Nov. 30, 1965 J. J. GILBERT 3,220,550

SEPARATING APPARATUS

Filed Feb. 27, 1963 5 Sheets-Sheet 1

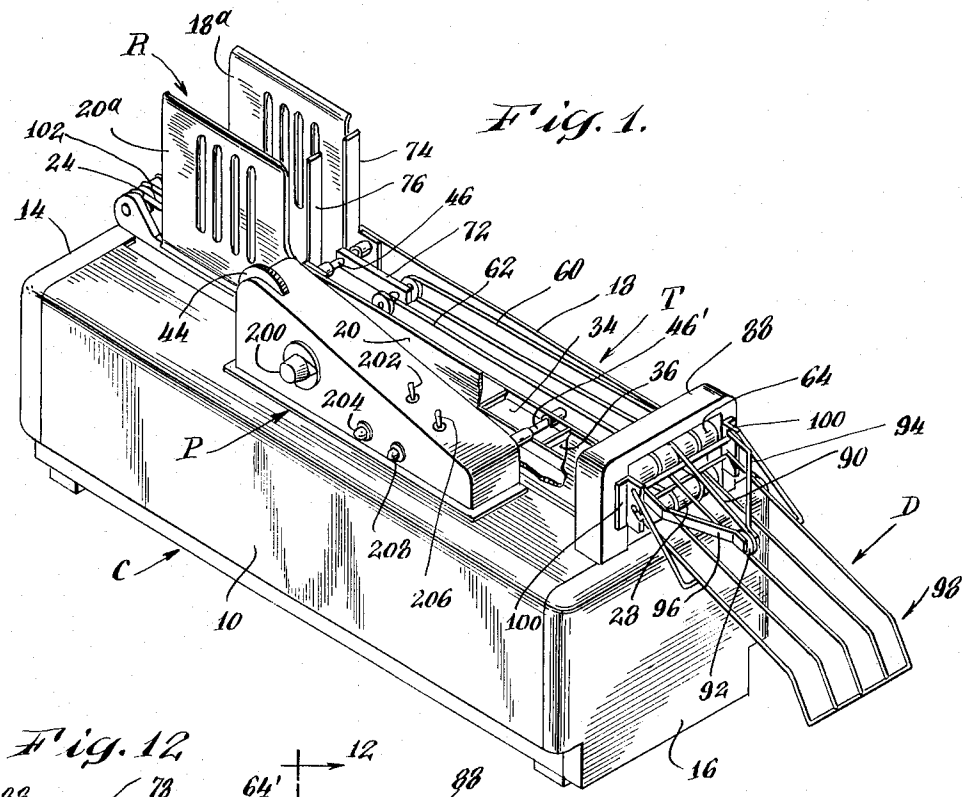
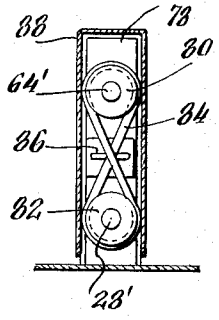


Fig. 1.

Fig. 12.



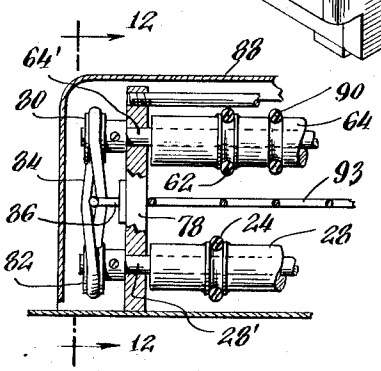


Fig. 11.

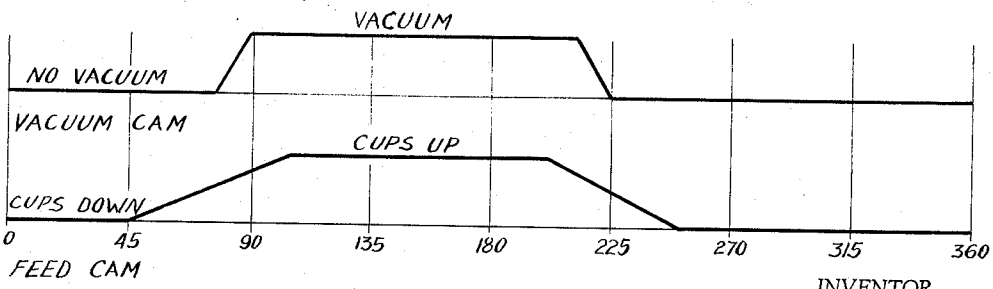


Fig. 15.

INVENTOR.
Jack James Gilbert
BY
Wooster, Davis & Cifelli
ATTORNEYS

Nov. 30, 1965 J. J. GILBERT 3,220,550

SEPARATING APPARATUS

Filed Feb. 27, 1963 5 Sheets-Sheet 2

Fig. 2.

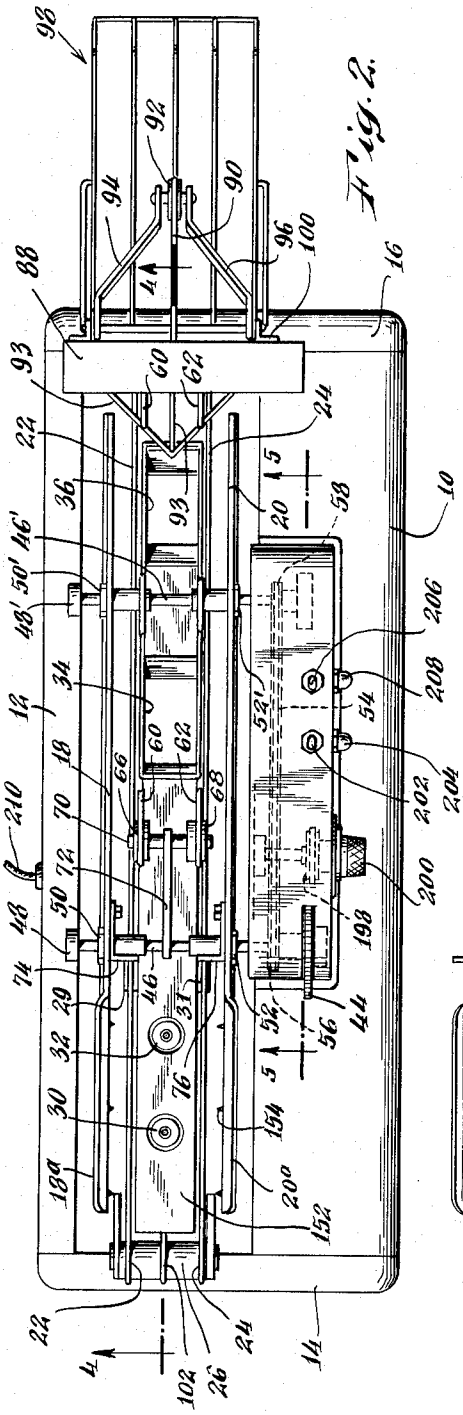
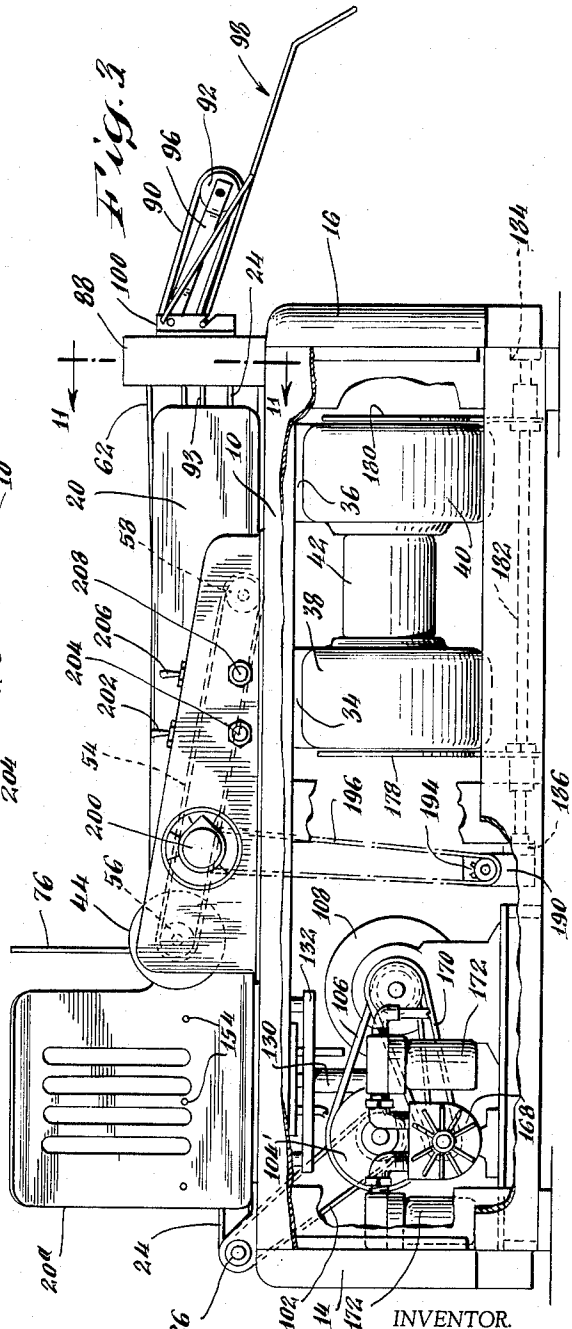


Fig. 3



INVENTOR.
BY Jack James Gilbert
Wooster, Davis & Cifelli
ATTORNEYS

Nov. 30, 1965 J. J. GILBERT 3,220,550

SEPARATING APPARATUS

Filed Feb. 27, 1963 5 Sheets-Sheet 3

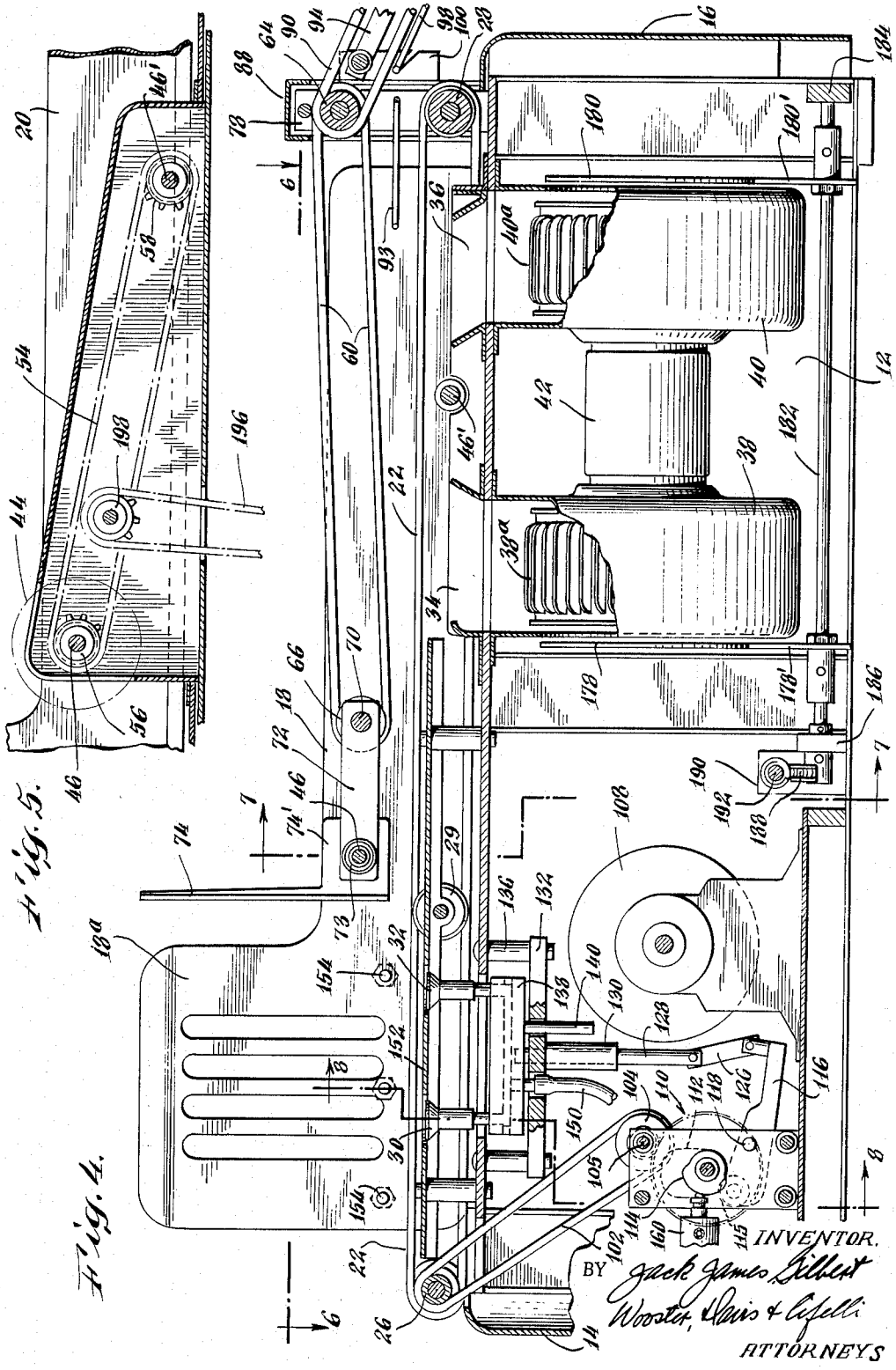


Fig. 4.

Fig. 5.

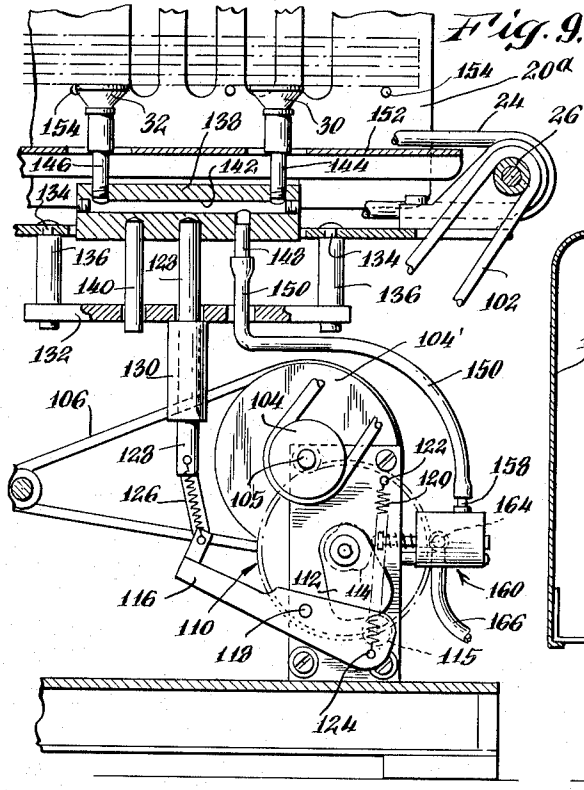
INVENTOR.
BY Jack James Gilbert
Wooster, Davis & Cifelli
ATTORNEYS

Nov. 30, 1965 J. J. GILBERT 3,220,550

SEPARATING APPARATUS

Filed Feb. 27, 1963 5 Sheets-Sheet 4

Fig. 9.



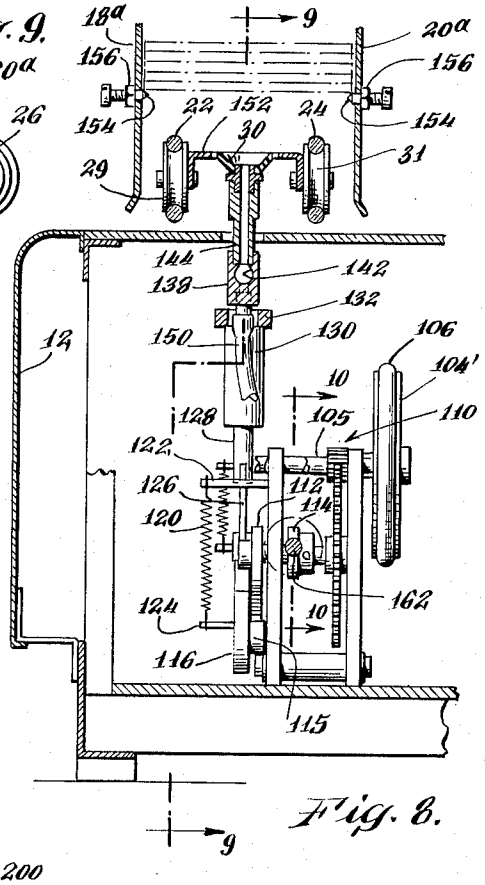


Fig. 8.

Fig. 7.

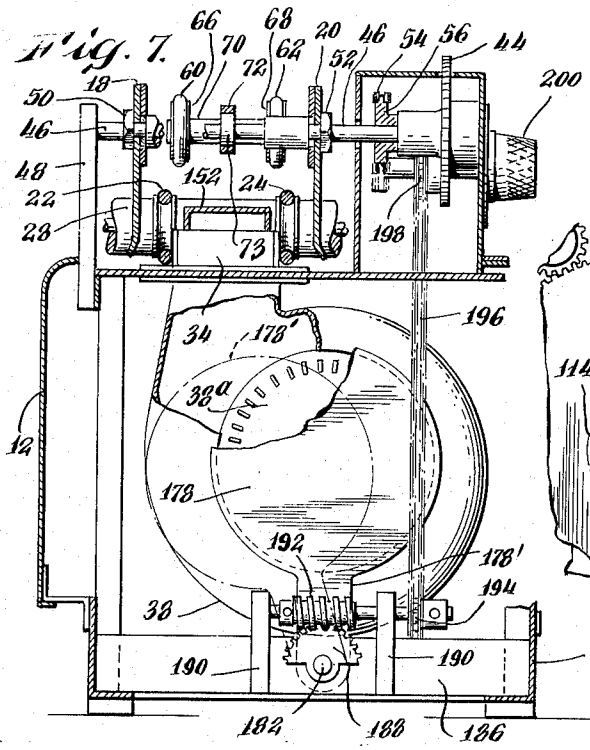
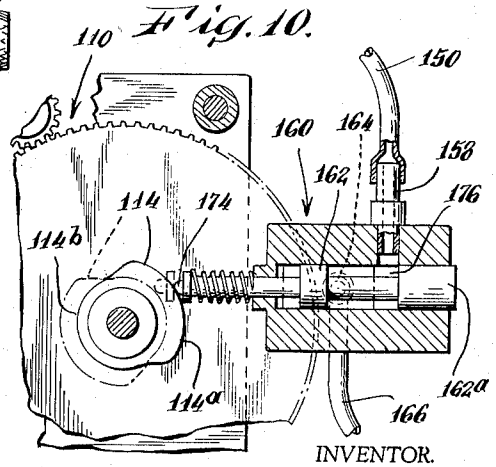


Fig. 10.



INVENTOR.

BY Jack James Gilbert

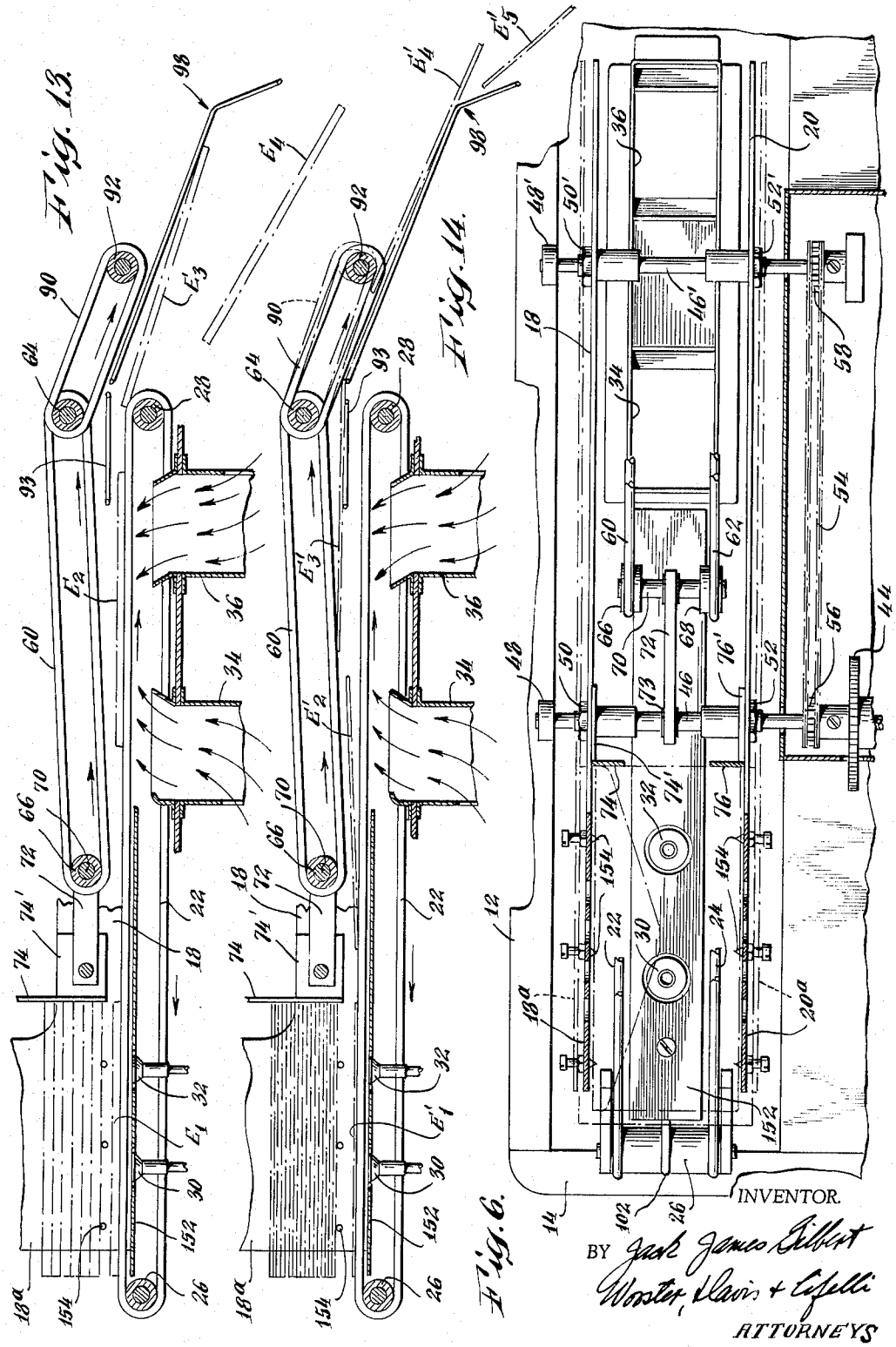
Wooster, Davis & Gilli

ATTORNEYS

Nov. 30, 1965 J. J. GILBERT 3,220,550

SEPARATING APPARATUS

Filed Feb. 27, 1963 5 Sheets-Sheet 5



INVENTOR.

BY Jack James Gilbert

Wooster, Davis & Cefelli

ATTORNEYS

United States Patent Office 3,220,550 Patented Nov. 30, 1965

3,220,550

SEPARATING APPARATUS

Jack James Gilbert, Suffern, N.Y., assignor to Howe Sound Company, New York, N.Y., a corporation of Delaware

Filed Feb. 27, 1963, Ser. No. 261,260
4 Claims. (Cl. 209—120)

This invention relates to apparatus for sorting articles in accordance with weight and, more particularly, for separating mail.

Much research time and money have been devoted to means for automating the handling of mail. This has been an important project, for both the Post Office and for private firms handling large quantities of mail. Devices have been developed for automatically stamping mail, for automatic addressing, for mechanical reading of labels, for transporting mail, and for many similar purposes. However, one area remains in which improvements should be effected. This relates to the automatic classification or sorting of mail in accordance with weight. The Post Office Department annually loses considerable money because envelopes and packages with insufficient postage pass through its hands undetected. Similar problems exist for private enterprises handling large quantities of mail. For example, banks, catalog houses, and many other commercial establishments require a device capable of rapidly and automatically handling large quantities of mail and sorting it into classifications in accordance with weight.

Accordingly, it is the primary object of this invention to provide method and apparatus for the automatic weighing of mail. Other objects are to provide such an apparatus which is fully automatic in nature, which can handle large quantities of mail in a short period, which is simple and inexpensive to operate, and which is compact and reliable.

The foregoing objects and others are achieved by means of my novel method and apparatus wherein the separation of overweight and underweight mail is accomplished by means of a controlled air flow over which the pieces of mail sequentially pass. The manner in which these objects are accomplished will be more readily understood by reference to the following description, the appended claims, and the figures of the attached drawings, wherein:

FIG. 1 illustrates an isometric view of a weighing device constructed in accordance with this invention;

FIG. 2 is a plan view of the apparatus of FIG. 1;

FIG. 3 is a front elevational view of the apparatus of FIGS. 1 and 2 with a portion of the cover cut away to show the internal construction;

FIG. 4 is an enlarged cross section taken along the line 4—4 of FIG. 2;

FIG. 5 is an enlarged cross section taken along the line 5—5 of FIG. 2;

FIG. 6 is a cross sectional view taken along the line 6—6 of FIG. 4;

FIG. 7 is a cross sectional view taken along the line 7—7 of FIG. 4;

FIG. 8 is a cross sectional view taken along the line 8—8 of FIG. 4;

FIG. 9 is a cross sectional view taken along the line 9—9 of FIG. 8;

FIG. 10 is an enlarged cross sectional view taken along the line 10—10 of FIG. 8;

FIG. 11 is an enlarged fragmentary view taken along the line 11—11 of FIG. 3;

FIG. 12 is a cross sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is a schematic illustration showing the manner in which overweight mail is handled and discharged from the apparatus;

FIG. 14 is a schematic view showing the manner in which underweight mail is handled and discharged from the apparatus, and

FIG. 15 is a cam timing chart showing the interrelationship between the actions of the vacuum cam and the feed cam.

This invention consists basically of a feeder, a transport mechanism, a weighing mechanism, and a separator which are all contained within a single apparatus. The complete apparatus is illustrated in FIG. 1 which discloses the cabinet C, storage rack R, transport mechanism T, control panel P, and discharge chute D.

In the operation of this device, the mail to be sorted is first stacked in the storage rack R which is adjustable to receive any of the commonly used envelope sizes. A feed mechanism then sequentially removes the envelopes from the bottom of the pile and places them in turn on a travelling belt. The travelling belt causes the envelopes to traverse a stream of air which has been preadjusted to lift all envelopes lighter than a given weight. The envelopes which are lifted are forced against an upper belt and are ejected from the apparatus over the top of the discharge chute D. Envelopes which are heavier than the preselected weight are discharged on the underneath side of the discharge chute D.

By reference to FIG. 2 it will be noteded that the cabinet C includes a front panel **10**, a back panel **12**, a left end panel **14** and a right end panel **16**. Along the top of the apparatus there is positioned a back rail **18**, which terminates at its left end in an upright extension **18***a* forming the back of storage rack R. Running parallel to back rail **18** but spaced therefrom is a front rail **20** which terminates at its left end in an upright extension **20***a* forming the front of the storage rack R. The rails **18**, **20** are adjustable relative to one another to accommodate mail of different sizes, as will be further explained infra. Positioned between the rails **18**, **20** and running the entire length of the device are a pair of spaced belts **22**, **24**. These may be termed the lower feed belts and are formed of a pliable material, such as rubber or plastic, having a relatively high coefficient of friction aginst paper. Belts **22**, **24** are driven from a grooved drive cylinder **26** at the left end of the apparatus and pass over a cylinder **28** at the right end. In addition, idler pulleys **29**, **31** support the belts at the discharge end of storage rack R. The movement of the upper part of these belts is from left to right as viewed in FIG. 2. Between belts **22**, **24** and within the storage rack walls **18***a*, **20***a*, there are positioned two reciprocatingly vertically movable vacuum cups **30**, **32**. Also positioned beneath and essentially between the belts **22**, **24** but nearer the right hand end of the machine are a pair of air ducts **34**, **36**. Duct **34** is the outlet from a radial blower **38** and duct **36** is the outlet from a radial blower **40**. The rotor **38***a* of blower **38** and rotor **40***a* of blower **40** are connected to a single motor **42** as is best illustrated in FIG. 4.

As previously stated, the back rail **18** and the front rail **20** are movable relative to one another so as to adjust the space between them and the space between the associated storage rack members **18***a* and **20***a* to accommodate envelopes of various sizes. This adjustment is achieved by means of the knurled wheel **44** (FIG. 7) which rotates a transversely extending shaft **46** which is rotatably supported by a standard **48** extending upwardly from the main cabinet C. The shaft **46** includes portions which are threaded in opposite directions so as to engage the oppositely threaded nuts **50**, **52** secured, respectively, to rails **18** and **20**. Accordingly, rotation of wheel **44** in one direction will cause the rails **18**, **20** to move closer together while rotation in the opposite direction will cause them to move apart. In order to provide parallelism of movement along the length of the machine, a similar ar-

rangement is provided nearer the right end of the machine where a shaft 46' (FIG. 2) is supported in a standard 48' and operates upon the two side rails in a similar fashion. Shaft 46' is rotated indirectly by the same knurled wheel 44 through the intermediary of a chain 54 encircling a drive gear 56 on shaft 46 and a driven gear 58 on shaft 46'. Positioned directly above the lower feed belts 22, 24 but spaced therefrom are upper feed belts 60, 62. The right hand end of each of upper feed belts 60, 62 is mounted for rotation in the grooved portion of a drive cylinder 64 which is positioned directly above and parallel to the cylinder 28. The left end of belt 60 encircles an idler pulley 66 and the left end of belt 62 encircles an idler pulley 68. Pulleys 66 and 68 are mounted on a common "floating" shaft 70. The construction of this shaft will be seen most clearly from FIGS. 4 and 6. Shaft 70 is mounted for rotation within the free end of a pivotally mounted support bar 72. Bar 72 is, in turn, centrally positioned on shaft 46 by means of a suitable free running rotary bearing 73. The advantage of such a construction is that the support bar 72 and the pulleys 66, 68 remain fixed relative to the lower feed belts 22, 24 when back rail 18 and front rail 20 are adjusted for various sized envelopes.

Positioned against the rails 18, 20 and at either end of the shaft 46 there are affixed upright envelope retaining means 74, 76. These are in the form of flat vertical bars having their faces in a common plane for retaining the leading edge of the envelopes within the storage rack while the bottom envelopes are selectively placed on the feed belts 20, 22. The lower portion of each of the retaining means 74, 76 terminates in a flange 74', 76' secured to a corresponding side rail 18, 20.

The mounting of the cylinders 28, 64 will be apparent from the illustration of FIGS. 11 and 12. Cylinder 64 is provided with a shaft 64' which is rotatably mounted in support members 78. On the outer end of shaft 64' there is positioned a pulley 80. Cylinder 28 is mounted directly below cylinder 64 by means of a corresponding shaft 28', also rotatably mounted in support member 78 and carrying at its outer end a pulley 82. Pulleys 80, 82 are interconnected by means of a cross-over reversing belt 84 which causes the cylinders 64 and 28 to rotate in opposite directions relative to one another. The cross-over belt 84 is protected from selft-abrasion by means of a separator 86 comprising a bar mounted on the support member 78 and having a ninety-degree bend which is inserted between the opposite sides of the cross-over belt 84. The entire mounting assembly for the belt drive mechanism is mounted within an enclosure 88 for purposes of safety and appearance.

In addition to the belts 60, 62, the cylinder 64 carries a third "ejector" belt 90 which is positioned in a groove intermediate the belts 60, 62 and extends in an opposite direction from belts 60, 62. This belt is most clearly seen in FIGS. 1–4. The right hand of ejector belt 90 is carried by a floating idler pulley 92. Floating idler 92 is rotatably mounted between a pair of supporting arms 94, 96 which are pivotally mounted alongside cylinder 64. The weight of idler 92 and arms 94, 96 causes the lower right hand end of belt 90 to bear downwardly against the discharge chute 98 which extends outwardly from the right hand end of the apparatus and is angled slightly downward. In the illustrated embodiment, the discharge chute 98 is constructed of wire and is mounted in brackets 100 so that it may be easily positioned and removed. Attached to enclosure 88 and positioned between lower feed belts 22 and 24 and upper feed belts 60 and 62 is a separator 93 having a pointed end, as shown in FIG. 2, which extends toward the center of the apparatus and is constructed of wire to allow air passage therethrough.

It will now be noted that all of belts 22, 24, 60, 62 and 90 are interrelated and rotate simultaneously. As the upper halves of belts 22, 24 move from left to right as seen in FIG. 4, the lower halves of belts 60, 62 also move from left to right due to the action of the crossover belt 84. Furthermore, the bottom half of the ejector belt 90 will also move from left to right over the discharge chute 98. The entire belt assembly is driven by a single drive belt 102 which is centrally mounted on cylinder 26 intermediate lower belts 22, 24. Belt 102 is driven by means of conventional speed-reducing pulleys 104, 104', and a belt 106 from main drive motor 108 (FIGS. 3 and 9).

Motor 108 not only drives the belt 102 and the feed belts, but also drives a gear train, generally denominated 110 in FIG. 8, from the shaft 105 which is common to pulleys 104, 104'. To the output of gear train 110 there are mounted two cams. One such cam 112 (FIG. 9) is the feed actuating cam and the other cam 114 is the vacuum control cam. Feed actuating cam 112 bears against cam roller 115 of a feed actuating crank 116 rotatably mounted on a pivot 118. The cam roller 115 is urged against cam 112 by means of a coil spring 120 extending between a first stud 122 mounted on the housing of gear train 110 and a second stud 124 mounted on the crank 116. The oscillating rotary motion imparted to crank 116 by means of feed actuating cam 112 is converted to a vertical oscillatory motion by spring-loaded crank pin 126 which is pivotally connected at one end to crank 116 and by the other end to vertical piston 128.

Piston 128 is vertically slidable within a cylinder 130 which is fixedly mounted on a support bracket 132 held by means of bolts 134 and cylindrical spacers 136. The upper end of piston 128 terminates in a vacuum manifold block 138. An alignment pin 140 is affixed to the block 138 and extends downwardly through an opening in the support bracket 132. The manifold block 138 includes a central manifold passage 142 which is closed at each end and communicates with a first vacuum tube 144 which terminates in the vacuum cup 30, and a second vacuum tube 146 which terminates in the vacuum cup 32. A nipple 148 also communicates with passage 142 and connects the manifold to a vacuum hose 150.

It will be observed that rotation of cam 112 will cause a corresponding vertical displacement of the end of the feed actuating crank 116 which is converted to vertical oscillatory motion of the vacuum manifold block 138 and its connected vacuum cups 30, 32. The illustration of FIG. 9 shows the manifold and vacuum cups in the raised position with the cups in contact with a stack of envelopes shown by dashed and dotted lines. The illustrations of FIGS. 8 and 4 show the cups in the lowered position. When in the lowered position the vacuum cups are substantially flush with a cover plate 152 which extends between the belts, as illustrated in FIG. 8, and is provided with suitable openings for the vertical movement of the vacuum cups 30, 32. An additional feature of this invention is the provision of projecting support pins 154 which extend into the envelope storage space through holes in the storage rack sides 18*a*, 20*a*. Pins 154 have pointed ends and are secured by means of lock nuts 156 so as to project inwardly by a fixed but variable amount. The edges of the lower envelopes of the stack rest on these projecting pins and the stack is thereby supported above the belts 22, 24.

The vacuum hose 150 is connected with the inlet 158 of a standard piston valve 160 having a spring-loaded piston 162 controlled by the movements of vacuum-control cam 114 as is best illustrated in FIG. 10. The outlet port 164 of the valve 160 is connected by means of hose 166 to a vacuum pump 168 of standard design which is operated via belt 170 from motor 108. The vacuum pump 168 includes a trap and filter unit 172 on the intake side and a similar unit on the discharge side. The valve 160 is of the on-off type. In the position illustrated in FIG. 10 the spring-loaded cam rider 174 has been forced to its extreme right hand position by engagement with the cam surface portion 114*a*. In this position, the valve 160 is open and hose 166 communicates with the inlet 158

through the annular opening **176** around the central valve stem. As the cam continues to rotate, the cam rider **174** will reach the low portion **114***b* of the cam periphery and be at its extreme left hand position. When this is reached, the valve **160** is closed by reason of the piston **162***a* covering the port to inlet **158**.

As has been previously explained, the blowers **38**, **40** are of the radial type and are driven by a single motor **42** which is positioned between them, as illustrated in FIG. 4. Blowers of this type induct air along their central axes and the air is discharged radially outward by the action of the vanes on rotors **38***a* and **40***a*. The output air then passes through air ducts **34**, **36**. The air flow of these blowers is controlled by means of a pair of intake dampers **178**, **180** which are generally circular in shape but provided at their lower ends with extensions **178'**, **180'**, which are fixedly secured to a common shaft **182**. Shaft **182** is rotatably mounted in bearing blocks **184**, **186** at either end. One end of the shaft extends through bearing block **186** and has affixed to it a sector gear **188** best illustrated in FIG. 7. The sector gear **188** is positioned between a pair of brackets **190** which support a worm gear **192** which meshes with the sector gear **188** and is driven through a sprocket **194** by a chain **196**. The chain is actuated by a drive sprocket **198** which in turn is controlled by a knob **200** mounted on the panel P of the apparatus. Rotation of knob **200** is transmitted through the chain drive and the worm and sector gear and converted into arcuate rotation of the two dampers **178**, **180** before the inlet openings of the blowers. This is illustrated in FIG. 7 wherein the damper is illustrated at **178** in its closed position and at **178'** in a partially open position. To complete the description of the apparatus of the invention, it will be noted that an electrical switch **202** and a corresponding pilot light **204** are mounted on the instrument housing for controlling the motor **108** and a corresponding switch **206** and pilot light **208** control the operation of the blowers **38**, **40**. The wiring of the switches, motors, and pilot lights is conventional and is not illustrated. Power may be supplied by means of an electrical cord **210** (FIG. 2).

The operation of the invention may best be understood by considering the weighing of a number of envelopes of a given size but varying weights. This problem might be faced, for example, by a bank preparing its periodic mailing of cancelled checks and deposit account statements to its depositors. The first consideration of the operator is to adjust the distance between the railings to accommodate the envelopes to be used. This is accomplished by rotating the knurled wheel **44** until the distance between the rails and between the sides of the storage rack is sufficient to just accommodate the envelope size being employed. After this has been accomplished a number of envelopes may be placed in the storage rack between sides **18***a* and **20***a*. The lowermost envelope in the stack will rest upon the conical ends of the support pins **154**.

The blowed motor **42** may now be started by actuating switch **206**. The air flow from blowers **38** and **40** is then adjusted by means of the knob **200** which controls the position of the input dampers **178**, **180**. The position of the dampers for various air flows and thus variout weights may be predetermined and marked on the instrument to indicate the proper setting without trial and error. With the proper air flow achieved from ducts **34**, **36**, switch **202** is actuated to start motor **108**.

Motor **108** performs a number of important functions. To begin with, this motor drives the feed belts **22**, **24**, **60**, **62** and the ejector belt **90**. As motor **108** begins to operate, each of theses belts begins to move in the directions indicated in FIGS. 13 and 14. It will be noted that the upper portions of belts **22**, **24** move from left to right as do the lower portions of belts **60**, **62**, and **90**. The second important function of motor **108** is to operate the vacuum pump **168** so as to form a vacuum at the outlet port **164** of valve **160**. The third and fourth important functions of motor **108** are to actuate the cams **112**, **114** which respectively control the mechanical movements of the feed mechanism and also the vacuum applied to the vacuum cups **30**, **32**. Assuming that the cycle begins with vacuum cups **30**, **32** in the downward position, as illustrated in FIG. 8 and FIG. 4, reference to the timing chart of FIG. 15 will show that the first action to occur is for the cam **112** to begin raising the vacuum manifold **138** and the connected vacuum cups **30**, **32**. When cups **30**, **32** are within approximately one-quarter inch of the lowermost envelope, cam **114** opens valve **160** so as to connect the vacuum cups **30**, **32** through the passage **142** to the source of vacuum. The cups then begin to descend, pulling with them the lowermost envelope past the projecting pins **154**. Pins **154** allow this envelope to pass, but separate it from the remainder of the stack which they continue to support. As the vacuum cups **30**, **32** approach their lower position, the vacuum is released by operation of the vacuum valve **160** so that the envelope is freed to travel on the lower feed belts **22**, **24**. A relatively heavy envelope is shown in the initial position E_1 in the schematic illustration of FIG. 13. As the belts **22**, **24** continue to move to the right, they carry with it the envelope which soon reaches position E_2 directly above the converging air streams from air ducts **34**, **36**. However, this envelope is heavier than the preselected weight, so that it is not lifted by the air flow but passes beneath separator **93** and leaves the apparatus on the underneath side of the discharge chute **98**, as illustrated in positions E_3 and E_4.

Assume now that a lightweight envelope passes through the apparatus. This is illustrated in FIG. 14. The feed operates in the same manner as just described and the envelope successively passes from poition E_1' to position E_2' where it begins to be lifted by the air flow from ducts **34**, **36**. As the envelope rises, it contacts the underneath side of upper feed belts **60**, **62** which continually force the envelope to the right until it has reached position E_3'. At this point, the ejector belt **90** which lies on the upper surface of discharge chute **98** ejects the envelope over the top of discharge chute **98**, as illustrated in positions E_4' and E_5'.

It will be readily apparent that the selection between heavy and light envelopes occurs as the result of the amount of air flow passing out of ducts **34**, **36**. This is set by the position of knob **200**. Accordingly, the illustrated and described apparatus is capable of separating a large number of envelopes into those which exceed and those which are less than a predetermined weight. These are segregated and may be, for example, deposited in different containers. Alternatively, it would be possible to cascade a number of such weighing devices in series so that plural separations could be made. For example, all heavy mail could go to additional machines which would make a second, a third, and as many other separations as might be desired to separate them into weight classifications.

It will be readily apparent to those skilled in the art that the machine of this invention possesses a number of attractive and useful features. It is simple in operation, is small and compact, and is highly reliable. Furthermore, the machine is capable of automatically feeding and weighing envelopes at rates in excess of 4000 an hour. The advantages of such a device will be readily apparent. While the air flow and weights to be separated will vary widely from one application to another, it has been discovered that an airflow of 380 cubic feet per minute is sufficient to provide separation between envelopes greater than and less than four ounces in weight.

The apparatus of this invention will be seen to be highly useful in the handling of mail and equivalent items. Also, the device may be employed as one unit in automated handling systems which might include mechanical devices for performing other tasks required in the preparation and handling of such items.

Many variations and modifications will be apparent to those skilled in the art. Accordingly, the foregoing description is to be construed as illustrative only, rather than limiting. The invention is limited only by the scope of the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Automatic mail weighing apparatus which comprises: a pair of horizontally spaced first feed belts arranged to transport individual pieces of mail from a first location to a second location; a pair of horizontally spaced second feed belts positioned substantially parallel with and above said first feed belts and arranged to move in the direction toward said second location; first and second radial air blowers positioned beneath said pair of first feed belts and adapted to blow air upwardly therethrough and against said pair of second feed belts, said blowers having axial air intakes and a common power source; first and second damper plates mounted in parallel planes and affixed to a common shaft for arcuate rotation therewith; bearing means supporting said shaft; and control means for selectively rotatably positioning said shaft to thereby position said first and second plates relative to the air intakes of the respective first and second blowers.

2. The method of conveying a stream of articles of unknown weight along a first path from a source of said articles to a separating station; directing an air blast of

predetermined force upwardly against said articles; lifting those articles below a preselected weight vertically at least above a preselected reference plane; causing those articles of a weight greater than said predetermined weight to pass beneath said preselected reference plane thereby separating those articles above said plane from those below said plane; conveying all articles passing below said reference plane along a path to a first collection point; and conveying all articles passing above said reference plane along a path to a second collection point.

3. The method of claim 2 wherein the force of said air blast is selectively adjustable.

4. The method of claim 2 wherein said articles are successively removed from a storage location prior to traversing said first path.

References Cited by the Examiner

UNITED STATES PATENTS

2,168,419	8/1939	Paterson	198—20
2,261,970	11/1941	Matthews.	
2,643,120	6/1953	Jackson	271—32
2,991,893	7/1961	Kirsch.	

ROBERT B. REEVES, *Primary Examiner.*

SAMUEL F. COLEMAN, *Examiner.*