with the previously described prior art mechanisms.

The foregoing S-shaped motion path is achieved essentially by three parts of a linkage mechanism which drive connects a motor or other prime mover to the apparatus (such as suction cups) for gripping or holding the bag. Two parts are each pivoted about fixed, spaced apart centers or axes, and their opposite ends are pivotally connected to the third part which carries the bag holding or gripping means. The arrangement of pivot points and the ratio of lengths of the three parts provides the S-shaped, bag-transfer motion path described above.

The linkage mechanism of this invention was found to be additionally advantageous in that it starts the bag motion at a relatively slow speed and then rapidly accelerates the bag as it is displaced toward the spout. As a result, there is less likelihood that the bag will be jarred loose from the gripping apparatus by sudden acceleration as it is picked up from the stack in the magazine. Rapid acceleration of the bag after it is picked up reduces the time required for transferring the bag.

The foregoing S-shaped, bag transfer motion path also is effective in improving the reliability of suction cups which are used in this invention for picking up the bag from the magazine, for opening it, and for presenting it to the spout.

According to a further feature of this invention two sets of suction cups are provided for gripping and opening the bag. In its bag pick-up position a first of the two sets is displaced to engage the upwardly facing side of the topmost bag in the generally horizontal stack stored in the magazine. The cups in the second set are initially swung outwardly to extended positions on opposite sides of the

stack in the magazine, and as the bag is picked up by the first set, the cups in the second set, upon clearing the stack of bags in the magazine, are swung inwardly to engage the downwardly facing side of the lifted bag. The bag now pinched or gripped between the two suction cup sets continues its advancement toward the spout, and as it approaches the spout, the cups in the two sets are swung outwardly to open the mouth of the bag and to present the opened bag to the bag holder at the spout. The cups in the second set, after they release from the bag, are swung outwardly to their initial extended positions where they will clear the spout mounted bag on their return and where they will clear the stack as they enter the magazine in preparation for transferring the next bag to the spout.

The initial lift applied to the bag in its advancement along the previously described S-shaped motion path is advantageous in that it minimizes the forces tending to separate the bag from the first set of suction cups. As a result, more reliable operation of the bag placer is achieved.

As will become more apparent from the detailed description, the assembly of the two suction cup sets mentioned above is the only means utilized for picking up and transferring the bag from the magazine to the spout. This arrangement provides a simplified construction as compared with prior types of bag placers in which two separate mechanisms are employed, one of which picks the bag up and delivers or presents it to the other mechanism for transfer to the spout.

In the arrangement provided by this invention, the suction cups engage the bag sides at the forward corners thereof adjacent to the open end of the bag. As the bag is initially lifted it is also advanced forwardly, with the horizontal component of travel being iniitially less than the vertical travel component. To keep the bag mouth from opening widely before the cups in the second set are swung inwardly to pinch the bag, one or more streams or jets of air, which are directed from the forward end of the magazine, impinge against the downwardly facing side of the bag adjacent to its open end. This prevents the bag from opening so widely as to interfere with the proper engagement of the second suction cup set mentioned above.

With the foregoing in mind, it is a primary object of this invention to provide a novel bag placer which is efficient and reliable in operation and which is capable of feeding bags to a supply hopper or the like at a rapid rate.

Another major object of this invention is to provide a bag transfer mechanism which picks the bag from a stack in the magazine and which delivers it to the hopper along a smoothly curved motion path approaching an S-shaped configuration to thereby provide a relatively low vertical distance between the levels of the spout and the stack of bags in the magazine.

Still another object of this invention is to provide a novel, relatively simplified suction cup arrangement for gripping and opening the bag.

Other important objects of this invention include the provision of a novel, electrical circuit for controlling the automatic operation of the bag placer.

Further novel features, additional important objects, and other significant advantages of this invention will become more fully apparent from the appended claims and as the detailed description proceeds in connection with the drawings described below.

DESCRIPTION OF DRAWINGS

FIG. 1 is a partially diagrammatic plane view of a bag placer according to a preferred embodiment of this invention and showing the bag-filling, scale hopper in section;

FIG. 2 is a perspective view of the apparatus shown in FIG. 1 as seen from the direction of the arrow indicated at A in FIG. 1;

FIG. 3 is a rear elevation of the magazine shown in FIG. 1;

FIG. 4 is a section taken substantially along lines **4—4** of FIG. 3;

FIG. 5 is a front view of the magazine as seen from a plane defined by lines **5—5** of FIG. 4;

FIG. 6 is a plane view of the magazine as seen from a plane defined by lines **6—6** of FIG. 4;

FIG. 7 is a fragmentary elevation of the bag-engaging suction cup assembly of this invention at its bag pick-up position in the magazine;

FIGS. 8, 9, and 10 are sections taken respectively along lines **8—8**, **9—9**, and **10—10** of FIG. 7;

FIG. 11, which is a section taken substantially along lines **11—11** of FIG. 1, illustrates the linkage mechanism for connecting the drive motor or other prime mover to the bag pick-up and transfer mechanism shown in FIG. 7;

FIGS. 12, 13, 14, 15, and 16 are generally diagrammatic elevations as seen from the right-hand side of FIG. 1 and showing the operation of the linkage mechanism illustrated in FIG. 11 as well as operation of the suction cup assemblies illustrated in FIG. 7;

FIG. 17 is a fragmentary perspective view showing the return movement of the suction cup assemblies after the bag is clamped by the bag holder at the bottom of the scale hopper;

FIG. 18 is a graph diagrammatically illustrating the various positions of the suction cups shown in FIG. 7 for picking up a bag from the magazine, for pinching or gripping the bag for transfer to the supply hopper, and for opening the bag during its movement toward the scale hopper;

FIG. 19 is a diagrammatic view of the pneumatic circuit for operating the bag placer shown in FIG. 1;

FIG. 20 is an enlarged, fragmentary elevation of the suction cup positioning mechanism shown in FIG. 11;

FIGS. 21 and 22 are sections respectively taken along lines **21—21** and **22—22** of FIG. 20;

FIG. 23 is a section taken substantially along lines **23—23** of FIG. 22;

FIG. 24 is a section taken substantially along lines **24—24** of FIG. 22;

FIG. 25 is an enlarged, fragmentary elevation of the motion transmitting mechanism shown in FIG. 11 for operatively connecting the bag-transfer linkage mechanism to the suction cup positioning mechanism illustrated in FIGS. 20–24;

FIG. 26 is a section taken substantially along lines **26—26** of FIG. 11;

FIGS. 27A and 27B schematically illustrate the electrical control circuit for the bag placer, with FIG. 27B being a continuation of the circuit shown in FIG. 27A;

FIG. 27C is a diagrammatic view of the bag-filling scale together with the control circuit therefor;

FIG. 28 is a schematic of the vacuum circuit for the suction cups shown in FIG. 7;

FIG. 29 is a fragmentary, enlarged, partially sectioned elevation of the bag holder shown in FIG. 2;

FIG. 30 is a view generally in planed of a bag height sensing mechanism in operative position on the magazine shown in FIG. 2;

FIG. 31 is a fragmentary front elevation of the bag height sensing mechanism shown in FIG. 30;

FIG. 32 is a section taken along lines **32—32** of FIG. 30; and

FIG. 33 is a diagrammatic view of the bag height sensing mechanism shown in FIG. 30.

DETAILED DESCRIPTION

Referring now to the drawings and more particularly to FIGS. 1 and 2, the bag placer, according to the preferred embodiment of this invention, comprises a magazine **20** for storing a stack **21** of collpased, flattened, empty bags and a bag feeding and opening mechanism **22** for automatically picking the top bag in stack **21** and

feeding it to a bag holder 23 at a spout 24 of a supply hopper 26 or other suitable receptacle. Hopper 26 forms a part of a weighing and bag filling machine 28 which may be of any suitable, conventional form for automatically weighing out and dispensing successive, descrete drafts of material of preselected weight.

Spout 24 is spaced forwardly from magazine 20 and is located at a higher level than magazine 20 as best shown in FIG. 2. The longitudinal axis of spout 24 is vertical and is contained in a plane that medially intersects magazine 20 and also stack 21 when the latter is properly arranged in the magazine. As shown, the bags in stack 21 are slightly inclined from a horizontal plane.

Mechanism 22, in transferring the bags, moves the bags upwardly and forwardly and also swings each bag from the position occupied in magazine 20 to a vertical position with the open end facing upwardly for presentation to bag holder 23.

Machine 28 is actuated by placing an opened, empty bag on bag holder 23 to automatically dispense a measured amount or, more specifically, a pre-selected weight of material through spout 24 and into the empty bag which is suspended from spout 24 in a manner to be described later on. The filled bag is then released from spout 24 and drops onto a suitable, motor-driven conveyor belt assembly 30 which has a horizontal belt run 32 passing in the region vertically below the spout. Conveyor assembly 30 transfers the filled bag away from the vicinity of the bag placing and filling apparatus just described. Suitable, rigid structural members 34 on opposite sides of conveyor assembly 30 guide the filled bag as it is conveyed away by belt run 32 to prevent the bag from tipping or falling off to either side of assembly 30.

With continued reference to FIG. 2, magazine 20 comprises a rigid support frame 40, a bag support platform 42, and a motor driven platform elevating mechanism 44. Frame 40 comprises a pair of parallel, rectangular, frame-like side sections 46 and 48 which are rigidly joined together by suitable cross members indicated at 50.

Mechanism 44, as shown in FIGS. 3–6, comprises an electric motor 52 having an unshown output shaft coupled through a gear drive unit 53 to a horizontally extending sprocket support shaft 54. Shaft 54 extends transversely between sections 46 and 48 and is journalled at opposite ends by suitable bearings in sections 46 and 48. As shown, shaft 54 is in the region of the lower rearward corner of magazine 20 and non-rotatably, coaxially mounts a pair of sprocket wheels 56 and 58 which are disposed adjacent to sections 46 and 48 respectively.

A pair of endless, platform supporting, elevator roller chains 60 and 62 forming a part of mechanism 44 are respectively trained around sprocket wheels 56 and 58 and extend upwardly in the rearward corners of magazine 20. At their upper ends, chains 60 and 62 are respectively trained over a pair of sprocket wheels 64 and 66. Sprocket wheels 64 and 66 are rotatably supported on side sections 46 and 48 as shown.

Platform 42, which comprises a flat-sided, rigid plate, has, as best shown in FIG. 6, a pair of laterally outwardly extending arms 68 and 70. Arms 68 and 70 are formed along the rearward edge of platform 42 and extend in back of the rearward runs of chains 60 and 62. Platform 42 is removably seated on suitable lugs or hooks 72 (see FIG. 3) which are fixed to chains 60 and 62. With this construction it is clear that the platform 42 is supported along its rearwardly facing edge on the rearward upstanding runs of chains 68 and 70.

At its forward edge, platform 42 is removably seated on another lug 74 (see FIG. 6) which is fixed to chain 76. Chain 76 thus supports platform 42 at its forwardly facing edge and is trained around spaced apart sprocket wheels 78 and 80 which are respectively disposed near the upper and lower ends of magazine 20. Sprocket wheel 78 is rotatably supported on frame 40, and sprocket wheel 80 is coaxially, non-rotatably mounted on a horizontally extending shaft 82 (see FIG. 5) which extends between side sections 46 and 48 of frame 40 along the forward, lower region of the magazine. Shaft 82 is journalled at opposite ends by suitable bearings which are mounted in frame 40. Shaft 82 is drive connected to shaft 54 by a chain and sprocket wheel assembly 84 shown in FIG. 4.

As shown, the rotational axes of shafts 54 and 82 and of sprocket wheels 64, 66, and 68 are parallel. The rotational axes of sprocket wheels 64 and 66 are axially aligned. Chains 60, 62 and 76 all travel in parallel paths. A vertical plane medially intersecting magazine 20 medially intersects chain 76 and extends equidistantly between chains 60 and 62.

The upper portions of chains 60, 62 and 76 are each tilted forwardly by an angle of about 15 degrees with respect to a vertical plane. Also, shaft 54 is at a higher level than shaft 82 such that a plane containing the rotational axes of shafts 54 and 82 is inclined at an angle of about 15 degrees with the horizontal. The arrangement and spacing of lugs 72 and 74 are such that the rearward edge of platform 42 is tilted upwardly from a horizontal plane by an angle of about 15 degrees. Thus, platform 42 lies in a plane which is inclined with the horizontal by an angle of about 15 degrees and which intersects the runs of chains 60, 62 and 76 essentially at right angles.

The stack of flatly collapsed bags indicated at 21 in FIG. 12, is seated on platform 42 in such a way that the open ends of the bags are adjacent to the forwardly facing edge of platform 42 and to chain 76. In the direction extending rearwardly toward the closed ends of the bags, the bags in stack 21 are therefore inclined upwardly at an angle of about 15 degrees with the horizontal.

By energizing motor 52, chains 60, 62 and 76 are advanced at uniform speeds to raise platform 42 and the stack of bags on platform 42. Energization of motor 52 is controlled by the height of stack 21 in a manner to be described later on to ensure that the top bag in stack 21 is at a proper level for being picked up by mechanism 22.

As the supply of bags in magazine 20 diminishes, platform 42 normally is approaching the upper region of the magazine. To replenish the bag supply at this stage, platform 42 is removed and re-mounted on the elevator chains at the lower region of magazine 20. A new supply of bags is then stacked on platform 42 in preparation for further operation of the bag placer.

To avoid any appreciable interruption of operation in order to replenish the supply of bags in magazine 20, a second bag support platform (see the phantom lines indicated at 42*a* in FIG. 4), which is preferably identical to platform 42, is mounted on chains 60, 62 and 76 at the lower region of magazine 20 when platform 42 is at or near the upper region of magazine 20. During operation, therefore, the operator may stack new bags on this second platform while bags are still being picked up from platform 42. When the supply of bags on platform 42 is depleted, the operator then removes platform 42 from magazine 20 and motor 52, as will be described later on, is automatically energized to raise the second platform carrying the new supply of bags to a location where the top bag on the second platform is in proper position to be picked up by mechanism 22. As a result, interruption of the operation of the bag placer is only momentary.

As shown in FIGS. 3, 5, and 6 a pair of parallel, upstanding flat plates 90 and 91 are adjustably secured by assemblies 95, 95*a*, 95*b* and 95*c* to frame 40 and extend along opposite sides of platform 42 between arms 68 and 70 and the front end of magazine 20. Plates 90 and 91, by engaging the side edges of the bags in stack 21 as platform 42 is raised, maintain the side edges of the bags properly aligned. The bags on platform 42 normally ride down toward the forward end of magazine 20 such that the edges of the bags around their open ends seat against a pair of straight, parallel, upstanding guide members 92 and 93 which are fixed to frame 40 equidistantly on op-

posite sides of chain **76**. Guide members **92** and **93** are inclined so that their bag-engaging guide surfaces are normally intersected by a plane containing platform **42** when the latter is mounted in its tilted, illustrated position in the magazine. This keeps the open ends of the bags properly aligned in a straight row. By virtue of being guided by plates **90** and **91** and by members **92** and **93**, the bags in stack **21** will be oriented properly in such a position as to ensure that they will reliably be picked up by mechanism **22**. As shown, a rigid guard **94** is provided for chain **76** at the front of magazine **20** and is suitably fixed to frame **40**.

As shown in FIGS. 2, 5, and 6, assembly **95**, which secures plate **90** to frame **40**, comprises an elongated rigid structural member **96** which is fixed to plate **90** and which is apertured at its forward end to slidably receive a slide rod **97**. Member **96** extends longitudinally in magazine **20** along the upper region of the outwardly facing side of plate **90** and is disposed perpendicularly with respect to rod **97**. Rod **97** is horizontal and extends between guard **94** and frame section **46** at the front of magazine **20** and at right angles to the longitudinal axis of the magazine. Rod **97** is fixed at opposite ends to frame **40**.

The rigid sub-assembly of plate **90** and member **96** is slidable axially along rod **97**. A screw member **98** threaded into the apertured end portion of member **96** along an axis extending normally with respect to the axis of rod **97** is tightened to secure structural member **96** to rod **97**.

Advantageously, assembly **95***a* (see FIGS. 3 and 5), which is of the same construction as assembly **95**, is provided at the lower region of plate **90** to retain plate **90** substantially rigid throughout its length. Like reference numerals suffixed by the letter *a* have been applied to designate the parts of assembly **95***a* which correspond to assembly **95**. Rods **97** and **97***a* are co-extensive, and their axes are in parallel spaced apart relationship as shown.

With the foregoing construction it will be appreciated that by loosening screw members **98** and **98***a*, plate **90** and members **96** and **96***a* may be slid as a unit axially along rods **97** and **97***a* in either direction to thus move plate **90** laterally toward or away from the opposing side of stack **21**. This adjustment accommodates bags of different widths and ensures that the bags, regardless of width within predetermined limits, will be properly guided during their elevation in magazine **20**.

The structure securing plate **91** to frame **40** comprises assemblies **95***b* and **95***c* which are respectively disposed adjacent to the upper and lower ends of plate **91** in the same manner described for assemblies **95** and **95***a*. Assembly **95***b* is identical to assembly **95**. Like reference numerals suffixed by the letter *b* have therefore been applied to designate like parts. Similarly, assembly **95***c* is the same as assembly **95** with like reference numerals suffixed by the letter *c* being applied to designate the corresponding parts of assembly **95***c*. Rods **97***b* and **97***c* are co-extensive, and their axes are parallel and respectively aligned with the axes of rods **97** and **97***a*. Member **96***b* is fixed to the upper region of plate **91**, and member **96***c* is fixed to the lower region of plate **91**. Members **96**, **96***a*, **96***b*, and **96***c* are all parallel.

By loosening screw members **98***b* and **98***c*, plate **91** together with structural members **96***b* and **96***c* may be slid as a unit in either direction along the axes of rods **97***b* and **97***c* to thus position plate **91** with respect to the opposing side of stack **21** in magazine **20**.

It is clear from the foregoing that plates **90** and **91** are laterally adjustable independently of each other so that they may be shifted toward or away from each other as required to accommodate a given bag width.

Referring now to FIGS. 7 and 8, mechanism **22** comprises a pair of bag-engaging suction cup assemblies **100** and **102** and a suction cup assembly support arm unit **104**. Support arm unit **104** comprises a pair of parallel, spaced apart, rods **106** which are rigidly fixed together by brackets **108** and which extend horizontally at right angles to the longitudinally extending medial plane of magazine **20**.

Suction cup assembly **100** comprises an elongated suction cup support arm **110** which is secured at one end to rods **106** by an assembly **112**. Assembly **112** comprises a pair of clamp members **114** and **116** which are rigidly secured to each other by a bolt and nut assembly **118**. As shown, support arm **110** is fixed to member **116** and extends perpendicularly away from rods **106**. The longitudinal axis of arm **110** is always normal to a plane containing the longitudinal axes of rods **106**.

As best shown in FIG. 9, arm **110** is in the form of a structural channel, and a pair of parallel plates **122** are rigidly fixed to opposite sides of arm **110** to form a lateral extension. A rigid suction cup-mounting finger **124** (FIGS. 7 and 9) is pivotally mounted on a cylindrical member **126** extending perpendicularly between plates **122**. Member **126** is mounted at opposite ends in plates **122**. Finger **124** is swingable through a limited angle about the axis of member **126** which is laterally offset from and at right angles to the axes of rods **106**. A plane normally intersecting the longitudinal axis of arm **110** contains the axis of member **126**.

As shown in FIG. 7, finger **124** extends transversely from arm **110** toward the medial plane of magazine **20** and occupies a position over the forward portion of the bag. At its end remote from arm **110**, finger **124** rigidly mounts a suction cup **130**. Cup **130** and finger **124** therefore swing a unit, with cup **130** being a fixed distance from the pivot axis provided by member **126**.

Suction cup **130** may be of any suitable conventional form having a flexible skirt portion made of rubber or other elastically deformable material and defining a suitable suction chamber along an axis which is offset from and generally perpendicular to the pivot axis of member **126**. The longitudinal axis of cup **130** is therefore tangential to the arc through which cup **130** is swingable.

A coiled tension spring **132** which is anchored at one end to arm **110** and which is secured at the other end to finger **124** biases the sub-assembly of finger **124** and cup **130** in a clockwise direction about the axis of member **126** as viewed from FIG. 7. In FIG. 7, cup **130** is shown near the limit of its movement in a counterclockwise direction, and in this position, the longitudinal axis of cup **130** is essentially perpendicular with relation to the longitudinal axes of rods **106**. When suction cup assembly **100** is at its bag pick-up position shown in FIG. 7 suction cup **130** will be engageable with the upwardly facing side of the top bag in stack **21** under the bias exerted by spring **132**.

Still referring to FIGS. 7 and 9, a second suction cup mounting finger **134** is pivotally mounted on a cylindrical member **136** which is secured at opposite ends in plates **122**. Member **136** extends perpendicularly between plates **122** along an axis that is parallel with that of member **126**, and a plane containing the pivot axes of members **126** and **136** substantially perpendicularly intersects the longitudinal axes of rods **106**.

At its end remote from member **136**, finger **134** rigidly mounts another suction cup **140** which is preferably identical to cup **130**. The sub-assembly of finger **134** and cup **140** is swingable as a unit about the pivot axis of member **136**, between a position where finger **134** is extended to about against arm **110** and a position where cup **140** opposes and seats against cup **130** in axial alignment therewith. The angular distance between these positions is about 90 degrees. When cup **140** approaches the latter position mentioned above, it opens toward cup **130** and is adapted to engage the downwardly facing side of the bag picked up by cup **130**. This operation will be described in greater detail later on. It will be noted that when cups **130** and **140** are in their opposed, bag gripping or pinching positions, the longitudinal axes of cups **130** and **140** are approximately aligned. When cup **140** is swung back to the first of the two positions mentioned

above and when cup **130** is in its bag pick-up position, as shown in FIG. 7, the longitudinal axes of cup **140** will transversely intersect the longitudinal axis of cup **130** at an angle of approximately 90 degrees.

The position occupied by the sub-assembly of finger **134** and cup **140** in FIG. 7 enables this sub-assembly to clear stack **21** in magazine **20** and to extend down along the side of plate **90** as shown. This enables arm **110** to swing to a bag pick-up position where cup **130** is disposed vertically over the forward left-hand corner (as viewed from FIG. 7) of the top bag in stack **21**.

The longitudinal axis of cup **140**, as best shown in FIG. 7, extends at essentially right angles to the pivot axis of member **136** and is therefore essentially tangential to the arc through which cup **140** is swingable. Cup **140**, being fixed to finger **134**, is at a fixed distance from the pivot axis provided by member **136**.

Assembly **100** is adjustable along the axis of rods **106** to accommodate bags of different widths. This adjustment is accomplished by unthreading the bolt of assembly **118** to loosen members **114** and **116** which are clamped against diametrically opposite peripheral portions of rods **106**. Assembly **100** then may be slid as a unit in either direction along rods **106** to a new position, and assembly **118** is then tightened, thus clamping members **114** and **116** tightly against rods **106** to preclude relative movement between arm **110** and rods **106**.

As shown in FIGS. 7, 8, and 10, assembly **102** is preferably identical to assembly **100**, with assembly **102** being in aligned mirror image relation to assembly **100**. Accordingly, like reference numerals suffixed by the letter *a* have been used to designate like parts.

Adjustment of assembly **102** along rods **106** to accommodate bags of different widths is achieved in the same manner as described for assembly **100**. It will be appreciated that assemblies **100** and **102** are adjustable independently of each other axially along rods **106**.

As shown in FIG. 11, mechanism **22** further comprises a reversible drive motor assembly **170** and a motion transmitting linkage mechanism **172** which drive connects motor assembly **170** to the suction cup assembly support arm unit **104**. The motion path which unit **104**, and, consequently, suction cup assemblies **100** and **102** follow for transferring an empty bag from magazine **20** to spout **24** is indicated at **174** in FIG. 12 and is determined by linkage mechanism **172**. This path together with the associated operation of suction cups **130**, **140**, **130***a* and **140***a* will now be described followed by a detailed description of motor assembly **170**, linkage **172**, and the apparatus controlling pivotal displacement of cups **130**, **140**, **130***a* and **140***a* relative to unit **104** and support arms **110** and **110***a*. Although FIGS. 12–16 do not illustrate assembly **100**, it will be appreciated that it is always in mirror image relation to assembly **102**.

With reference to FIG. 12, unit **104** is shown in its lowered, bag pick-up position at magazine **20**. Cups **130** and **130***a* are in engagement with the forward corners on the upwardly facing side of the topmost bag closely adjacent to the mouth of the bag. The topmost bag, as well as the other bags, is, at this stage, in a flattened condition. Arms **110** and **110***a* are swung downwardly and rearwardly slightly beyond a vertical position to position the longitudinal axes of suction cups **130** and **130***a* closely perpendicular with respect to the plane of the bag surface engaged by suction cups **130** and **130***a*. In this connection, it will be recalled that the bags in stack **21** are generally inclined at an angle of about 15 degrees with a horizontal plane.

The bags near the top of stack **21**, however, will not necessarily be uniformly inclined depending on the number and stiffness of the bags in the stack. These bags near or at the top of the stack may be inclined more gently adjacent to their open ends as compared with the incline at their closed ends. This condition, however, does not interfere with a bag-height sensing mechanism **430** (to be later described) to accurately sense the bag level.

With continued reference to FIG. 12, fingers **134** and **134***a* are swung laterally outwardly to their extended positions so that when cups **130** and **130***a* are positioned for bag pick-up, fingers **134** and **134***a* extend downwardly from arms **110** and **110***a* along the oppositely facing sides of plates **90** and **91**. Cups **140** and **140***a* are facing toward the outwardly facing sides of plates **90** and **91**, and as shown in FIG. 7 there is sufficient clearance between cup **140** and plate **90** and between cup **140***a* and plate **91** so that the cups can be swung freely out of the magazine. At this stage, the longitudinal axes of cups **140** and **140***a* are substantially horizontal and aligned.

By applying a vacuum through cups **130** and **130***a* to grip the upwardly facing side of the topmost bag in stack **21** and by imparting movement to unit **104**, the gripped portion of the bag and suction cup assemblies **100** and **102** will unitarily be advanced with unit **104** along a first section of path **174** which is indicated at **176** in FIG. 12. Section **176**, which is defined by a smooth curve extending upwardly and forwardly toward spout **24**, has, in effect a progressively increasing radius such that it becomes progressively less curved and begins to approach a generally straight line in the direction of advancement toward spout **24**. As shown, section **176** has a relatively short radius R_1 at magazine **20** to provide a vertical elevation component of displacement that is greater than the horizontal component of advancement. This motion along the initial part of section **176**, which is mainly upward, enables suction cups **140** and **140***a* to quickly clear stack **21** and magazine **20**.

The provision for an initial bag pick-up displacement in an upward direction and essentially perpendicular to the gripped surface of the bag is advantageous for a number of reasons. First, it enables air to flow between the bag being picked up and the next bag in stack **21**. This allows air pressure on the downwardly facing side of the bag to balance air pressure applied to the upwardly facing side of the bag. As a result, the force exerted on the bag on the upwardly facing side and tending to separate the bag from suction cups **130** and **130***a* is, in effect, cancelled out by the air pressure on the underside of the bag.

Another advantage attributable to the initial mainly upward displacement of the bag during its advancement along the first portion of section **176** is that friction between the topmost bag being picked up and the next bag in stack **21** is appreciably less as compared with arrangements where the topmost bag is slid out of the magazine along a plane that is essentially parallel to the plane containing the next bag in the stack. With apparatus of this invention, therefore, the frictional force tending to hold the bag in place against the suction force applied by cups **130** and **130***a* will be almost negligible. As a result, there is less likelihood that cups **130** and **130***a* will slide forwardly to objectionable positions on the bag or that the vacuum applied to the bag will be lost. These features improve the reliability of the mechanism **22** in picking up bags from magazine **20** and transferring them to bag holder **23**.

As the radius of section **176** approaches its maximum or, more specifically, as the absolute value of the second derivative of the curve described by section approaches zero, the horizontal travel component will be greater than the vertical component of displacement. It will be appreciated that as assemblies **100** and **102** travel along the first portion of section **176**, they will be raised by a distance that is greater than their forward travel. But as assemblies **100** and **102** move along the terminal part of section **176**, their forward component of travel will increase progressively and will become much greater than their vertical displacement component which is progressively decreasing. It is evident, of course, that the gripped forward portion of the bag at its open end and

unit **104** together with assemblies **100** and **102** all follow a common path.

Upon advancing a predetermined distance along section **176**, assemblies **100** and **102**, by virtue of being displaced upwardly and forwardly toward spout **24**, will clear magazine **20** and stack **21** (see FIG. 13). At this stage, fingers **134** and **134***a* are simultaneously swung inwardly toward the downwardly facing side of the bag to engage suction cups **140** and **140***a* with the downwardly facing side of the bag and to firmly clamp or pinch the spaced forward corner regions of the bag in cooperation with cups **130** and **130***a*.

The bag-pinching positions of the suction cups is shown in FIG. 14. Continued, uninterrupted travel of unit **104** and assemblies **100** and **102** will completely remove the pinched bag from magazine **20**.

When the gripped, forward portion of the bag reaches the end of section **176**, the bag will be approximately midway between its magazine and spout positions both with respect to vertical and horizontal travel.

As shown in FIG. 14, section **176** smoothly merges with a second section **178** of path **174**. Section **178** extends along a smooth curve of progressively decreasing radius, starting with a large radius R_3 and terminates with a much smaller radius R_4.

Therefore, initial travel of the gripped portion of the bag along section **178** will provide a greater forward component of displacement as compared with the vertical component of displacement. This portion of section **178**, as shown, begins to approach a relatively straight line in the direction of displacement toward magazine **20**. The straighter portions of sections **176** and **178** which are joined together define a segment of path **174** which is upwardly inclined in the direction extending toward spout **24**. Since the upward swing of section **178** becomes much greater toward its end terminating at spout **24**, the gripped bag portion, as it moves along the terminal part of section **178** and approaches spout **24**, will have a vertical component of travel that is much greater than its horizontal component of travel. Motion at the end of section **178** will be essentially vertical to ensure that the bag is properly presented to bag holder **23**.

It will be noted that, starting at magazine and advancing toward spout **24**, the absolute value of the second derivative of the curve described by motion path **174** continuously decreases until it becomes zero at the point of inflexion between sections **176** and **178** and then continuously increases (along section **178**) from the point of inflexion to the end of motion path **174** at spout **24**. Lines drawn tangential to the ends of motion path **174** at magazine **20** and bag holder **23** are generally vertical.

As the bag approaches bag holder **23** and spout **24** during its travel along section **178** and with a vacuum applied to suction cups **130**, **130***a*, **140** and **140***a*, fingers **124** and **134** are pivoted away from each other to a bag opening position (see FIG. 15) and fingers **124***a* and **134***a* are also pivoted away from each other to a bag opening position. This bag-opening movement of fingers **124**, **134**, **124***a*, and **134***a* will be simultaneous. As a result, the vacuum applied through cups **130**, **140**, **130***a*, and **140***a* will pull the sides of the bag apart to thus open the bag as shown in FIG. 15.

As the opened bag advances to the terminal portion of section **178**, it is presented to bag holder **23** as shown in FIG. 16. In this connection, a line drawn tangential to the end of section **178** and medially intersecting the bag will closely align with the vertical axis of spout **24**.

By presenting the open bag to bag holder **23**, the edge of the bag around the open end engages an actuator **180** (see FIG. 29) which operates a pair of switches **182** to a closed position. This, as will be described in detail later on, will actuate bag holder **23** to securely clamp the bag in suspended relation below the spout. The vacuum applied through suction cups **130**, **130***a*, **140** and **140***a* is then released, and fingers **134** and **134***a* are pivoted outwardly to their original extended positions where they and cups **140** and **140***a* clear plates **90** and **91** for entry into the magazine. Once fingers **134** and **134***a* together with their respective suction cups have resumed their original positions, they are so located as to clear the bag which is now clamped in place by bag holder **23**. Unit **104** and assemblies **100** and **102** are now ready to begin the return movement to magazine **20** without interfering with the clamped bag.

As assemblies **100** and **102** are swung back along section **178**, fingers **134** and **134***a* together with cups **140** and **140***a*, as shown in FIG. 17, clear the sides of the opened bag that is at the bottom of spout **24** by holder **23**. During this return movement along section **178**, fingers **124** and **124***a* are also pivoted to swing suction cups **130** and **130***a* back to their original bag pick-up positions. Unit **104** and assemblies **100** and **102** will follow path **174** as they return to magazine **20** to pick up the next bag.

From the foregoing description it is clear that suction cups **130** and **130***a* are swingable between two positions, whereas suction cups **140** and **140***a* are swingable to three positions. The relation of suction cup positions is schematically developed in FIG. 18 which shows that suction cups **130** and **130***a* are swung back to their bag pick-up positions at the same point on path **174** where they were swung from the bag pick-up position to the bag-opening position. It will also be noted that cups **130** and **130***a* remain in their bag pick-up positions to pinch or grip the bag in cooperation with cups **140** and **140***a*.

With continued reference to FIG. 18, it is also clear that the bag opening position of each suction cup **140** and **140***a* is located angularly between the extreme magazine entry position and the bag pinching position. On advancement to the spout, cups **140** and **140***a* will be first in their extreme extended magazine entry positions, then in their extreme bag pinching positions, and finally in their intermediate bag opening positions. On the return to magazine, however, cups **140** and **140***a* are displaced directly from their bag-opening positions to their extreme magazine entry positions and remain there until after the next cycle is started.

From the foregoing description it will be appreciated that the curvature of path **174** approaches an S-shaped configuration having two tightly and oppositely curved end portions joined smoothly together by a sloping, much straighter intermediate portion.

It is also clear that sections **176** and **178** have opposite curvatures, are joined together by only one point or region of inflexion, and, when placed side-by-side, have similar contours.

Motor assembly **170** may be of any suitable, conventional form, and as shown in FIG. 19, comprises a reversible pneumatic motor **200** having an output shaft **202** which is journalled in a housing **204**. A sprocket wheel **206** is mounted on shaft **202** within housing **204**. Spaced from sprocket wheel **206** is another sprocket wheel **208** which is also journalled in housing **204** for rotation about an axis that is parallel to but offset from the rotational axis of shaft **202**. An endless roller chain **210** is trained around sprocket wheels **206** and **208**.

Mounted on one run of chain **210** is a piston **212** which is axially slidable between sprocket wheels **206** and **208** in a cylinder **214**. A sealing piston **216** mounted on the other run of chain **210** is smaller in diameter as compared with piston **212** and it is slidably received for axial movement in a cylinder **218**. An operating port **220** is formed through housing **204** and opens into a chamber **222** which is in fluid communication with the lower ends of cylinders **214** and **218**. As shown, chamber **222** receives sprocket wheel **206**.

A second operating port **224** is formed through housing **204** and opens into a chamber **226** receiving sprocket wheel

208. Chamber 226 is in fluid communication with the upper ends of cylinders 214 and 218.

By introducing air under pressure through port 220, piston 212 is displaced upwardly as viewed from FIG. 19. Chain 210 being fixed to piston 212 will be advanced to thus rotate shaft 202 in a clockwise direction. Residual air in the upper end of the cylinder 214 will be forced out of the motor through port 224. Pressurized air introduced through port 220 also enters the lower end of cylinder 218, but piston 216 forms a seal between chain 210 and the internal wall of cylinder 218 to prevent leakage of high pressure fluid into chamber 226.

To rotate shaft 202 in a counterclockwise direction, air under pressure is introduced through port 224 to drive piston 212 downwardly. Advancement of chain 210 in a corresponding direction rotates shaft 202 in a counterclockwise direction. Air under pressure introduced through port 224 also enters the upper end of cylinder 218 but cannot flow into chamber 222 owing to the seal provided by piston 216.

With continuing reference to FIG. 19, ports 220 and 224 are connected to separate operating ports of a four-way, dual solenoid operated valve 230 which is actuatable, in a manner to be described later on, to control the direction in which shaft 202 is rotated. Valve 230 has an inlet port 231 connected to the source of pressurized air indicated at 232 and also an outlet port 234 which opens to atmosphere.

When valve 230 is in the position shown in FIG. 19, air under pressure will be introduced through port 224 to rotate shaft 202 in a counterclockwise direction as previously described. Residual air in the lower end of cylinders 214 and 218 will flow out through port 220 and through valve 230 to outlet port 234 where it is dumped to atmosphere.

When valve 230 is shifted to its alternate position, the source of pressurized air 232 will be connected through valve 230 to operating port 220 to deliver pressurized air for displacing piston 212 upwardly. As a result, shaft 202 will be rotated in a clockwise direction in the manner previously described. Residual air at the upper ends of cylinders 214 and 218 will flow outwardly through port 224 and through valve 230 to port 234 where it is dumped to the atmosphere.

To dampen the motion imparted to shaft 202 by motor 200, a second motor 238 is operatively connected to shaft 202 and is of the same construction as motor 200. Accordingly like reference numerals suffixed by the letter *a* have been applied to designate like parts.

As schematically shown in FIG. 19, sprocket wheel 206*a* is non-rotatably mounted on shaft 202 As a result, shaft 202 is common to both motors 200 and 238.

Motor 238 is operatively connected to a closed hydraulic circuit comprising a cylinder 240 which acts as a closed reservoir and which has a common connection with four branch lines indicated at 242, 243, 244, and 245. Branch 243 connects cylinder 240 to port 224*a*, and branch 242 is connected between branch 243 and cylinder 240. Similarly, branch 245 connects cylinder 240 to operating port 220*a*, and branch 244 is connected between cylinder 240 and branch 245.

Branches 242 and 244 respectively contain flow restrictors 246 and 248. Branch 243 contains a check valve 250 between the connection to cylinder 240 and the connection to branch 242. Branch 245 also contains a check valve 252 between the connection to cylinder 240 and the connection to branch 244.

Check valve 250 allows hydraulic fluid to flow from cylinder 240 to operating port 224*a*, but prevents flow in the opposite direction, thereby forcing the hydraulic fluid to flow through restrictor 246 in branch 242. Similarly, check valve 252 allows hydraulic fluid to flow from cylinder 240 to operating port 220*a*, but prevents flow in the opposite direction to force the fluid to flow through restrictor 248.

When shaft 202 is rotated in a clockwise direction, piston 212*a* is displaced upwardly, forcing hyrdraulic fluid at the upper end of cylinder 214*a* and in chamber 226*a* to flow through operating port 224*a*. The flow will be diverted by check valve 250 to pass through restrictor 246. As a result, the rotary motion of shaft 202 in a clockwise direction is damped. As piston 212*a* is displaced upwardly, hydraulic fluid is allowed to flow freely through check valve 252 and through operating port 220*a* into chamber 222*a* and the lower end of cylinder 214*a*.

When shaft 202 is rotated in the opposite direction, piston 212*a* is displaced downwardly, forcing hydraulic fluid in the lower end of cylinder 214*a* and in chamber 222*a* to flow through port 220*a*. This flow will be diverted by check valve 252 to pass through restrictor 248, thus damping the rotary motion of shaft 202 in a counterclockwise direction. As piston 212*a* is displaced downwardly, hydraulic fluid is allowed to flow freely through check valve 250 into chamber 226*a*.

Linkage mechanism 172, which provides the motion transmitting connection between output shaft 202 and the suction cup assembly support unit 104 comprises a rigid crank arm 250 as best shown in FIG. 11. One end of arm 250 is non-rotatably fixed on shaft 202, and the other end of arm 250 is pivotally connected by a suitable cylindrical pin 252 to a rigid motion transmitting link 254. The opposite end of link 254 is pivotally connected by a suitable cylindrical pin 256 to a rigid arm 258.

Rods 106, as best shown in FIG. 12, are fixed at corresponding ends to arm 258. Rods 106 extend laterally from arm 258 and through a slot 262 (see FIG. 2) in a cabinet 275 at right angles to the longitudinal axis of magazine 20. With this construction it is clear that arm 258 supports rods 106 in cantilever fashion, and rods 106, in turn, support suction cup assemblies 100 and 102. A reinforced rod 260 (see FIGS. 7 and 11) is rigidly fixed to rods 106 by brackets 108, extends in parallel spaced apart relation with respect to rods 106, and is also secured to arm 258.

With continued reference to FIGS. 11, arm 258 is pivotally connected at one end by a suitable cylindrical pin 266 to one end of a further rigid arm 268. The other end of arm 268 is non-rotatably mounted on a pivot shaft 270 which is journalled at opposite ends in suitable bearing assemblies indicated at 272. Bearing assemblies 272 are suitably fixed to a rigid support frame 274. As a result, arm 266 is swingable about the axis of shaft 270 which is, in effect, fixed.

Also fixed to frame 274 are the housings 204 and 204*a* of motors 200 and 238. Frame 274, motors 200 and 238, linkage mechanism 172, and other equipment are enclosed in cabinet 275 (see FIGS. 1 and 2). Shaft 202 therefore rotates about an axis which is, in effect, fixed and spaced apart from the axis of shaft 270 in parallel relation thereto.

Still referring to FIG. 11, a rigid essentially straight, rod-shaped motion transmitting member is rigidly fixed at 278 to arm 258 so as to provide an extension 276 of arm 258. The end of extension 276 opposite from arm 258 is pivotally connected by a suitable cylindrical pin 280 to one end of a rigid, rod-shaped link 282. The opposite end of link 282 is pivoted on a cylindrical pin 284 which is fixed in a bracket 286. Bracket 286 is rigidly fixed to frame 274. Link 282 is thus swingable about the axis of pin 284 which is, in effect, fixed. The axes of shafts 202 and 270, of pins 252, 256, 280 and 284 and of rods 106 and 260 are all in parallel spaced apart relation with respect to each other.

The pivot axis of pin 284 is at a level that is higher than the levels at which the axes of shafts 202 and 270 are located. The axis of shaft 202 is located at an intermediate level between the levels at which the axis of shaft 270 and the axis of pin 284 are located. A vertical

plane containing the rotational axis of shaft **202** is disposed between and in parallel spaced apart relation to vertical planes respectively containing the axis of pin **284** and the rotational axis of shaft **270**.

The essential parts of the motion transmitting linkage just described are arm **258** together with its extension **276**, link **282**, and arm **268**. Crank arm **250** and link **254** could be replaced by other drive means such as an unshown air cylinder that would be connected to arm **258** at the location of pin **256**. The provision of crank arm **250** and the motion transmitting link **254** are preferred, however, because they avoid the development of dead center positions which would interfere with a smooth uninterrupted operation of the bag placer. The unitary motion of unit **104**, assemblies **100** and **102** and the gripped portion of the bag is determined by the fixed locations of the pivot axes provided by shaft **270** and pin **284**, and by the ratios of the length of link **282** extending perpendicularly between its pivot pin connections, the effective length of arm **258** extending perpendicularly between pivot pins **266** and **280**, and the length of arm **268** extending perpendicularly between the axes of shaft **270** and pin **266**. One example of these dimensional features that provide the motion patch **174** is as follows:

(1) Distance between parallel vertical planes respectively containing the axes of pin **284** and pivot shaft **270**=28¾".

(2) Distance between parallel horizontal planes respectively containing the axes of pin **284** and pivot shaft **270**=29$\frac{1}{19}$".

(3) Length of link **282** perpendicularly between the axes of pins **280** and **284**=25".

(4) Length of arm **268** perpendicularly between the axes of pivot shaft **270** and pin **266**=15".

(5) Length of arm **258** perpendicularly between the axes of pins **266** and **280**=12½".

The positions of arms **250**, **258** and **268** and of links **254** and **282** shown in FIGS. 11 and 12 are the positions which these parts occupy when suction cup assemblies **100** and **102** are in their bag pick-up positions (see FIG. 12). Crank arm **250**, as shown in FIG. 11 is in its extreme bag pick-up position and seats on a resilient stop **290** which is mounted on frame **274**.

Crank arm **250**, as viewed from FIG. 12, extends generally horizontally to the left of drive shaft **202** so that pin **252** is spaced to the left of shaft **202**. Link **254** extends upwardly and to the right above crank arm **250**, and pin **256** is located above and to the left of pins **266** and the connection **278**. Pin **266** is located above and to the left of pivot shaft **270**.

Arm **268** is at its extreme position in a counterclockwise direction as viewed from FIG. 12. Extension **276** extends upwardly and to the right from the main part of arm **258**, with pin **280** being located at a level above pins **256** and **266** and in a vertical plane that extends between vertical planes containing the axes of pivot shaft **270** and pin **266**. With this position of pin **280**, link **282** extends downwardly from pin **284** at an acute angle.

When motor **200** is actuated by operation of valve **230** to rotate shaft **202** in a clockwise direction as viewed from FIG. 12, suction cup assemblies **100** and **102** together with the bag picked up from magazine **20** start their advancement along section **176** of motion path **174**. Displacement of crank arm **250** in a clockwise direction causes relative pivotal movement of link **254** in a direction to increase the angle between crank arm **250** and **254** as shown in FIG. 13.

The motion imparted by crank arm **250** through link **254** displaces arm **258** upwardly and to the right as viewed from FIGS. 12 and 13 to thus cause arm **268** to swing in a clockwise direction about the axis of pivot shaft **270** and to cause link **282** to swing in a counterclockwise direction about the axis of pin **284**.

By virtue of increasing the angle between crank arm **250** and link **254** the motion imparted to arm **258** correspondingly increases, with the result that upon being picked up from magazine **20**, the bag motion along section **176** will be accelerating. The speed at which the bag is initially displaced from stack **21** in magazine **20** will, however, be relatively low owing to the relatively small acute angle defined between crank arm **250** and link **254**. The relatively slow speed of bag motion upon initial displacement from magazine **20** is advantageous since there is less likelihood that the picked-up bag will become jarred loose from suction cups **130** and **130***a* which, at this stage, are the only means carrying the bag along the motion path **174**. The acceleration of bags along section **176** of motion path **174** is advantageous, for it reduces the time required to transfer a bag from magazine **20** to spout **24**. By the time the bag approaches a relatively high velocity, suction cups **140** and **140***a* will have been displaced to their bag pinching positions. As a result, the bag at its relatively high velocity will firmly be gripped by the two pairs of suction cups.

At the initial stage of motion where the radii of section **176** is relatively small, pin **266** will be appreciably off center or laterally displaced from a line perpendicularly intersecting the axes of pivot shaft **270** and pin **280**. In addition, pin **266** will be off center or laterally displaced from a line perpendicularly intersecting the axes of pin **256** and pivot shaft **270**. These relationships enable link **282** to swing upwardly and in a counterclockwise direction (as viewed from FIG. 12) as crank arm **250** is swung in a clockwise direction.

As link **282** swings upwardly during the initial motion of assemblies **100** and **102** along the first part of section **176**, arm **258** will swing in a clockwise (as viewed from FIG. 12) direction about the axis of pin **280** to reduce the angle between extension **276** and link **282** and to increase the angle between extension **276** and arm **268**. This is due to the movement of link **282** and to the off center relation of pin **266** with respect to the line perpendicularly intersecting the axes of shaft **270** and pin **256**. Angular motion of arm **258** about the axis of pin **280**, however, is relatively small.

Owing to the foregoing movements of link **282** and of arm **258** and of the above described off center relationships of pin **266** with respect to pin **256** and pivot shaft **270** in one instance and with respect to pin **280** and pivot shaft **270** in the other instance, the motion imparted to assemblies **100** and **102** as they are advanced along the initial portion of section **176** from magazine **20** is controlled mainly by arm **268** which has a fixed center of pivotal motion about the axis of pivot shaft **270**. Due to this fixed center, the radius of the curve defining the initial portion of section **176** will tend to remain uniform and will tend to have a value related to the radius of arm **268** between the axes of shaft **270** and pin **266**.

The foregoing motion imparted to assemblies **100** and **102** by arm **268**, however, is modified by the comparatively small pivotal displacement of arm **258** about the axis of pin **280** in such a direction as to increase the angle between link **276** and arm **268**. This motion imparted by arm **258** and superimposed upon the motion imparted by arm **268** will cause the radius of the curve defining section **176** to progressively increase. As will become more apparent later on, the radius of the curve defining section **176** increases as the angle facing away from crank arm **250** and defined between arm **268** and extension **276** increases.

Since the angular displacement of arm **258** about the axis of pin **280** is relatively small as compared with the angular displacement of arm **268** about the axis of shaft **270** the increase in radius of the initial portion of section **176** will be correspondingly small.

The angular displacement of crank arm **250** as previously mentioned, bodily displaces arm **258** toward the region occupied by spout **24** under the control of arm **268**

and link 282. As a result, pin 266 is advanced toward the line perpendicularly intersecting the axes of pivot shaft 270 and pin 280 along an arc defined by the effective length of arm 268. In addition, pin 266 is advanced toward the line perpendicularly intersecting the axes of pivot shaft 270 and pin 256, and as assemblies 100 and 102 approach the flatter, terminal portion of section 176, pin 256 is closely approaching the above mentioned line that perpendicularly intersects the axes of shaft 270 and pin 256. When the axis of pin 266 intersects this line, link 254 will be essentially perpendicular with respect to crank arm 250 with the result that the velocity component of pin 252 along the axis of link 254 will essentially be at a maximum.

Arm 268 and the portion of arm 258 connected between pins 256 and 266 define a toggle joint so that as a result of continued displacement of crank arm 250, pin 266, which defines the knee of toggle joint, moves over center with respect to the line perpendicularly intersecting the axes of shaft 270 and pin 256. During this period, the angle between extension 276 and arm 268 continues to increase as shown in FIG. 13.

By moving pin 266 over center with respect to the perpendicular line between pin 256 and pivot shaft 270, the angular displacement of arm 258 about the axis of pin 280 will be reversed, and arm 258 will now begin to swing in a counterclockwise direction (as viewed from FIG. 13) while link 282 continues to advance in a counterclockwise direction and while arm 268 continues to advance in a clockwise direction. The over center movement of pin 268 with respect to pin 256 and pivot shaft 270 continues the acceleration of assemblies 100 and 102.

Owing to the increasing angular displacement of arm 258 about the axis of pin 280, the radii of the curve defining the latter part of section 176 will become relatively very large. As a result, the motion of assemblies 100 and 102 along this portion of section 176 begins to approach a straight line.

As crank arm 250 continues to advance, pin 266 will be displaced, by virtue of the displacement of arm 258, over center with respect to the line perpendicularly intersecting the axes of pivot shaft 270 and pin 280. The point of inflexion between sections 176 and 178 of motion path 174 coincides with the intersection of the axes of pin 266 with the line perpendicularly intersecting pivot shaft 270 and pin 280 as shown in FIG. 14. At this stage the angle between extension 276 and arm 268 is susbtantially 180 degrees with the result that arm 268 and extension 276 are aligned as shown. These aligned positions of arm 268 and extension 276 limits pivotal displacement of link 282 in a counterclockwise direction as viewed from FIG. 14.

Extension 276 and arm 268 define a toggle joint, the knee of which is at the axes of pin 266. The action of this toggle joint throws pin 266 forwardly as it moves over center with respect to pivot shaft 270 and pin 280. Thus, for a given distance that pin 252 is advanced, pin 266 will advance a greater distance to continue the acceleration of assemblies 100 and 102 as they advance along the initial, straighter portion of section 178.

By displacing pin 266 over center with respect to shaft 270 and pin 280, link 282 will be pulled downwardly in a clockwise direction. The initial angular displacement of link 282 in the counterclockwise direction will be relatively small as compared with the distance through which arm 268 is displaced on the downswing. This is due to the relatively wide obtuse angle defined between extension 276 and arm 268 on the side facing toward crank arm 250.

The foregoing difference in angular displacement between arm 268 and link 282 causes arm 258 to be displaced in its counterclockwise direction about the axis of pin 280 and through an angular distance which is much greater than the angular distance through which link 282 is displaced. This displacement of arm 258 modifies the tendency of link 282 to swing assemblies 100 and 102 along an arc of uniform radius.

These combined motions of link 282 and arm 258 about the axes of pins 284 and 280 respectively provide the initial portion of section 178 with relatively large radii. The curvature of this part of section 178 extending from the point of inflexion will therefore be considerably straighter as compared with the terminal part of section 178 at spout 24. As will be more apparent shortly, the radius of section 178 progressively decreases as the angle between extension 276 and link 282 increases and as the angle facing crank arm 250 and defined between extension 276 and arm 268 decreases.

As assemblies 100 and 102 approach the terminal, upswung portion of section 178, pin 280 is approaching a dead center position between pins 280 and 266, and pin 252 is approaching a dead center position between shaft 202 and pin 256. That is, pin 280 will approach a point of intersection with a line extending perpendicularly between the axes of pins 280 and 266, and pin 280 will approach a point of intersection with a line extending perpendicularly between the axes of shaft 202 and pin 256.

As pin 280 approaches its dead center position between pins 280 and 266, the pivotal motion of arm 268 slows down. The pivotal motion of arm 268 is finally arrested by alignment of link 282 and extension 276 as shown in FIG. 16. In this position, pin 280 is essentially in its dead center position mentioned above.

By slowing down and finally stopping arm 268, arm 258 will pivot at an increasing rate about the axis of pin 266. This pivotal motion of arm 258 progressively and rapidly decreases the radius of the terminal portion of section 178 causing assemblies 100 and 102 and the opened end of the bag to swing upwardly and thus vertically orient the open end of the bag at holder 23.

As crank arm 250 approaches its dead center, aligned position with link 254, the motion imparted is such that asemblies 100 and 102 will slow down as they swing into the terminal upswung end of section 178. Motion of linkage mechanism 172 and, consequently, assemblies 100 and 102 are arrested by abutment of crank arm 250 with a stop 296 (FIG. 11) which is fixed on frame 274.

As shown in FIG. 7, suitable push-pull cables 310 and 312 are connected at corresponding ends to fingers 134 and 134*a* respectively and are operable to swing fingers 134 and 134*a* about their respective pivot members 136 and 136*a*. The other ends of cables 310 and 312 are, as shown in FIGS. 22 and 24, secured to a cylindrical pin 316. The opposite ends of pin 316 are fixed to a pair of parallel plate portions 318 which are rigidly joined together by a hub portion 320 to form a motion transmitting arm 322.

Still referring to FIGS. 22 and 24, arm 322 is rotatably mounted on a shaft member 324 which extends coaxially through hub portion 320. Shaft member 324 as best shown in FIGS. 20 and 21, is fixed at opposite ends to parallel arm portions 326 of a U-shaped bracket 330. Arm portions 326 are rigidly fixed to frame 274 and are integrally joined together by a cross piece 332. Fingers 134 and 134*a* together with their respective suction cups 140 and 140*a* are swingable about the axes of their associated pivot members 136 and 136*a* by rotating arm 322 about the axis of shaft member 324.

An air cylinder assembly 334 (see FIGS. 22 and 23) comprises a piston 337 (FIG. 19) axially slidable in a cylinder 336 and connected by a piston rod 338 to pin 316. Piston rod 338 is shown in its extended position to position arm 322 in its extreme counterclockwise position as viewed from FIG. 23. By controlling delivery and exhaust of pressurized air to cylinder 336, rod 338 is axially shifted between the extended position mentioned above and a retracted position where it rotates arm 322 in a clockwise direction as viewed from FIG. 23.

In the position of arm **322** shown in FIGS. 20–24, cables **310** and **312** position fingers **134** and **134***a* in their outwardly swung, magazine entry and bag clearing positions shown in FIGS. 7 and 12. When piston rod **338** is fully retracted to rotate arm **322** to its extreme position moving in a clockwise direction, cables **310** and **312** position fingers **134** and **134***a* in their inwardly swung bag pinching positions where cups **140** and **140***a* engage the bag as shown in FIG. 14. Control of delivery and exhaust of air for cylinder assembly **334** is correlated with the movement of linkage mechanism **172** in a manner to be described in detail later on. As viewed from FIG. 7, it will be recalled that pivotal motion of finger **134** from its magazine-entry, bag clearing position to its bag pinching position is in a counterclockwise direction about the axis of member **136**. As viewed from the same figure, corresponding displacement of finger **134***a* to its bag-pinching position is in a clockwise direction about the axis of member **136***a*.

As shown in FIGS. 20–22 and 24, a second arm **340** is rotatably mounted on shaft member **324** and is formed by a pair of parallel spaced apart plate portions **342** which are rigidly joined together by a hub portion **344**. Shaft member **324** coaxially extends through hub portion **344** as shown. A pin **346** extends between and is secured at opposite ends to plate portions **342**. The axes of pins **316** and **346** are both parallel to the axis of shaft member **324**.

A second pair of suitable push-pull cables **348** and **350** are secured at corresponding ends to pin **346**. The opposite ends of cables **348** and **350** are respectively secured to fingers **124** and **124***a* as shown in FIG. 7. Through the motion transmitting connections provided by cables **348** and **350** rotation of arm **340** imparts pivotal displacement to fingers **124** and **124***a* about the axis of members **126** and **126***a* respectively to displace suction cups **130** and **130***a* between their bag pick-up and bag opening positions.

When arm **340** is in the position shown in FIGS. 20–22 fingers **124** and **124***a* are pivoted to position cups **130** and **130***a* in their bag pick-up positions shown in FIG. 7. By rotating arm **340** in a counterclockwise direction (as viewed from FIG. 21) to a second position, cables **348** and **350** respectively swing the assembly of finger **134** and cup **130** and the assembly of finger **134***a* and cup **130***a* to their bag-opening positions.

It will be recalled that pivotal displacement of finger **134** from its bag pick-up position to its bag-opening position is in a clockwise direction (as viewed from FIG. 7) about the axis of member **136** and that pivotal displacement of finger **134***a* from its bag pick-up position to its bag-opening is in a counterclockwise direction (as also viewed from FIG. 7) about the axis of member **136***a*.

As shown in FIG. 21, a motion transmitting rod **354** is pivotally connected to one end of arm **340** at a region spaced from shaft member **324**. The other end of rod **354** is, as shown in FIG. 25, connected by an arm to roller **356** which is mounted on a bracket **355**. Bracket **355** is fixed on a shaft **357** which is rotatably supported by a bracket **358**. Bracket **358** is fixed to frame **274**. The assembly of bracket **355** and roller **356** is spring biased to swing forwardly toward the path through which crank arm **250** is displaced. This spring bias urges rod **354** downward to swing arm **340** to the position shown in the drawings where cups **130** and **130***a* will be urged to their bag pick-up positions.

Roller **356** is engageable by a cam **360** (see FIGS. 11 and 26) which is fixed to crank arm **250**. As crank arm **250** is advanced to a position where the picked-up bag is approaching the terminal upswing of section **178** an inclined surface **362** of cam **360** engages roller **356** to swing it against its spring bias and in a direction that displaces rod **354** axially upwardly. As a result, arm **340** is rotated in a counterclockwise direction (as viewed from FIG. 21) to pivot the assemblies of finger **124** and cup **130** and of finger **124***a* and cup **130***a* from their bag pick-up positions to their bag opening positions, the latter being shown for finger **124***a* and cup **130***a* in FIG. 15. The inclined surface **362** provides for a relatively gradual bag opening motion to thus prevent the apparatus and the bag from being so jarred as to separate the bag from the suction cups.

At this stage, piston rod **338** will be retracted to position arm **322** in its downwardly swung position for holding suction cups **140** and **140***a* in their bag pinching positions. A lifter arm **368**, as shown in FIGS. 23 and 24 is so fixed to arm **340** that when arm **340** is rotated in a counterclockwise direction (as viewed from FIG. 21), it swings upwardly to abut against arm **322** and to thereby rotate arm **322** in a counterclockwise direction simultaneously with the rotation of arm **340**. As a result, suction cups **130**, **130***a*, **140** and **140***a* will be simultaneously swung to their bag-opening positions. Clockwise displacement of arms **322** and **340** is limited by engagemnet of lifter arm **368** with stop **369** (FIG. 21).

Referring now to FIG. 27A, a control circuit **400** providing for the automatic operation of the bag placer of this invention is shown in stand-by, de-energized condition and comprises a main disconnect switching device **402** which is adapted to be connected to a suitable source of A.C. power and which, when closed, energizes the primary winding of a suitable transformer **404**. As a result, the secondary winding of transformer **404** is energized to apply secondary voltage across a pair of conductors **406** and **408** up to a set of normally open contacts PC–**1** of a power relay PC.

Operation of circuit **400** will now be described starting with the condition where suction cup assemblies **100** and **102** are in their lowered, bag pick-up positions at magazine **20**, where a supply of bags has been loaded into the magazine, and where all the necessary adjustments have been made for automatic operation. Under these conditions, power is now applied to the remainder of circuit **400** in preparation for starting operation by depressing a spring-loaded push-button switch **410** which completes a circuit for energizing power relay PC. This circuit may be traced from one terminal of the transformer secondary through a normally closed spring loaded, push-button, power-off switch **412**, through switch **410**, serially through sets of normally closed overloaded contacts **414** and **416** and through the operating winding of relay PC to the other terminal of the transformer secondary winding. Energization of relay PC closes contacts PC–**1** and a further set of normally open contacts PC–**2**.

By closing contacts PC–**1**, transformer secondary power is made available across the remainder of circuit **400**. By closing contacts PC–**2**, a holding circuit is provided around switch **410** to maintain relay PC energized after which switch **410** is released. Contacts **414** will open to de-energize relay PC in the event that a vacuum pump motor **418** becomes overloaded. Contacts **416** will open to de-energize relay PC in the event that the magazine elevator motor **52** becomes overloaded.

With relay PC energized automatic operation of the bag placer is initiated by actuating a selector switch **420** to its auto-cycle "in," circuit-making position. This completes a circuit for energizing a vacuum pump motor starter relay VMS which is shown in FIG. 27B.

The energizing circuit for relay VMS may be traced from one terminal of the transformer secondary winding through contacts PC–**1**, through switch **420**, through a conductor **422**, through the operating winding of relay VMS, and through conductor **408** to the other terminal of the transformer secondary winding. By energizing relay VMS, three sets of normally open contacts VMS–**1**, VMS–**2**, VMS–**3** are closed to energize motor **418**.

By virtue of closing switch **420**, a magazine elevator motor starter relay EMS is also energized as shown in FIG. 27A. This energizing circuit may be traced from one terminal of the transformer secondary, through contacts PC–**1**, through switch **420**, through conductor **422**, through a set of normally closed contacts ICC–**1** of an improper

cycle relay ICC, through a limit switch **426**, through the operating winding of relay EMS, and through conductor **408** to the other terminal of the transformer secondary winding. Relay ICC will be de-energized unless there are certain abnormal conditions which will be described later on. Switch **426** will be closed if the bags stacked in magazine **20** have not been raised to their proper level.

When the bags loaded in magazine **20** are raised to their proper level by operation of motor **52**, switch **426** will open. Operation of switch **426** is controlled by a bag-height sensing mechanism indicated generally at **430** in FIG. 32. Mechanism **430** will be described in greater detail later on.

Assuming that the topmost bag stacked in magazine **20** has not been raised to its proper level, switch **426** will be closed. As a result, relay EMS will energize to close three sets of normally open contacts EMS–**1**, EMS–**2**, and EMS–**3** for energizing motor **52** as shown in FIG. 27A.

With the magazine elevator motor **52** energized, platform **42** will be elevated to raise the stack of bags on the platform to a position where the topmost bag in stack **21** is at its proper level for pick-up by suction cup **130** and **130***a*. When the topmost bag in stack **21** reaches this level, mechanism **430** as will be described in detail later on actuates switch **426** to its circuit-interrupting, open position. As a result, relay EMS is de-energized to open contacts EMS–**1**, EMS–**2**, and EMS–**3** to de-energize motor **52**. Elevation of stack **21** on platform **42** is consequently interrupted.

As shown in FIG. 27A, a further switch **432** is suitably ganged to switch **426** in such a manner that it will be open when switch **426** is closed and will close when switch **426** is opened. Thus, when the stack of bags on platform **42** has been raised to its proper level, switch **432** closes as switch **426** opens. This completes a partial circuit for energizing a solenoid AV. Solenoid AV is operatively connected to valve **230** as shown in FIG. 19.

By virtue of closing switch **420**, a further circuit is completed for energizing a relay ADC (see FIG. 27B). This circuit may be traced from one terminal of the transformer secondary, through contacts PC–**1**, through switch **420**, through conductor **422**, through a limit switch **434**, through the operating winding of relay ADC, and through conductor **408** to the other terminal of the transformer secondary winding.

As shown in FIG. 11, actuation of switch **434** is controlled by a suitable conventional rotary cam mechanism **436** which is drive connected to arm **268** by a motion transmitting linkage indicated at **438**. As arm **268** is swung about the axis of pivot shaft **270**, cam mechanism **436** is rotated to actuate switch **434** as well as others yet to be described. Cam mechanism **436** is so contoured that switch **434** will be closed when arm **268** is in its extreme clockwise position shown in FIG. 11. With arm **268** in this position, the suction cup support arms **110** and **110***a* will be in their lowered, bag pick-up positions at magazine **20**.

With relay ADC energized, a set of normally open contacts ADC–**1** (see FIG. 27A) will be closed to complete the circuit for energizing solenoid AV. This energizing circuit may be traced from one terminal of transformer secondary winding, through conductor **406** and contacts PC–**1**, through switch **420**, through conductor **422**, through contacts ICC–**1**, through limit switch **432**, through a set of normally closed contacts BIP–**1** of a bag-at-spout relay BIP (see FIG. 27B), through contacts ADC–**1**, through a set of normally closed contacts CY–**1** of a system cycling relay CY (FIG. 27A), through a fourth set of normally open contacts VMS–**4** of relay VMS, through a second auto-cycle switch **440**, through a conveyor belt interlock switch **441**, through the operating winding of solenoid AV, and through conductor **408** to the other terminal of transformed secondary winding.

Switch **440** is so ganged to switch **420** that it will be in its run, closed position when switch **420** is in its circuit-making position. Contacts VMS–**4** will be closed if relay VMS is energized. Relay BIP will be de-energized to thus close contacts BIP–**1** if no bag is positioned on bag holder **23**. Switch **432**, as mentioned previously, will be closed when the topmost bag in stack **21** has been elevated to its proper position for pick-up by suction cups **130** and **130***a*. Switch **441** is so operatively connected to conveyor belt assembly **30** that it will close when assembly **30** is operating and will open when assembly **30** is not in operation.

From the foregoing, it will be appreciated that solenoid AV will be energized provided that:

(1) Switch **440** is closed indicating that the system is in a "run" position.

(2) The vacuum pump motor starter relay VMS is energized.

(3) Relay CY is de-energized, indicating that the previous cycle of operation has been completed. Operation of relay CY will be described later on.

(4) Switch **434** is in its closed position, indicating that the suction cup support arms **110** and **110***a* are in their lowered bag pick-up positions at magazine **20**.

(5) Relay BIP is de-energized, indicating that a bag is not positioned at spout **24**.

(6) Switch **432** is closed, indicating that the topmost bag in stack **21** has been raised to its proper pick-up position.

(7) Relay ICC is de-energized, indicating that the system is not in an improper cycle.

(8) Interlock switch **441** is closed, indicating that conveyor belt assembly **30** is in operation.

By energizing solenoid AV, valve **230** is shifted to its illustrated position where pressurized air is applied to port **224** of motor **200** for driving shaft **202** in a direction that will raise the suction cup assembly support arms **110** and **110***a* for lifting the topmost bag in magazine **20** and for advancing it along motion path **174** to bag holder **23** in the manner previously described.

As show in FIG. 28, the vacuum system for suction cups **130**, **130***a*, **140** and **140***a* comprises a pump **442** drive connected to motor **418** and having suction port which is connected through a filter **443** to suction cups **130** and **130***a* by a main conduit **444**. A branch conduit **445** is connected through a two-way valve **446** to suction cups **140** and **140***a*. Branch conduit **445** is connected to conduit **444** between the connections of conduit **444** to the assembly of suction cups **130** and **130***a* and to another branch line **447**. Branch line **447** connects to a port of a second two-way valve **448**. The other port of valve **448** is connected to atmosphere.

When valves **446** and **448** are closed during operation of pump **442**, vacuum will be applied to cups **130** and **130***a* and not to cups **140** and **140***a*. When valve **446** is open and valve **448** is closed, vacuum will be applied to all four cups **130**, **130***a*, **140** and **140***a*. When valve **448** is opened the vacuum is removed from cups **130** and **130***a*, and also from cups **140** and **140***a*.

Valves **446** and **448** are respectively operated by solenoids FV and EV and are opened by energizing solenoids FV and EV respectively. At the time when solenoid AV is energized to lift the suction cup support arms **110** and **110***a*, solenoids FV and EV will be de-energized as will be explained in greater detail shortly. As a result, valves **446** and **448** will be closed, and with motor **418** energized at this stage, vacuum will be applied to cups **130** and **130***a* at the time when solenoid AV is energized to lift the suction cup support arms **110** and **110***a*. Thus, by virtue of the vacuum applied to cups **130** and **130***a*, the topmost bag in stack **21** will be gripped as previously described to be lifted with arms **110** and **110***a* for transfer along motion path **174** to spout **24**.

When valve **230** is shifted to the illustrated position shown in FIG. 19, pressurized air, in addition to being applied to port **224**, is supplied through a conduit **448** to an inlet port of a solenoid-operated three-way valve **450**. Valve **450** has an operating port **452** which is connected to cylinder **336** on the piston rod side of piston **337**.

Cylinder **336**, on the opposite side of piston **337**, is connected directly to that operating port of valve **330** which is connected to port **220**. Solenoid GV is energizable to shift valve **450** to its position illustrated in FIG. 19.

Thus, when solenoid GV is de-energized, valve **450** is shifted to its alternate position where port **452** is connected to an outlet port **454**. Outlet port **454** is connected to atmosphere as shown.

Upon the return of the suction cup support arms **110** and **110***a* to magazine **20** during the cycle preceding the one currently being described, piston rod **338** will have been shifted in a manner to be described later on, to its extended position where fingers **134** and **134***a* are swung outwardly and into essential alignment with arms **110** and **110***a* for clearing stack **21** as they enter the magazine. Therefore, from before the end of this prior cycle and into the currently described cycle, solenoid GV will be de-energized, and piston rod **338** will be in its extended position. This condition of solenoid GV and position of valve **450** are maintained when solenoid AV is energized in the currently described cycle. Therefore, as the suction cup support arms **110** and **110***a* are lifted by virtue of energizing solenoid AV to shift valve **230** to the position illustrated in FIG. 19, fingers **134** and **134***a* will remain in their extended, outwardly swung positions to clear stack **21** in magazine **20**.

Upon initial advancement of the suction cup support arms **110** and **110***a* away from magazine **20**, arm **268** will have been displaced through a sufficient angle to advance cam mechanism **436** to a position where it actuates switch **434** to its opened position. As a result, relay ADC is de-energized to open contacts ADC–**1**. The energizing circuit for solenoid AV is consequently interrupted. Valve **230**, however, will remain in its illustrated position until a further solenoid BV (FIGS. 19 and 27A) is energized.

When crank arm **250** is raised to an angle of about 45 degrees from its initial bag pick-up position, arm **268** will have rotated cam mechanism **436** to a position where it closes a further limit switch **460** (see FIG. 27A) to complete an energizing circuit for solenoid GV. Energization of solenoid GV shifts valve **450** to its position illustrated in FIG. 19 where pressurized air supplied through valve **230** is transmitted through valve **450** to cylinder **336** for application to the piston rod side of piston **337**. As a result, piston rod **338** will retract forcing residual air on the opposite side to be exhausted through port **234** of valve **230**.

Retraction of piston rod **338** swings arm **322** downwardly and in a clockwise direction (as viewed from FIG. 23) to a position where it seats on lifter arm **368**. This motion of arm **322** is transmitted by push-pull cables **310** and **312** to swing fingers **134** and **134***a* inwardly and upwardly toward the downwardly facing side of the bag being lifted to thereby displace suction cups **140** and **140***a* to their bag-engaging, bag-pinching positions previously described. At this stage, therefore, the picked-up bag will firmly be gripped between the suction cup pair of cups **130** and **140** at one forward corner and between the suction cup pair of cups **130***a* and **140***a* at the other forward corner.

When crank arm **250** has advanced through an angle of about 50 degrees, cam mechanism **436** will have been rotated by arm **268** through an angle sufficient to cause cam mechanism **436** to actuate a further limit switch **462** (see FIG. 27A) to its closed position. By closing switch **462**, a vacuum control relay VCC is energized to close a set of normally open contacts VCC–**1**.

By closing contacts VCC–**1**, a circuit is completed for energizing solenoid FV. This circuit may be traced from one terminal of the transformer secondary winding, through conductor **406** and contacts PC–**1**, through switch **420**, through conductor **422**, through a switch **466**, through contacts VCC–**1**, through a set of normally closed contacts VBC–**1** of a vacuum break relay VBC (FIG. 27B), through the operating winding of solenoid FV, and through conductor **408** to the other terminal of the transformer secondary winding.

At this stage, switch **466** will be closed by virtue of being ganged to switch **434**. In this connection, switch **466** will be closed when switch **434** is opened and will be opened when switch **434** is closed.

Also at this stage, relay VBC will be de-energized with the result that contact VBC–**1** will be closed. Contacts VBC–**1** provide an interlock to ensure that solenoid FV will not be energized at the same time that relay VBC is energized.

By energizing solenoid FV, valve **446** is actuated to its opened position to establish fluid communication between suction cups **140** and **140***a* and the vacuum port of pump **442**. It therefore is clear that at this stage a vacuum will be applied through all of the cups **130**, **130***a*, **140** and **140***a* while the cups are in their bag-pinching positions.

By virtue of energizing relay VCC, a further set of normally open contacts VCC–**2** (FIG. 27A) is actuated to its closed position to complete a circuit for energizing relay CY. This circuit may be traced from one terminal of the transformer secondary winding through conductor **406** and contacts PC–**1**, through switch **420**, through conductor **422**, through a normally closed set of contacts **468** of a reset switch assembly **270**, through a set of normally closed, time delay contacts BFT–**1** of a bag filling timer BFT (FIG. 27B), through contacts VCC–**2**, through the operating winding of relay CY, and through conductor **408** to the other terminal of the transformer secondary winding. At this stage, contacts BFT–**1** will be closed.

By energizing relay CY, contacts CY–**1** are opened, and normally open contacts CY–**2** (FIG. 27A) are closed. By closing contacts CY–**2**, a holding circuit is provided around contacts VCC–**2** to maintain relay CY energized after contacts VCC–**2** are opened. By virtue of opening contacts CY–**1**, energization of solenoid AV is prevented until the bag placer has completed its current cycle.

When cam mechanism **436** is displaced by arm **268** to a position corresponding to displacement of crank arm **250** through an angle of approximately 110 degrees from its original, bag pick-up position, it will actuate switch **460** to its opened position. As a result, solenoid GV will be de-energized, and valve **450** will consequently be shifted to its position where port **452** is connected to port **454**. However, piston rod **338** will remain in its extended position because the air pressure on opposite sides of piston **337** will now be equal. As a result, arm **322** will remain in its downwardly swung position where it seats on lifter arm **368**.

As the gripped bag is advanced along motion path **174** and approaches the more tightly curved upswing of section **178**, cam **360** engages roller **356** to pivot suction cups **130**, **130***a*, **140** and **140***a* to their bag-opening positions as previously described. Arms **110** and **110***a* will reach their fully raised, essentially horizontal positions when the bag is properly positioned for clamping engagement by holder **23**. When the assembly of arms **110** and **110***a* reach this limiting position, cam mechanism **436** will have been rotated by arm **268** to a position where it actuates a further limit switch **471** (FIG. 27A) to its closed position in preparation for returning arms **110** and **110***a* to their pick-up positions at the magazine. By placing the opened bag at holder **23** switches **182** (see FIG. 27B) are actuated to their closed positions to energize relay BIP. Contacts BIP–**1** (FIG. 27A) will therefore open to prevent energization of solenoid AV when a bag is in position on spout **24**.

Energization of relay BIP closes normally open contacts BIP–**2** (FIG. 27B) to energize a scale-signalling relay OKD (FIG. 27B). This energizing circuit may be traced from one terminal of the transformer secondary winding through conductor **406** and contacts PC–**1**,

through switch **420**, through conductor **422**, through switch **466**, through contacts VCC–**1**, through a first vacuum sensing switch **474**, through a second vacuum sensing switch **476**, through an auto-cycle, hold-run selector switch **478**, through contacts BIP–**2**, through the operating winding of relay OKD, and through conductor **408** to the other terminal of the transformer secondary winding. By virtue of switch **434** being open at this stage, switch **466** will be closed. Contacts VCC–**1** will also be closed, because relay VCC is currently energized.

Switch **474**, which, as shown in FIG. 28, is actuated by air pressure in conduit **444**, will be closed if sufficient vacuum is applied at suction cups **130** and **130***a*. Switch **476**, which, as shown in FIG. 28, is connected to be actuated by the air pressure in branch conduit **445**, will be closed if there is sufficient vacuum at suction cups **140** and **140***a*. The level of the vacuum for closing switches **474** and **476** will be enough for holding the bag on bag holder **23** before holder **23** is actuated to clamp the bag in suspended relation below spout **24**.

Switch **478** is ganged to switch **440** so that it will be closed when switch **440** is closed. By virtue of closing contacts BIP–**2**, a bag clamp solenoid CIV (FIG. 27B) will also be energized through a set of normally closed, time delay contacts BFT–**2** (FIG. 27B) of timer BFT.

From the foregoing it will be appreciated that relay OKD and solenoid CIV will be energized only if switches **440** and **478** are in their circuit-making, run positions and if there is sufficient vacuum at cups **130**, **130***a*, **140** and **140***a* to hold the bag on holder **23**. If either or both of the foregoing conditions are not satisfied, neither relay OKD nor solenoid CIV will be energized.

As shown in FIG. 19, solenoid CIV is operatively connected to a four-way valve **482** having an inlet port **484** connected to the pressurized air source **232** and an outlet port **486** which is connected to atmosphere. As shown, valve **482** has two operating ports **488** and **490**. Port **488** is connected through a check valve **492** to the outboard end of a cylinder **494**. Cylinder **494** axially and slidably receives a piston **496** which is connected to a piston rod **498**. Operating port **490** is connected to the inboard side of cylinder **494** on the piston rod side of piston **496**. With continuing reference to FIG. 19, a second piston and cylinder assembly is provided for and comprises a cylinder **500**. Cylinder **500** slidably and axially receives a piston **502** which is connected to a piston rod **504**. The two piston and cylinder assemblies respectively comprising cylinder **494** and cylinder **500** form a part of bag holder **23**. As shown, operating port **490** in addition to being connected to cylinder **494** is also connected to the inboard side of cylinder **500** on the piston rod side of piston **502**. Port **488** is connected through check valve **492** and a further check valve **506** to the outboard side of cylinder **500**.

As shown in FIG. 29, bag holder **23** further comprises a pair of bag clamping assemblies **508** and **510**. Assembly **508** comprises an arm **512** which is pivotally connected at one end to piston rod **498**. A bag clamping member **514** is rigidly mounted on the other end of arm **512** as shown. At a region intermediate its ends, arm **512** is pivotally mounted on the lower end of supply hopper **26** by a cylindrical pin indicated at **516**.

When piston rod **498** is retracted, it pivots arm **512** in a clockwise direction about the axis of pin **516** to thereby swing clamping member **514** down to a clamping position where it seats against a stationary clamp **518**. Clamp **518** comprises a pad mounted on a plate which is rigidly fixed to the lower end of the supply hopper. By extending piston rod **498**, arm **512** is pivoted to swing clamping member **514** to its illustrated bag-unclamping position.

Assembly **510** preferably is of the same construction as assembly **508**. Accordingly, like reference numerals suffixed by the letter *a* have been applied to designate like parts. Assemblies **508** and **510** are conventional. A pair of plates **519** suspended from stationary clamps **518** and **518***a* guide the bag into position where one side will be clamped between member **514** and clamp **518** and where the other side will be clamped between member **514***a* and clamp **518***a*.

Still referring to FIG. 29, arm **512***a* is pivotally connected to pistoin rod **504**, and displacement of clamping member **514***a* between its bag-clamping and bag-unclamping positions is effected in the same manner just described for assembly **508**.

From the foregoing description, it will be appreciated that when solenoid CIV is energized to actuate valve **482** to its position in FIG. 19, air under pressure is supplied through check valve **492** to the outboard end of cylinder **494** and also through check valves **492** and **506** to the outboard end of cylinder **500**. As a result, piston rods **498** and **504** are extended to respectively swing clamping members **514** and **154***a* to their previously described bag-clamping positions where they firmly clamp the raised bag in place.

Energization of relay OKD closes two sets of normally open contacts OKD–**1** (FIG. 27B) and OKD–**2** (FIG. 27B). By closing contacts OKD–**1**, a holding circuit is established for relay OKD through contacts BIP–**2**. By closing contacts OKD–**2** (FIG. 27B), relay VBC will be energized through switch **466**. Energization of relay VBC opens contacts VBC–**1** and closes the normally open contacts VBC–**2** (FIG. 27B). By virtue of respectively opening VBC–**1** and closing contacts VBC–**2** solenoid FV will be de-energized and solenoid EV will be energized.

By energizing solenoid EV, valve **448** is actuated to its open position to connect the vacuum system shown in FIG. 28 to atmosphere. As a result, the vacuum at suction cups **130**, **130***a*, **140** and **140***a* will be removed. Switches **474** and **476** will consequenlty open, but relay OKD remains energized through contacts OKD–**1**.

A third set of normally open contacts OKD–**3** (see FIG. 27C) of relay OKD will close when relay OKD is energized to electrically signal a control circuit **530** of scale **28** to open a discharge door **532** at the bottom of hopper **26**. As a result, the pre-selected weight of material in hopper **26** will be discharged into the bag which is clamped by holder **23** under spout **24**. Circuit **530** will be described later on and may be of any suitable, conventional form which responds to an electrical signal for operating the discharge door of the scale. Such types of electrical control circuits and scales are well known in the art.

As shown in FIG. 27A, relay OKD has a fourth set of normally open contacts OKD–**4** and a set of normally closed contacts OKD–**5**. By virtue of energizing relay OKD, contacts OKD–**5** will open and contacts OKD–**4** will close. By virtue of opening contacts OKD–**5**, an energizing circuit for relay ICC cannot now be completed through switch **471** which is closed at this stage owing to the fact that suction cup supporting arms **110** and **110***a* are in their fully raised position where the bag was placed on spout **24**.

By virtue of closing contacts OKD–**4** a circuit is completed through switch **471** and a set of normally closed contacts RD–**1** of a reset relay RD (FIG. 27A) to energize solenoid BV.

Energization of solenoid BV actuates valve **230** to its alternate position where port **231** is connected to port **220** and where port **234** is connected to port **224**. As a result, pressurized air from source **232** is supplied through port **220** to reverse the direction of rotation of drive shaft **202**.

At the same time, the air under pressure is supplied through port **220**, it also is supplied to the outboard end of cylinder **336** to extend piston rod **338**. The extension of piston rod **338** swings arm **322** upwardly and in a counterclockwise direction as viewed from FIG. 23 to displace arm **322** from its bag-opening position to its position where, through the motion transmitting push-pull cables **310** and **312**, it will swing fingers **134** and **134***a* outwardly

to their extended bag-clearing and magazine entry positions shown in FIG. 16.

Air in chamber **226** will be exhausted through port **224** and through valve **230** to atmosphere. Air in cylinder **336** on the piston rod side of piston **337** will be exhausted through valve **450** to atmosphere.

From the foregoing it is celar that as the suction cup supporting arms **110** and **110***a* begin their return movement along motion path **174** to magazine **20**, fingers **134** and **134***a* together with their respective suction cups **140** and **140***a* will be swung outwardly to their extended positions aligning with arms **110** and **110***a* respectively so that they will clear the bag clamped at spout **24**.

When shaft **202** reverses direction for returning arms **110** and **110***a* to magazine **20**, the initial movement of arm **268** corresponding to initial movement of arms **110** and **110***a* away from their fully raised positions causes rotation of cam mechanism **436** to a position where it will open switch **471**.

When crank arm **250** reaches a position of approximately 110 degrees from its bag pick-up position, rotary displacement of cam mechanism **436** by arm **268** will result in the re-closing of switch **460**. As a consequence, solenoid GV will be re-energized to return valve **450** to its position shown in FIG. 19. This, however, will have no effect upon the operation of the system since air in cylinder **336** on the piston rod side of piston **337** has already been exhausted. Fingers **134** and **134***a* together with their respective suction cups **140** and **140***a* will therefore remain in their outwardly swung, extended positions.

When crank arm **250** reaches a position on its return movement that is approximately 50 degrees from its bag pickup position, cam mechanism **436** will be positioned by arm **268** to re-open switch **462**. As a result, relay VCC will be de-energized.

By de-energizing relay VCC, contacts VCC–2 will open, but relay CY will remain energized through contacts CY–2. Contacts VCC–1 will also open to reset the energizing circuits for solenoid FV, relay OKD and solenoid CIV in preparation for the next cycle.

When crank arm **250** reaches a position approximately 45 degrees from its bag pick-up position, cam mechanism **436** will be positioned by arm **286** to actuate switch **460** to its open position, thereby de-energizing solenoid GV. Valve **450** will therefore be actuated again to its alternate position, but this will have no effect on the operation of the air pressure circuit for the reason previously mentioned.

When crank arm **250** reaches its position on stop **290**, cam mechanism **436** will be positioned by arm **268** to close switch **434**, and consequently, open switch **466**. By opening switch **466**, relay VBC and solenoid EV will be de-energized. At this stage, the suction cup support arms **110** and **110***a* are in their fully lowered, bag pick-up positions at magazine **20**.

By virtue of de-energizing solenoid EV, valve **448** is actuated to its closed position with the result that vacuum is again applied to suction cups **130** and **130***a* preparatory to picking up the next bag in stack **21**. By de-energizing relay VBC, contacts VBC–1 will close and contacts VBC–2 will open. This reconditions the circuit controlling solenoids EV and FV for operation in the next cycle. As a result of re-closing switch **434**, relay ADC is re-energized, to close contacts ADC–1 in preparation for raising the suction cup support arms **110** and **110***a* in the next cycle.

Before the suction cup support arms **110** and **110***a* reach their fully lowered, bag pick-up positions at magazine **20**, the pre-selected weight of material normally will have been discharged from hopper **26** into the bag clamped at spout **24**. When the discharge is completed, control circuit **530** produces an electrical signal for energizing a relay DX as shown in FIG. 27C. Energization of relay DX closes a set of normally open contacts DX–1 (FIG. 27B) to complete an energizing circuit for timer BFT and for a relay SDC (FIG. 27B). The energizing circuit for both relay SDC and timer BFT may be traced from one terminal of the transformer secondary winding through conductor **406** and contacts PC–1, through switches **182**, through contacts DX–1, through the operating winding of relay SDC and in parallel through timer BFT, and through conductor **408** to the other terminal of the transformer secondary winding. Switches **182** will be closed at this stage for the bag is still clamped in its filling position by bag holder **23**.

By energizing relay SDC, normally open contacts SDC–1 (FIG. 27B) will close to provide a holding circuit for maintaining relay SDC and timer BFT energized after contacts DX–1 open. Relay DX will be de-energized shorty after the signal indicating that the discharge has been completed has been transmitted.

After a short time delay of approximately 1.5 seconds to ensure that all of the material in the scale hopper has entered the bag clamped at spout **24**, timer BFT times out. As a result, contacts BFT–1 will open to de-energize relay CY. By de-energizing relay CY, contacts CY–2 will open and contacts CY–1 will close. By opening contacts CY–2 the holding circuit for relay CY is reset for the next cycle. By closing contacts CY–1 the circuit is reset in preparation for raising arms **110** and **110***a* in the next cycle.

In addition to opening contacts BFT–1, timer BFT upon timing out, will open contacts BFT–2 to interrupt the energizing circuit for solenoid CIV. As shown in FIG. 27B, a switch **544** is ganged to contacts BFT–2 in such a manner that it will be open when contacts BFT–2 are closed and will be closed when contacts BFT–2 are opened. Thus, when contacts BFT–2 open, switch **544** closes to complete an energizing circuit for a bag unclamp solenoid C2V through a set of normally closed contacts RC–2 of reset relay RC.

Solenoid C2V is operatively connected to valve **482** to actuate value **482** to its alternate position from that which is illustrated in FIG. 19. Thus, when solenoid CIV is de-energized and when solenoid C2V is energized, valve **482** is actuated to its alternate position where inlet port **484** is connected to operating port **490** and where outlet **486** is connected to operating port **488**. Air under pressure from source **232** is thereby supplied to the inboard ends of cylinders **494** and **500** on the piston rod side of pistons **496** and **502** to retract piston rods **498** and **504** simultaneously. As a result, bag clamping members **514** and **514***a* will be swung to their bag-unclamping positions shown in FIG. 29. The filled bag is thereby released from bag holder **23** and will drop vertically onto conveyor assembly **30** for removal from the bag placing and filling apparatus previously described.

When the filled bag leaves spout **24**, switches **182** will open to de-energize relays BIP and SDC and timer BFT. The contacts of the two relays and of the timer will thereby be restored to their initial conditions for initiating the next cycle. In this connection, it will be noted that contacts BIP–2 will be opened when relay BIP is de-energized. Relay OKD and solenoid C2V will consequently be de-energized, and the contacts of relay OKD will be restored to their initial conditions in preparation for the next cycle of operation. It also will be noted that as a result of de-energizing relay BIP, contacts BIP–1 reclose to again complete the circuit for energizing solenoid AV in the manner previously described. Thus, the cycle of picking up the topmost bag in stack **21**, of advancing the bag toward spout **24**, of opening the bag during its advancement along motion path **174**, of presenting the bag to holder **23** and of clamping the bag beneath spout **24** will be repeated. It therefore will be appreciated that the foregoing cyclic operation will continuously be repeated until such time that it is desired to stop operation by pressing switch **412**.

An improper cycle causing energization of relay ICC will occur if relay OKD and solenoid CIV fail to energize

when the suction cup supporting, bag-carrier arms **110** and **110***a* are in their fully raised generally horizontal positions shown in FIG. 16 and when switch **420** is in its "in," circuit-making position. This circuit condition could be caused by arms **110** and **110***a* being at their fully raised positions at bag holder **23** without a bag being supported or carried by the suction cup assemblies **100** and **102**. This circuit condition could also be caused if there is insufficient vacuum to open switches **474** and **476** when the bag-carrier arms **110** and **110***a* are in their fully raised positions with a gripped bag being presented to bag holder **23**. The foregoing circuit condition could also occur if switches **440** and **478** are open when the bag-carrier arms **110** and **110***a* are fully raised with the bag and when there is sufficient vacuum in the system for maintaining switches **474** and **476**.

Should any of the foregoing conditions occur, relay ICC will be energized through switch **471** and normally closed contacts OKD–**5**. As a result, contacts ICC–**1** will open to prevent energization of the magazine elevator motor starter relay EMS. In addition, energization of solenoid AV is prevented by virtue of opening contact ICC–**1**. Automatic cycling of the bag placer will therefore be interrupted and the operator of the bag placer may now selectively lower the bag-carrier arms **110** and **110***a* by pressing the reset push button assembly **470**. As a result, contact **468** of switch assembly **470** will open to de-energize relay CY.

Switch assembly **470** has a further set of contacts **550** (FIG. 27A) which will close when contacts **468** are opened to energize reset relay RC.

By virtue of energizing relay RC, contacts RC–**1** and RC–**2** will open and two sets of normally open contacts RC–**3** and RC–**4** (FIG. 27B) will close. By closing contacts RC–**3**, relay C2V will be energized. By closing contacts RC–**4**, solenoid BV is energized.

The electrical and pneumatic circuits of the bag placer will consequently be conditioned to return the bag-carrier arms **110** **110***a* to magazine **20** in the manner previously described. The return movement of crank arm **250** toward stop **290**, which corresponds to the bag pick-up position previously described, will result in rotary displacement of mechanism **436** to cause actuation of switch **471** to its open position. Relay ICC will therefore de-energize as arms **110** **110***a* leave their fully raised positions at bag holder **23**. Contact ICC–**1** will consequently close so that relay EMS will be energized if switch **426** is closed. In addition to the foregoing, the closure of contact ICC–**1** also resets the circuit for re-energizing solenoid AV at the proper time in the cycle in the manner previously described.

To manually operate the bag placer, switch **420** is selectively actuated to its circuit-interrupting, "out" position. This will prevent automatic operation. A further switch **552** (see FIG. 27B), which is ganged to switch **420**, will be closed when switch **420** is opened. Switch **552** will open when switch **420** is closed. By virtue of closing switch **552**, the circuit is conditioned for manual operation.

The operator of the bag placer now places a bag on bag holder **23**, and by doing so, causes switches **182** to close for energizing relay BIP. Contacts BIP–**2** will therefore close to complete partial circuits for energizing relay OKD and solenoid CIV.

While holding the open, empty bag in place on bag holder **23**, the operator now actuates a foot switch **554** (see FIG. **27**B) to complete circuits for energizing relay OKD and solenoid CIV. Energization of solenoid CIV will actuate bag holder **23** to clamp the open empty bag in place in suspended relation below spout **24** in the manner previously described. The operator now removes his foot from switch **554** to allow it to resume its open position under the bias of an unshown spring. When relay OKD is energized by closing switch **554**, contacts OKD–**1** are closed to establish a holding circuit for maintaining relay OKD and solenoid CIV energized through contacts BIP–**2** after switch **554** is opened.

Energization of relay OKD closes contacts OKD–**3** to signal the scale control circuit **530** to discharge the contents in hopper **26** into the bag which is now clamped in place below spout **24** by bag holder **23**. In a manner to be described in greater detail shortly, the scale will then return a scale discharging signal to energize relay DX.

Contacts DX–**1** will therefore close to energize relay SDC and timer BFT. Energization of relay SDC encloses contacts SDC–**1** to provide the holding circuit for maintaining relay SDC and timer BFT energized when relay DX de-energizes to open contacts DX–**1**.

Timer BFT, as previously explained, will time out after a short time delay to ensure that all of the material in hopper **26** has entered the bag clamped in place by bag holder **23**. By timing out, timer BFT opens contacts BFT–**2** to de-energize solenoid CIV. By virtue of opening contacts BFT–**2**, contacts **524** will close to energize the bag unclamping solenoid C2V.

Energization of solenoid C2V actuates valve **482** to its previously described position where pressurized air is supplied to swing the bag clamping member **514** and **514***a* to their bag unclamping positions shown in FIG. 29. The unclamped, filled bag will therefore drop from bag holder **23** onto conveyor assembly **30** which carries the filled bag away as previously explained. Switches **182** will therefore open to de-energize relays BIP and SDC and timer BFT.

By virtue of de-energizing relay BIP, contacts BIP–**2** will open to de-energize relay OKD and solenoid C2V. The foregoing manual cycle of filling a bag may now be repeated.

To hold the bag-carrier arms **110** and **110***a* in their lowered, bag pick-up positions at magazine **20** during an automatic cycle, switches **440** and **478** are actuated to their "hold", circuit interrupting positions. As a result, arms **110** and **110***a* will remain in their lowered, bag-pick-up positions at magazine **20** until switches **440** and **478** are selectively actuated to their "run" circuit-making positions.

To hold the bag-carrier arms **110** and **110***a* in their fully raised positions for presenting an empty bag to bag holder **23** during an automatic cycle, switches **440** and **478** are actuated to their "hold" circuit-interrupting positions as arms **110** and **110***a* begin to raise in the automatic cycle of transferring a bag from magazine **20** to bag holder **23**. Under such conditions, arms **110** and **110***a* will travel through a full cycle to present a bag to bag holder **23**, but bag holder **23** will not be actuated to clamp the bag in place under spout **24**. Arms **110** and **110***a* together with the bag presented to bag holder **23** will remain in the fully raised position until switches **440** and **478** are selectively actuated to their "run" circuit-making position.

Scale **28** is of the conventional, pre-weigher type such as that described in United States Pat. No. 3,252,531 issued May 24, 1966 for Weighing Apparatus. As shown in FIG. 27C, scale **28** comprises a suitable weigh beam structure **560**, which is fulcrummed about a horizontal fulcrum axis by a suitable knife edge and bearing block pivot assembly **562**. Hopper **26** is supported from one of the free ends of beam structure **560** by a suitable knife edge and load bearing assembly **564**. Selected counterweights **566** are hung from the other end of beam structure **560** at a predetermined distance from the horizontal fulcrum axis. Beam structure **560** is freely swingable about its fulcrum axis between upper and lower closely spaced fixed stops **568** and **570** and occupies a static, balanced position between stops **568** and **570** when a predetermined weight of material in hopper **26** counterbalances weights **566**.

Material to be segregated into descrete, measured drafts of preselected weight by scale **28** is stored in a supply bin

indicated at **572**. In this embodiment, bin **572** has a bottom discharge opening located vertically above the open upper end of hopper **26**. Delivery of the material stored in bin **572** to hopper **26** is controlled by a feed door or feed gate **572** of suitable form. When door **574** is open, material in supply bin **572** is discharged by gravity in a continuous, descending stream into hopper **26**. Discharge door **532** will be closed while hopper **26** is being filled. As the weight of material delivered to hopper **26** approaches the value which will counterbalance weights **566**, beam structure **560** swings away from its rest position on lower stop **570** and will approach its static balance position between stops **568** and **570**.

Still referring to FIG. 27C, feed door **574** is operated by a suitable cylinder and piston assembly **576**. Supply and exhaust of air for operating piston assembly **576** is controlled by a suitable valve **578**. Operation of valve **578** is controlled by a solenoid FVS.

As shown, solenoid FVS is connected in series with serially connected limit switches **580** and **582** between a pair of conductors **584** and **586** in control circuit **530**. Conductors **584** and **586** are connected to respective terminals of a suitable source of A.C. power. Switch **582** is operatively connected to be actuated to its closed, circuit-making position when discharge door **532** is fully closed. Switch **582** is operably connected to beam structure **560** so that it will be closed when beam structure **560** is in an unbalanced position. When there is no material in hopper **26**, beam structure **560** will be in an unbalanced position on stop **570** with the result that switch **580** will be closed.

Discharge door **532** is of the conventional toggle type and is operably connected to an operating cylinder and piston assembly **590**. When drive assembly **590** is activated it will swing discharge door **532** to its over center position where it begins to open. Discharge door **532** will then fully open and will be held open by the weight of material being dispensed from hopper **26**. Discharge door **532** with its conventional toggle mechanism is counterbalanced so that it will automatically close when there is no weight of material being applied to the door.

Supply and exhaust of air for operating drive assembly **590** is controlled by a suitable valve **592**. Valve **592** is actuated by a solenoid DVS in circuit **530**. When solenoid DVS is energized, it actuates valve **590** to displace the piston of assembly **590** to a position where the toggle mechanism of discharge door **532** will be moved to its over-center position. Discharge door **532** will therefore move to its fully opened position under the influence of the over-centered movement of the toggle mechanism. The circuit for energizing solenoid DVS may be traced from conductor **584**, through switch **582**, through another limit switch **596**, through contacts OKD–3, and through the operating winding of solenoid DVS to conductor **586**. Switch **596** is ganged to switch **580** in such a manner that it will be closed when switch **580** is opened and will be open when switch **580** is closed.

At the beginning of the scale cycle, discharge door **532** will be closed, beam structure **560** will be in its unbalanced rest position on lower stop **570**, and solenoid FVS will be energized through switches **582** and **580** as a result of having closed the discharge door **532** in the previous cycle. Material will therefore be delivered from supplybin **572** to hopper **26**, thus causing beam structure **560** to swing from its unbalanced position toward its static, balanced position. When the weight of material delivered to hopper **26** closely approaches the preselected weight as determined by the weight of counterweights **566**, switch **596** will close and switch **580** will open. By opening switch **580**, solenoid FVS will be de-energized to actuate valve **578** which, in turn, operates assembly **576** to close door **574**. Delivery of material from supply bin **572** to hopper **26** is therefore interrupted. The weight of material delivered to hopper **26** will now be the pre-selected weight as determined by the weight of counterweights **566**.

When relay OKD is energized to close contacts OKD–3 a circuit is completed for energizing solenoid DVS through switches **582** and **596**. As a result, valve **592** is actuated which, in turn, activates assembly **590** to shift the toggle mechanism of door **532** to its over-centered position. By virtue of the weight of the material on door **532** in hopper **26**, door **532** will now be swung to its full open position to discharge the contents of hopper **26** into the bag which is now clamped in place by bag holder **23** below spout **24**.

As discharge door **532** begins to open, switch **582** will open, and a further switch **598** (see FIG. 27C) will close. Switch **598** is so ganged to switch **582** that it will close when switch **582** opens, and will open when switch **582** closes.

By closing switch **598**, relay DX is energized to close contacts DX–1 and thus energize relay SDC and timer BFT, and the previously described operation of circuit **400** will take place.

As soon as the discharge of material from hopper **26** begins to take place, beam structure **560** moves toward its original unbalanced position with the result that switch **580** will open and switch **596** will close. When the preselected weight of material in hopper **26** has been completely discharged into the bag clamped below spout **24**, door **532**, by virtue of its previously mentioned counterweight, will automatically close with the result that switch **582** will close and switch **598** will open.

By opening switch **598**, relay DX will be de-energized. By opening switch **596** solenoid DVS wll be de-energized. By closing switch **582** after switch **580** has been closed, solenoid FVS will be re-energized to open feed door **574**. As a result, the scale cycle just described will automatically be repeated.

The construction of some bags is such that as the top most bag is picked up from stack **21** by suction cups **130** and **130*a*** it will tend to open so much that suction cups **140** and **140*a***, when swung inwardly toward the downwardly facing side of the bag, will not engage the proper bag regions for pinching and later opening the bag in cooperation with suction cups **130** and **130*a***. To avoid this objectionable condition, a pair of nozzles, **600** and **602** are respectively mounted in guide members **92** and **93** so as to direct jets or streams of air upwardly toward the downwardly facing side of the bag adjacent to its open end as the bag is lifted and displaced forwardly over the front wall of magazine **20**. These jets of pressurized air force the downwardly facing side of the bag adjacent to the open end of the bag upwardly toward the upwardly facing bag side to thus prevent the mouth of the bag from opening up objectionably before suction cups, **140** and **140*a*** are swung inwardly to pinch the bag in cooperation with suction cups **130** and **130*a***.

Displacement of suction cups **140** and **140*a*** to their bag-pinching positions will be at a time before the front of the bag moves so far beyond the air stream provided by nozzles **600** and **602** that the jets of air impinging against the downwardly side of the bag will no longer be effective to prevent the bag from opening objectionably. It therefore will be appreciated that during the period between the time that the bag is lifted from stack **21** by suction cups **130** and **130*a*** and the time that suction cups **140** and **140*a*** are swung inwardly to their bag-pinching positions, the jets of air issuing from nozzles **600** and **602** and impinging against the downwardly facing side of the bag will prevent the bag mouth from opening objectionably and will keep the downwardly facing side of the bag senssentially flat.

By preventing the downwardly facing side of the bag from drooping, the air jets directed from nozzles **600** and **602** will prevent the downwardly facing side of the bag from scraping against the front wall of magazine **20** as the bag is lifted from stack **21**.

As shown in FIG. 19, nozzles **600** and **602** are directly connected to the pressurized air exhaust **232** through a manually operable valve indicated at **606**.

As shown in FIG. 30, bag height sensing mechanism **430** comprises a rigid support frame **610** which is formed by a pair of arms **612** and **613** and a cross piece **614**. Arms **612** and **613** are rotatably mounted on the stub shafts which respectively mount sprocket wheels **66** and **64**.

Still referring to FIG. 30, arms **612** and **613** extend forwardly toward the front of magazine **20** along the sides of frame sections **46** and **48** and are rigidly joined together at their forward ends by cross piece **614**. Cross piece **614** comprises a rod, the axis of which is parallel to the aligned axes of the shaft mounting sprocket wheels **64** and **66**. Frame **610** is, therefore, swingable from the illustrated, lower position to a raised, bag-clearing position about the aligned axes of the shafts mounting sprocket wheels **64** and **66**.

As shown in FIGS. 30–32, a rigid, U-shaped, feeler-mounting bracket **616** is pivotally mounted on arms **612** and **613** by axially aligned cylindrical members **617** and **618**. Fixed to the cross piece of bracket **616** is a bag height feeler **620** which comprises a flat sided plate that is curved upwardly along its forward portion which is spaced forwardly from bracket **616** and frame **610**. As shown, the assembly of frame **610**, bracket **616** and feeler **620** is symmetrical with respect to a vertical, longitudinal plane medially intersectng magazine **20**. This plane extends at right angles to the pivot axis of frame **610**, cross piece **614**, and the pivot axis of bracket **616**.

As best shown in FIG. 32, a motion transmitting link **622** is pivotally connected to arm **612** at one of its ends and to a crank arm **624** at its other end. Crank arm **624** is non-rotatably mounted on drive shaft **202**. Thus, as drive shaft **202** is rotated in a clockwise direction (as viewed from FIG. 32) to raise the bag-carrier arms **110** and **110***a* for advancing a picked-up bag along motion path **174**, the assembly of frame **610**, bracket **616** and feeler **620** will be swung in a counterclockwise direction about the aligned axes of the shafts mounting sprocket wheels **64** and **66**.

Still referring to FIG. 32, a cylinder and piston assembly **628** is provided for swinging bracket **616** about the aligned axes of members **617** and **618** and relative to the swinging motion of frame **610**. Assembly **628**, as shown in FIGS. 32 and 19, comprises a cylinder **630** which coaxially and slidably receives a piston **632** (see FIG. 19). Piston **632** is connected to a rod **634** which, in turn, mounts a motion transmitting roller that abuttingly engages a portion of bracket **616** as shown in FIG. 32.

When piston rod **634** is retracted, bracket **616** together with feeler **620** is pivoted about the aligned axes of members **617** and **618** to its downwardly swung lowermost position shown in FIG. 32. This pivotal motion is the result of the weight of bracket **616** and feeler **620** and may be aided by a light bias of a spring **621** shown in FIG. 19.

By extending piston rod **634** as a result of supplying pressurized air to the outboard end of cylinder **630**, bracket **616** together with feeler **620** is pivoted about the aligned axes of members **617** and **618** to swing feeler **620** upwardly and out of the path initially travelled by a bag as it is picked up and lifted by suction cups **130** and **130***a*.

As shown in FIG. 19, the outboard end of cylinder **630** is connected to that operating port of valve **230** which is connected to port **224** of motor assembly **200**. Thus when valve **230** is actuated by energization of solenoid AV to supply pressurized air to port **224** for rotating shaft **202** in a direction for lifting the bag-carrier arms **110** and **110***a* and thus for advancing a picked-up bag from magazine **20** to bag holder **23**, pressurized air is immediately supplied to cylinder **630** for extending piston rod **634**. As a result, the assembly of bracket **616** and feeler **620** is swung in a counterclockwise direction (as viewed from FIG. 32) about the aligned axes of members **617** and **618** to thus swing feeler **620** out of the initial path through which the picked-up bag is lifted by suction cups **130** and **130***a*. Rotation of shaft **202** to raise the bag-carrier arms **110** and **110***a* will, through the connections provided by crank arm **624** and link **622**, further raise the assembly of bracket **616** and feeler **620** by swinging frame **610** upwardly and rearwardly so that this entire assembly is out of the path of the bag being advanced along motion path **174**.

When shaft **202** reverses direction to return arms **110** and **110***a* from bag holder **23** to magazine **20** for picking up another bag, the assembly of frame **610**, bracket **616** and feeler **620** are swung in a clockwise direction (as viewed from FIG. 32) from the raised, bag-clearing position to the lowered bag-sensing position shown in FIG. 32. On the return movement of arms **110** and **110***a* to magazine **20**, valve **232**, it will be recalled, will have been actuated to its alternate position where the operating port which is connected to the outboard end of cylinder **630** will be connected to atmosphere. As a result, piston rod **634** returns to its retracted position forcing the residual air out of cylinder **630**. Consequently, feeler **620** will resume its lowered, bag-height sensing position shown in FIG. 32.

As diagrammatically shown in FIG. 33, switch **426** has an actuator **638** which is operatively engaged by a part **640**. Part **640** is rigidly fixed to bracket **616**. As the bags in stack **21** are successively picked up and transferred to bag holder **23**, the height of stack **21** on platform will reduce. Feeler **620**, which may be slightly spring biased in a clockwise direction as viewed from FIG. 33, will follow the decreasing height of stack **21** so that it continues to seat on the topmost bag in the stack.

Thus, as the height of stack **21** decreases, feeler **620** together with bracket **616** will swing in a clockwise direction as viewed from FIG. 33 allowing displacement of actuator **638** in such a direction that when there is a predetermined decrease in the height of stack **21**, switch **426** will be actuated to its closed position. It will be recalled that by closing switch **426**, relay EMS is energized to cause energization of the magazine elevator motor **52**. Thus, platform **42** will be raised to thereby raise the level of stack **21** and thus cause feeler **620** together with bracket **616** to swing in a counterclockwise direction as viewed from FIG. 33.

Actuator **638** will therefore be displaced in the opposite direction, and when the topmost bag in stack **21** reaches its optimum level for pickup by suction cups **130** and **130***a*, actuator **638** will have been displaced sufficiently far to open switch **426**. By opening switch **426**, relay EMS will be de-energized to de-energize motor **52**. Thus, upward displacement of platform **42** will be arrested.

As best shown in FIGS. 30 and 31, feeler **620** is disposed laterally between suction cup **130** and **130***a* so that it will seat on the forwardly disposed region of the upwardly facing side of the bag immediately adjacent to the open end of the bag. Feeler **620** therefore senses a level of a portion of the bag which will be essentially at the same level at which those portions of the bag engaged by suction cups **130** and **130***a* are disposed. As a result, energization of motor **52** is controlled to accurately position the stack for keeping the stack **21** at an optimum level to ensure reliable pickup of the topmost bag by suction cups **130** and **130***a* throughout the repeated cyclic operation of the bag placer.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. In a bag placing apparatus for presenting bags to a downwardly opening discharge end of a bag-filling receptacle, means for supporting said bags one over the other in a stack below and laterally of said discharge end, and means for transferring the topmost bag from said stack to said discharge end along a path having smoothly contoured opposite curvatures at least in the regions of said stack and said discharge end, respectively, said transfer means being operative to position the transferred bag vertically below said discharge end with its open end facing up in alignment with said discharge end.

2. The bag placing apparatus defined in claim 1 wherein the portions of said path defining said opposite curvatures continuously rise in a direction advancing toward the receptacle and are joined at their adjacent ends by only one point of inflexion.

3. In a bag placing apparatus for presenting bags to a downwardly facing discharge opening of a bag filling station, means for supporting the bags one over the other in a stack disposed below and laterally offset from said discharge opening and means for picking up the topmost bag from said stack and for transferring the topmost bag to said discharge opening along a predetermined, continuously rising, curved path, the absolute value of the second derivative of the curve described by said path (a) continuously decreasing from a bag pickup point adjacent to said stack to a point of inflexion intermediate said pickup point and said discharge opening and (b) then continuously increasing from said point of inflexion to said discharge opening.

4. In a bag placing apparatus for presenting bags having an open, intake end to a bag holder at the vertically disposed discharge end of a bag-filling hopper, means for supporting said bags one over the other in a stack below and laterally of the discharge end of said hopper with the intake ends facing toward the vertical axis of said discharge end, and means for picking up the topmost bag in said stack and transferring it to said holder along a predetermined path which is smoothly curved at least between a bag pickup point at the top of said stack to a point intermediate said stack and said holder to provide the picked-up bag with horizontal and vertical components of travel which respectively increase progressively from a minimum value and decrease progressively from a maximum value as the bag is moved from said pickup point toward said holder.

5. The bag placing apparatus defined in claim 4 wherein said bag pickup and transferring means comprises suction means for gripping the upwardly facing side of the topmost bag in said stack to hold the bag for transfer to said holder.

6. In a bag placing apparatus for presenting bags to a bag-filling station, means for supporting said bags one over the other in a stack, means for gripping the topmost bag in said stack, and means for displacing said gripping means to transfer the gripped bag to said filling station, said displacing means comprising first and second links mounted for pivotal motion about first and second axes which are disposed in fixed, predetermined spaced apart relationship to each other, a third link pivotally connected to said first and second links at regions which are in predetermined relation from said axes, means for supporting said gripping means on said third link, prime mover means, and motion transmitting means operatively connecting said prime mover means to said third link for moving said third link and the gripping means supported thereby back and forth between said stack and said filling station, said first and second links guiding said third link to confine the bag transfer motion of said gripping means to a predetermined path between said stack and said filling station.

7. The bag placing apparatus defined in claim 6 wherein said third link is pivotally connected to said first link about a third axis which is disposed at a fixed, predetermined, radial distance from said first axis, wherein said third link is further pivotally connected to said second link about a fourth axis which is spaced from said third axis and which is disposed at a predetermined, fixed radial distance from said second axis, said first, second, third, and fourth axes being disposed in parallel relation with respect to each other, the locations of said first and second axes and the ratios of the length of said first link extending perpendicularly between said first and third axes, the length of said second link extending perpendicularly between said second and fourth axes, and the length of said third link extending perpendicularly between said third and fourth axes being pre-selected to impart a motion to said gripping means that is described by two curves of opposite curvature which define said path and which are joined at their adjacent ends by a single point of inflexion.

8. The bag placing apparatus defined in claim 7 wherein said motion transmitting means comprises a linkage for bodily displacing the assembly of said third link and gripping means along said path.

9. In a bag placing apparatus for presenting bags to the discharge end of a bag-filling receptacle, means for supporting said bags one over the other in a stack below and laterally of said discharge end, a pair of spaced transfer arms, means for rigidly joining said arms together, means supported on each arm for gripping the topmost bag in said stack, and means for bodily displacing the assembly of said transfer arms and said gripping means along a predetermined curved path having a varying radius of curvature.

10. In a bag placing apparatus for presenting bags to the discharge end of a bag-filling receptacle means for supporting said bags one over the other in a stack below and laterally of said discharge end, and means for picking up the topmost bag in said stack and for transferring it to said discharge end along a predetermined path having first and second oppositely curved sections respectively disposed adjacent to said stack and to said discharge end, said first section being described by a curve having a progressively increasing radius in the direction of bag movement toward said discharge end, and second section being described by a curve having a progressively decreasing radius in the direction of bag movement toward said discharge end.

11. In a bag placing apparatus for presenting bags having opposed side walls and an open intake end to a bag holder at the discharge end of a bag-filling hopper, means for supporting a stack of said bags in collapsed condition below and laterally of the discharge end of said hopper, the bags in said stack being arranged one over the other with the intake ends of said bags facing toward the vertical axis of said discharge end, a pair of bag transfer arms, a first pair of suction cups pivotally mounted one on each of said transfer arms, a second pair of suction cups pivotally mounted one on each of said transfer arms, means for applying a vacuum in said first and second pairs of suction cups, and control means for sequentially positioning said arms and said first and second pairs of suction cups to first engage the upwardly facing side wall of the topmost bag in said stack with said first pair of cups for gripping the topmost bag by the vacuum applied thereto by said vacuum applying means, displacing said arms to pick the gripped bag up from said stack and to move it toward said holder, pivoting said second pair of suction cups into engagement with the downward facing wall of the topmost bag after it is picked up from said stack to thereby grip the downwardly facing side wall by the vacuum applied thereto by said vacuum applying means, and pivoting said first and second pairs of cups away from each as the gripped, moving bag approaches said holder to open the mouth of said bag and thereby

enable said bag to be grasped by said holder in suspended relation from the discharge end of said hopper.

12. The bag placing apparatus defined in claim 11 wherein the cups of said first and second pairs of pivoted about parallel axes.

13. The bag placing apparatus defined in claim 12 wherein the suction cups of said second pair are pivotally positioned by said control means to respectively extend on opposite sides of said stack in spaced relation thereto when said first pair of cups are positioned to engage the upwardly facing side of the topmost bag in said stack.

14. The bag placing apparatus defined in claim 11 comprising means for supporting said transfer arms in opposed, parallel relation with respect to each other and including means for selectively adjusting said arms to vary the spacing between said arms and thereby accommodate bags of different widths.

15. A bag placing apparatus for presenting bags to a bag filling station and comprising a magazine for receiving said bags at a level below said filling station, and bag engaging means for transferring the bags one at a time from said magazine to said filling station, said magazine comprising a platform for supporting the bags one over the other in a stack, means for supporting and elevating said platform and the stack thereon to present the topmost bag in the stack to said bag-engaging means, a pair of opposed guide walls disposed on opposite sides of said stack for guiding the bags as they are elevated, and means for selectively, laterally adjusting said guide walls toward and away from each other to accommodate bags of different widths, said platform supporting and elevating means comprising a pair of power driven chain and sprocket wheel assemblies respectively laterally outwardly disposed with respect to said guide walls, and said platform having portions extending laterally beyond said walls and engaging the chains of said assemblies.

16. In a bag placing apparatus for presenting bags having opposed side walls and an intake mouth to a bag-filling station, a magazine for supporting said bags one over the other in a stack, bag pickup and transport means for gripping the upwardly facing wall of the topmost bag in said stack adjacent to the open end thereof to pick up the topmost bag and to transfer it over one end of said magazine to a bag-filling station, and means for directing at least one stream of high velocity air at the underside of the topmost bag upon being picked up from said stack by said pickup and transport means to urge said mouth toward a closed position as the picked up bag passes over said one end of said magazine.

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