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McAlister

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[54] **PNEUMATIC MULTI-STATION REMOTE CONTROLLED SWITCHING STATION**

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[52] **U.S. Cl.** **193/23**

[51] **Int. Cl.** **B65g 11/00**

[58] **Field of Search** ..... 222/482; 209/74, 139; 193/23, 29, 31 R, 31 A

[56] **References Cited**

UNITED STATES PATENTS

647,749	4/1900	Hell	193/23
716,087	12/1902	Nicolay	193/23
1,413,505	4/1922	Stump	193/23
3,557,924	1/1971	Schlagel, Jr.	193/23

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[57] **ABSTRACT**

A remote controlled switching station permits selection of one output chute from a number of output chutes without excessive wear on sealing members during transfer of input chute to the selected output chute. Motor driven plates are separated from each other during rotation for frictionless movement. After selection, the system is automatically sealed to a fluid-tight condition.

11 Claims, 3 Drawing Figures

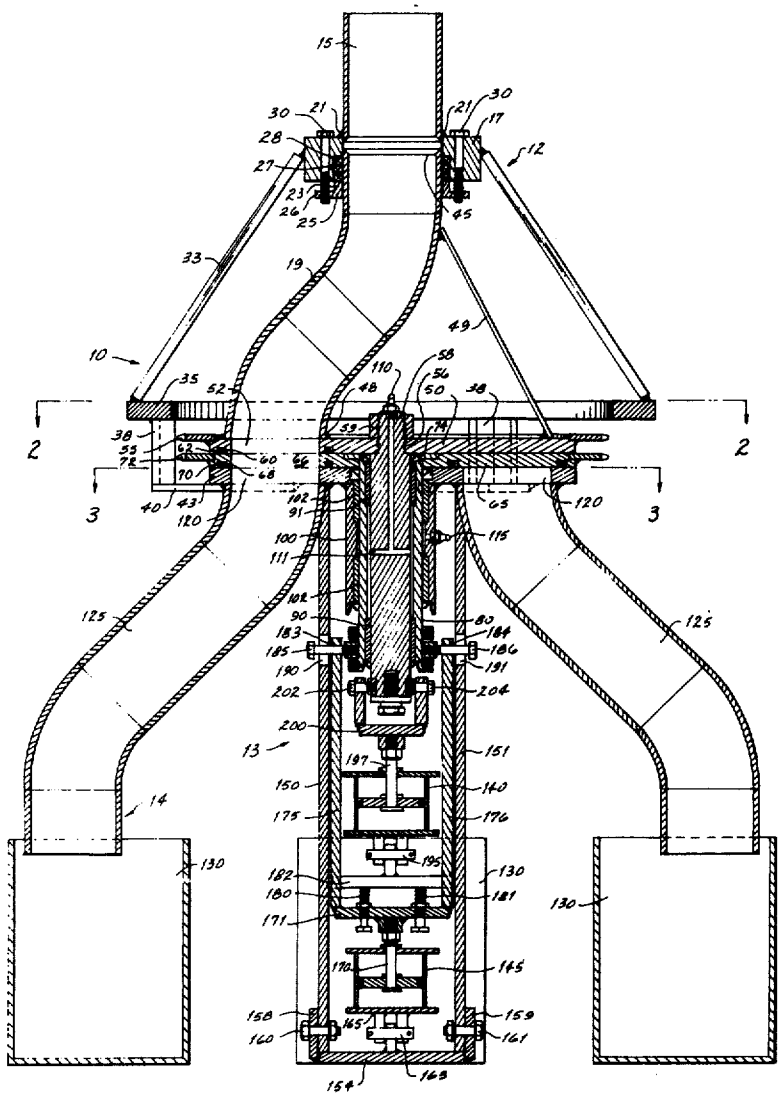


Fig. 1

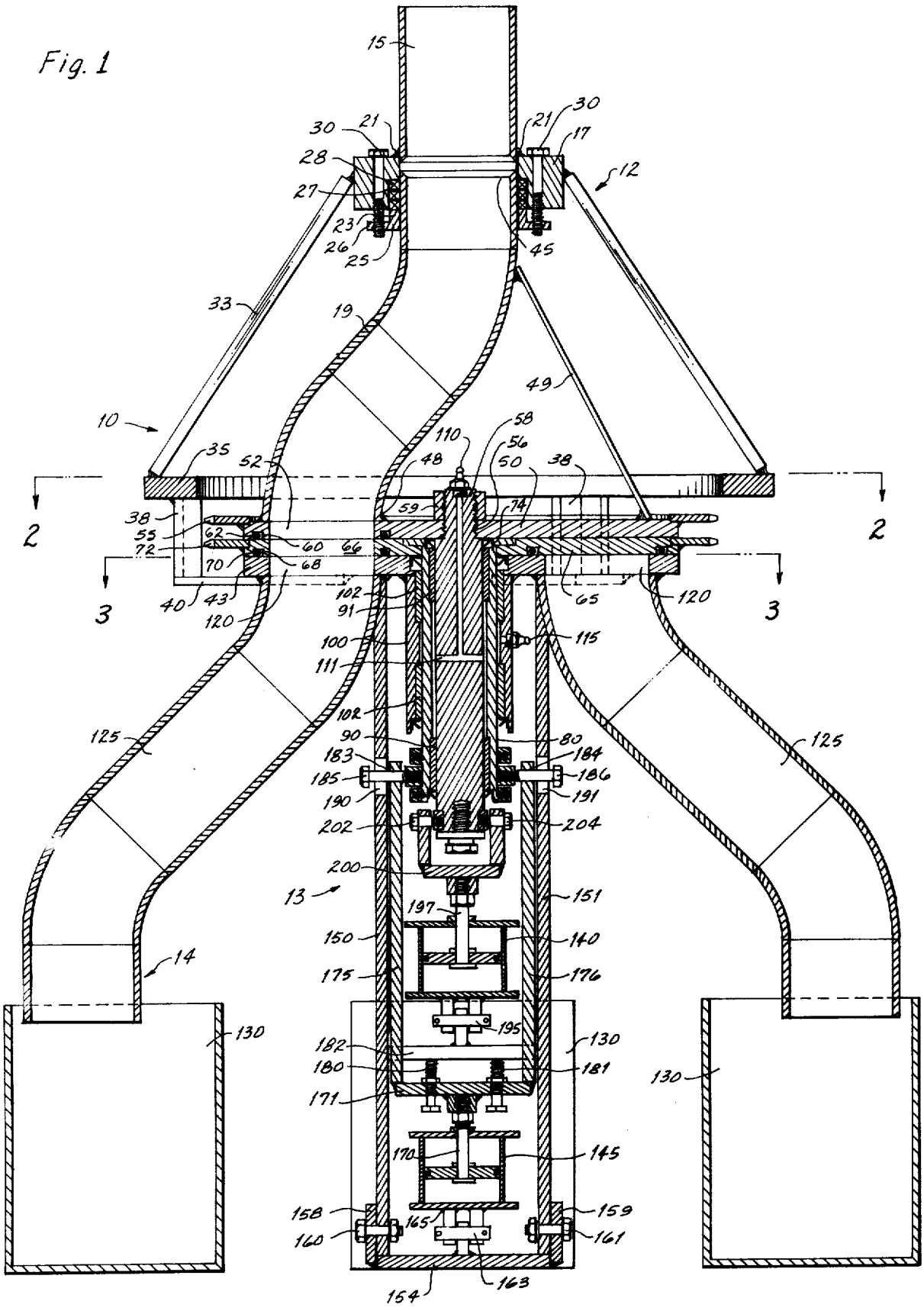

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Fig. 2

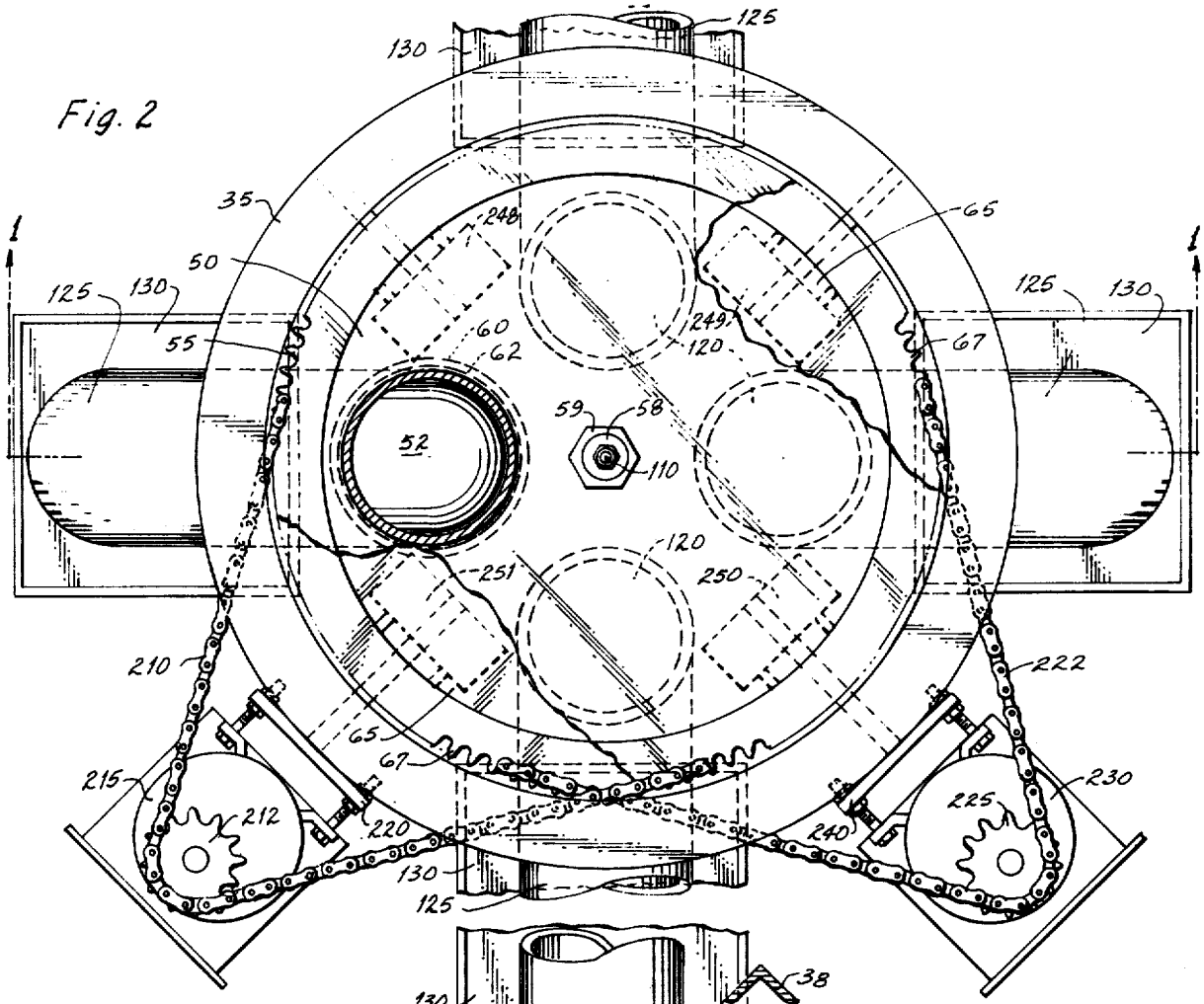
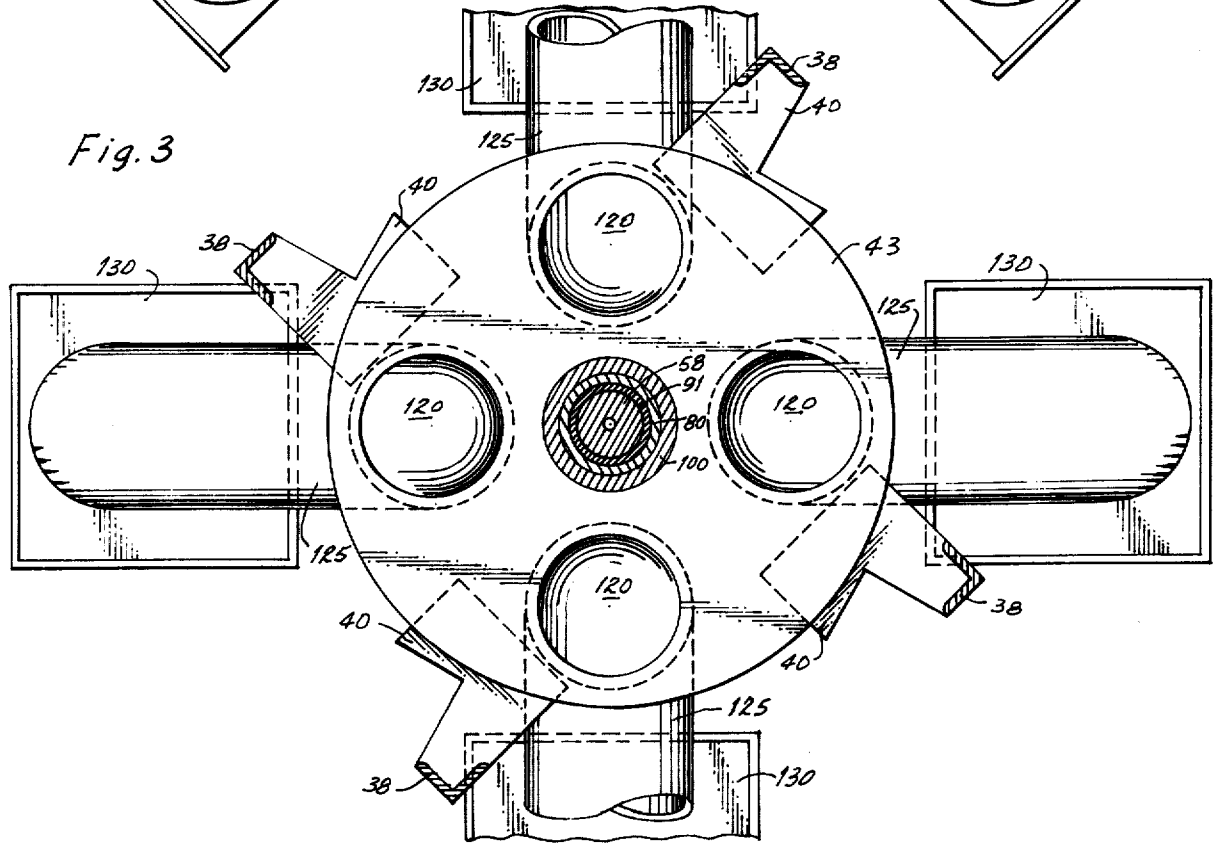

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65
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Fig. 3


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PNEUMATIC MULTI-STATION REMOTE CONTROLLED SWITCHING STATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is to be used most commonly in the field of transfer of particles of limited range of sizes from an air classifier to a selected receptacle, using air as a means of particle movement.

2. Background of the Invention

Air classifiers of the type shown in U.S. Pat. Nos. 3,384,238 and 3,615,009, now assigned to The Georgia Marble Company, have been found to be very useful in selecting particles within a very limited size range and rejecting particles having sizes above and below the selected range. For example, for certain applications, it has been found that calcium carbonate particles in a size range of between 40 microns and 1 micron are particularly suitable as extender pigments for use in paint, rubber, putties, and latex compounds. The output of the classifier is put into drums. However, it is necessary to insure that only particles of the selected sizes are transferred to the drums or containers for shipment. Since other ranges of sizes can be selected by the same classifier, it becomes necessary to insure that only particles of the selected sizes are put into the containers. As the same apparatus may be used to package particles of different size ranges, it becomes necessary to flush out the tubes. Furthermore, there is a need for an apparatus which will be easily switched from one packaging station to another with a minimum of difficulty. Additionally, since the particles may be dusty, it is well to have a sealed pneumatic system during particle movement.

SUMMARY OF THE INVENTION

The invention covers a remote controlled switching station for particle movement in which certain output chutes may be selected by rotational movement of selector plates.

It is, therefore, an object of the present invention to provide a novel switching station which can easily transfer airborne particles from a source to a selected one of several output chutes.

It is another object of the present invention to provide a novel switching station in which an input chute can be changed to any one of several output chutes with a minimum of friction and wear on sealing members.

It is yet another object of the invention to provide a novel switching station which is fluid tight during particle movement.

Other objects and advantages of the present invention will become apparent from the following discussion taken in conjunction with the accompanying drawings in which like numerals indicate like elements and in which:

FIG. 1 is a cross-sectional view of the remoted controlled switching station of the present invention, except for certain parts which will be added in subsequent figures.

FIG. 2 is a top view of a portion of the remote controlled switching station of the invention taken along line 2—2 of FIG. 1 with certain operating features added; and

FIG. 3 is a top view of a portion of the remote controlled switching station of the invention taken along line 3—3 of FIG. 1.

Referring now to FIG. 1, there is shown in cross-section a portion of the novel switching station **10** of the invention having an upper input section, generally indicated at **12**, a control section, generally indicated as **13**, and an output section generally indicated as **14**.

Input section **12** acts to receive particulate matter from a source (not shown) which may be an air separator or classifier, as hereinbefore discussed. The upper portion of input section **12** comprises an input chute **15** which may be a sheet metal cylinder or 4 inches standard cast iron pipe. The lower end of chute **15** is encased in a steel packing gland stuffing box **17** which forms an air-tight seal between the lower end of chute **15** and the upper end of a sinuous shaped tube or pipe **19**. The packing gland stuffing box **17** is welded to the lower end of chute **15**, as at **21** to prevent movement or rotation of chute **15** with respect to the rest of the apparatus. To complete the sealing arrangement, a steel packing gland **23** in the form of a collar **25** with a peripheral outwardly extending flange **26** has its collar **25** received within a recessed lower portion **27** of stuffing box **17**. Packing gland rings **28** of square braided packing material are inserted in recess **27** and compressed by collar **25**. Bolts **30** connect collar **25** and stuffing box **17** to compress packing rings **28**.

To support upper section **10**, a series of four steel flat bars **33** (only **2** of which are shown) are welded to stuffing box **17** and to a support ring **35**. Support ring **35** is rigidly secured by angle plates **38** to steel plates **40**. Plates **40** are welded to the underside of an outside flange **43**. The entire upper section **10** of the multi-station remote controlled switching station is thus rigidly held in place and supported on a base (not shown) by steel support beams (not shown) connected vertically to steel plates **40** and to a base or foundation (not shown).

Rotatable pipe or chute **19** has its upper end **45** spaced a short distance (about three-eights inch) from the lower end of input chute **15** within the confines of packing gland box **17**. The upper end **45** of chute **19** is cylindrical with its rotational axis along the central vertical axis of the switching station. The lower end **48** of chute **19** is displaced from the centerline by virtue of the sinuous turns of chute **19** and is welded to the upper surface of a circular plate **50**. A brace rod or bracket **49** for rigidity and support of tube **19** is welded to tube **19** at its upper end and to plate **50** at its lower end. Plate **50** has a circular aperture **52** aligned with the opening in lower end **48** of chute **19**. The outer rim of plate **50** has a series of teeth **55** protruding outwardly around its periphery to form a sprocket which can be rotated by a chain, as will be described hereinafter. The center of plate **50** has an opening **56** which is internally threaded to be attached to a threaded protruding reduced end of a rotatable steel center shaft **58**. A hex nut **59** is screwed on the protruding threaded end of center shaft **58** to secure plate **50** thereto.

The underside of plate **50** has a circular groove **60** which surrounds aperture **52** to receive an O-ring **62**. O-ring **62** may be of rubber or other elastomeric material and is slightly thicker than the depth of groove **60** so that it will provide an air-tight seal around aperture **52** where pressed against a plate **65** lying in registration below plate **50**. Plate **65** is similar to plate **50** in that it

has a circular aperture **66** which can be placed in registration with aperture **52** of plate **50** when suitably rotated into position. For reasons to be discussed later, plate **65** also has four grooves **68** cut into its lower face and spaced symmetrically with respect to the centerline of plate **65**. Thus, the grooves **68** are on lines placed at right angles to each other. One of the grooves **68** surrounds aperture **66**. The grooves **68** have a diameter slightly greater than that of aperture **66**. O-rings **70** are inserted into grooves **68** and are of such thickness as to extend slightly outwardly of their respective grooves. The outer peripheral rim of plate **65** has a series of teeth **72** protruding outwardly therefrom in spaced relationship to form a sprocket which can be rotated by a chain. The center of plate **65** has an opening **74** which is larger than aperture **56** of plate **50**. Plate **65** near the inner edge of opening **74** is secured to an intermediate hollow tubular shaft **80**. Hollow shaft **80** is tubular and surrounds center shaft **58** so that center shaft **58** and intermediate shaft **80** can rotate independently of each other, a pair of annular bronze bushings **90** and **91** are placed between shafts **58** and **80** at each end of shaft **80**. Shaft **80** has annular recesses along short portions of each of its ends to receive bushings **90** and **91**.

An outside tubular shaft **100** is welded at its upper edge to the inner lower face of plate **43**. Tubular shaft **100** surrounds intermediate shaft **80** along most of the length of shaft **80** but is separated therefrom by annular bronze bushings **102**. Thus, while tubular shaft **100** is fixed against rotation, intermediate hollow shaft **80** is free to rotate and permits rotation of plate **65** to which it is fixed.

To permit lubrication of the shafts to avoid frictional binding, a zerk fitting **110** is attached to the upper end of central shaft **58** which has a drilled center bore and cross-drilled passageway **111**. Since the diameter of center shaft **58** is slightly less than that of intermediate tubular shaft **80**, lubricating fluid can flow between the two shafts. In like manner, a zerk fitting **115** is tapped into the side of outside tubular shaft **100** to feed lubricant into the area between shaft **100** and the outside surface of intermediate shaft **80**. Suitable grease seals are located at each end of bushings **90**, **91** and **102** in a well-known manner.

Referring now to plate **43**, which, as previously explained, is secured by welding to plates **40** and thence to the frame supporting the upper section **10** of the switching station, plate **43** forms the upper fixed terminal for lower section **14** of the station. Plate **43** is circular and approximately the same diameter as plates **50** and **65**. Plate **43** has four apertures **120** spaced at 90° intervals from each other and at locations such that aperture **52** of plate **50** and aperture **66** of plate **65** can all be brought into alignment with each other and with one of the apertures **120** of plate **43**. Each aperture **120** of plate **43** forms the opening for the upper end of an output chute **125**. There are four output chutes **125**, one corresponding to each aperture **120** of plate **43**. Chutes **125** may be pipes or tubes of 4 inches diameter, and are secured in air-tight fashion by welding to the underside of plate **43** surrounding aperture **120**. As can be seen for convenience, chutes **125** are also sinuous in shape and extend away from the centerline of the station. If desired, bins or sacks **130**, capable of receiving the particulate output of the switching station, may be placed at the open extremities of chutes **125**.

It will be recalled that plates **50** and **65** are rotatable relative to each other and to the fixed plate **43**. It should be realized that mere rotation of the plates **50** and **65** not only would destroy O-rings **62** and **70** by frictional rotation, but also could result in severely damaging the O-rings as they move across the sharp edges of the openings **52** and **66**. In addition, the O-rings **62** and **70** could roll out of their respective grooves as they pass over the openings **52** and **66** and cause binding of the apparatus.

To avoid these problems provision is made for axially moving shafts **58** and **80** which carry plates **50** and **65** respectively. An air operated cylinder **140** is connected to center shaft **58** to move it upwardly and with it, plate **50**, out of sealing contact with plate **65**. A second air cylinder **145** is connected to intermediate hollow shaft **80** to move it upwardly and with it, plate **65**, out of contact with both plate **50** and base plate **43**. When both air cylinders are operated, plates **50** and **65** are held out of contact with each other. The reason for the small gap between the upper edge of chute **19** and the lower edge of chute **15** is now apparent. When plate **50** is moved upwardly, the upper edge of chute **19** is also moved upwardly within the packing box **17**.

The mechanical connection of air cylinders **140** and **145** will now be described. Two steel bars **150** and **151** are welded to the underside of plate **43** and extend downwardly in spaced parallel relation to each other to enclose air cylinders **140** and **145**. A U-shaped closure plate **154**, having upwardly extending flanges **158**, **159**, is secured to the lower ends of plates **150** and **151** by bolts **160** and nuts **161**. Air cylinder **145** is secured to plate **154** by a clevis **163** welded to plate **154** and connected to air cylinder **145** at **165**.

Air cylinder **145** has a central operating plunger **170** which is connected to a bar **171**. Bar **171** is welded to two bars **175** and **176** which extend forwardly inside bars **150** and **151**. Adjustable bolts **180** and **181** are threaded through bar **171** to provide a means for limiting the amount of forward travel of plunger **170**. The leading ends of bolts **180** and **181** strike bar **182** which is fixed by welding or the like to outer bars **150** and **151**. Bar **182** has recesses cut in its upper area to permit free vertical movement of bars **175** and **176**. The free ends of bars **175** and **176** have holes **183** and **184** therein to receive bolts **185** and **186** which are secured to the outer surface of intermediate hollow shaft **80**. Elongated slots **190** and **191** are cut in steel bars **150** and **151** to permit axial vertical movement of bolts **184** and **185**, and axial vertical movement of intermediate hollow shaft **80**.

Thus, while air cylinder **145** is secured at its remote end by clevis **163** to plate **154**, cylinder **145** through its plunger **170** can move intermediate hollow shaft **80** longitudinally vertically forwardly or rearwardly. It will be recalled that intermediate shaft **80** is connected to cylindrical plate **65** so that the latter can be moved forward out of frictional engagement with outside fixed flange **43**. In order to provide frictionless clearance for O-rings **70**, it has been found that a distance of about one-sixteenth inch for the forward movement of plunger **170** and hence, plate **50** is suitable.

In like manner, air cylinder **140** is connected to the inner shaft **58** which in turn is connected to circular plate **50** to move it forward about twice the distance of movement of plate **65** or about one-eighth inch.

More specifically, air cylinder **140** is secured to bar **182** by a clevis **195.** The operating plunger **197** of cylinder **140** is connected to inner shaft **58** by a U-shaped bracket **200** and bolts **202** and **204** which extend through holes drilled in bracket **200** into threaded holes in inner shaft **58.**

That portion of the apparatus of the invention which provides for axial separation of plates **50** and **65** from each other and plate **65** from fixed outside flange **43,** and the sealing of the plates when in contact has been described. The apparatus and manner of rotation of the plates **50** and **65** to shift end **48** of tube **19** between input chute **15** and a selected one of output chutes **125** will now be described with reference to FIGS. **2** and **3.**

FIG. **2** illustrates a top view of the apparatus taken along line 2—2 of FIG. **1** and shows upper circular plate **50** which has spaced teeth **55** mounted on an inner shaft **58.** A chain drive **210** connects the outer rim of plate **50** to the sprocket wheel **212** attached for rotational movement to the shaft of a motor **215.** Motor **215** is secured to support ring **35** by means of a support bracket assembly **220.** Aperture **52** can be seen in plate **50.** On the underside of plate **50** and surrounding aperture **52** is groove **60** with O-ring **62.**

Energization of motor **215** will cause plate **50** to rotate around its axis and move aperture **52** in a circular path to overlie one of the openings **120** of output chutes **125.**

In like manner, lower plate **65** has its teeth **67** engaging a chain drive **222** which in turn engages a sprocket wheel **225** connected to the shaft of a motor **230.** A bracket assembly **240** secures motor **230** to support ring **35.** Energization of motor **230** rotates plate **65** so that its aperture **66** is in registration with aperture **52** of plate **50** and with one the openings **120** of output chutes **125.**

Eight limit switches in four housings **248, 249, 250,** and **251** are spaced at 90° intervals around the interior of support ring **35.** These limit switches may be Cutler Hammer No. 10316H2372G limit switches with adjustable levers. The purpose of the limit switches is to assure alignment of apertures **52, 66** and **120** to provide an open path from input to output through the pipes **19** and **125** in a manner to be explained later.

FIG. **3** shows the outer or bottom plate **43** in greater detail with four apertures **120** leading to four output chutes **125.** Angle plates **38** (shown in cross-section) are welded to plates **40** which in turn are welded to the underside of plate **43.**

The operation of the pneumatic remote controlled switching station of the invention will now be described in conjunction with an electrical actuating system which is not shown in detail to avoid overcomplication of the disclosure. However, it should be understood that the electric motors **215** and **230,** and limit switches **248–251** are interconnected for related operation. The limit switches perform their function of stopping energization of the motor and hence rotation of the plates **50** and **65** so that the apertures **52, 62** and **120** can be aligned for any selected one of the four output chutes **125.** Air cylinders **140** and **145** are energized by an electro-pneumatic system (not shown).

The various functions can be controlled either by a sequential timing mechanism or by the limit switches which control an electrically activated control system. The sequential timing system can be patterned after one which controls the operation of a washing machine in that a constant speed timing control rod is made to rotate upon closure of a start switch. A threaded cam rides along the threaded rod and closes relay contacts as it proceeds along the rod. Closure of the relay contacts controls the operation of the motors and electro-pneumatic air cylinders in a preset sequence of operation so that the two plates **50** and **65** are moved out of contact with each other for frictionless rotation to move input tube **19** to a preselected output tube **125** and to permit alignment of apertures **52** and **66** of plates **50** and **65** respectively.

In order to monitor the operation of the station and to recognize which of the output chutes is connected to the input chute, pilot lights can be installed in the electrical system which will indicate which output chute is in operative connection to the input chute.

It will be assumed that the pneumatic multi-station remote controlled switching station is in the operating condition shown in FIG. **1.** That is, there is an open path from the input chute or tube **15** through sinuous tube **19,** thence, through apertures **52, 66** and **120** of plates **50, 65** and **43,** respectively, and through output chute or tube **125** into container **130.** If it is desired to shift the flow of particulate matter away from the container **130** on the left-hand side of FIG. **1** to the container **130** on the right-hand side of FIG. **1,** the following sequence of operations is used:

1. A start button (not shown) is operated to initiate the desired change. Generally, this will be a time-delay switch so that there will be a period of between one and five minutes for the system to purge itself before the switch operation begins.

2. In a timed sequence, air cylinders **140** and **145** are operated. Operation of cylinder **145** moves intermediate shaft **80** upwardly to lift circular plate **65** away from its contact with plate **43.** As previously discussed, the distance between the two plates is approximately one-sixteenth inch.

3. Simultaneously, air cylinder **140** moves inner shaft **58** upwardly a distance of about one-eighth inch so that plate **50** is now free of contact with plate **65.** Thus, both plates **50** and **65** are free of engagement with each other and with outside base plate **43.** Motor **230** is then energized and by its rotation through chain **222** causes plate **65** to rotate around its axis, aligning its aperture **52** with the next available opening **120** in base plate **43.** One of the limit switches of the group **248–251** will sense the alignment of aperture **66** and **120** and cause motor **230** to stop.

4. Following this, motor **215** will be energized and, through chain **210,** will rotate plate **50** about its axis until aperture **52** is in alignment with aperture **66** of plate **65.** Again, the appropriate limit switch will sense the proper alignment of the apertures and stop further rotation of motor **215.**

5. Following this, air cylinders **140** and **145** are deenergized so that plates **50** and **65** are again in contact with each other and with base plate **43.** Air cylinders **140** and **145** are double acting so that extension and retraction of their operating rods is positive in action.

6. Rotation of plate **65** has caused the lower end of chute **19** now to be brought in alignment with the upper end of chute **125** at the right-hand side of FIG. **1** and with aperture **66** in plate **65.**

In this way, the switching station now has changed so that there is an open pathway between input chute **15** and output chute **125** at the right-hand side of FIG. **1.**

At this time particulate matter of a different size range from that previously collected will be diverted into the container **130** at the right-hand side of FIG. **1**. When plates **50** and **65** are in their close position, sealing O-rings **52** and **70** are operative to form a fluid-tight passageway from input to output.

It will be recognized that while there are four output chutes **125** shown, that more or less can be included without departing from the scope of the invention.

It will be recalled that plate **65** has four sets of grooves **68** with an O-ring **70** in each groove. When plate **65** is held against outside plate **43**, the O-rings **70** surround each of the upper openings **120** in plate **43** to seal the upper openings in chutes **125**.

It should also be recognized that while chute **15** has been characterized as an input chute and chutes **125** as output chutes, the operation of the mechanism will be exactly as described if chutes **125** are considered to be input chutes and chute **15** an output chute. In this reversed condition, the essential operation of the station is not affected.

In summary, there has been described a pneumatic multi-station remote controlled switch station which permits frictionless selection of output chutes in an automatic manner.

I claim:

1. A station for connecting an input chute to a selected one of a plurality of output chutes, comprising:

an input chute having a discharge end and a plurality of output chutes,

a first rotatable plate connected to said input chute, said plate having an aperture in sealed registration with said discharge end of said input chute,

means for rotating said first plate,

a second rotatable plate lying in concentric relation with said first plate and having an aperture therein adapted to be in sealed registration with said aperture of said first plate,

means connected to said second plate for rotating said second plate,

a fixed outside flange plate having a plurality of openings, each of said openings being the input end of one of said plurality of output chutes,

means connected to said first and second plates for axial movement thereof away from each other and from said outside flange plate to align said apertures of said first and second plate with said opening in said outside flange plate,

said last named means adapted to axially move said first and second plates into sealed contact with each other and with said outside flange plate.

2. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **1**, in which said station has an input section, said input section comprising a fixed input chute and a vertically moveable input chute and an air-tight seal connecting said fixed input chute and said vertically moveable input chute whereby said vertically moveable chute can be displaced relative to said fixed chute while an air-tight seal is maintained.

3. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **1**, in which said means for rotating each of said plates comprises outwardly extending teeth equidistantly spaced around the periphery of each of said plates, a pair of sprocket wheels, a pair of motors, each of said motors energizable to rotate a corresponding one of said sprocket wheels and a pair of endless chains, each of said motors interconnecting a respective one of said plates and said sprocket wheels.

4. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **1**, in which said first and second plates have circular grooves cut in a lower surface of each plate surrounding said aperture in said plates, and sealing O-rings inserted into said grooves.

5. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **2**, in which said second rotatable plate has additional circular grooves cut into its lower surface and O-rings inserted into said grooves.

6. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **5**, in which the total number of grooves cut into the underside of said second plate equals the number of chutes of said plurality of output chutes and in which each of said grooves is in sealing registration with a corresponding one of said output chutes.

7. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **1**, in which said means connected to said first and second plates for axial movement thereof comprises a first axially moveable shaft connected to said first plate, a second axially moveable shaft connected to said second plate and means for moving said first shaft and said second shaft independently in axial direction.

8. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **7**, in which said second shaft is a hollow tube surrounding said first shaft and in which an outer fixed hollow tube is concentric with and surrounds said second shaft.

9. A station for connecting an input chute to a selected one of a plurality of output chutes, as recited in claim **7**, in which said means for moving said first shaft and second shaft are double-action air-operated cylinders connected to respective ones of said shafts for independent movement of each shaft.

10. A station for connecting an input chute to a selected one of a plurality of output chutes as recited in claim **7** in which said first axially moveable shaft has longitudinal and transverse passageways therethrough and lubrication insertion means connected to said longitudinal passageway.

11. A pneumatic multi-station remote controlled station having an input chute and a plurality of output chutes comprising:

An input chute having an input end and an output end, said input end lying in a plane along the central longitudinal axis of said station,

a first circular plate, said first plate lying in a plane normal to said central longitudinal axis of said station with its center lying on said central axis so that said first plate revolves around said axis having an aperture therethrough located away from said central axis,

said output end of said input chute being secured in fluid-tight relation to a surface of said first plate in concentric covering relation with respect to said aperture in said first plate,

sealing means surrounding said aperture

means connected to said first plate for imparting rotational movement thereof

a second circular plate lying in a plane parallel to that of said first plate and being concentric with said center of said first plane,

said second plate having an aperture therethrough, said aperture being located so as to be in registration with said aperture in said first plate,

sealing means surrounding said aperture in said second plate,

means connected to said second plate for imparting rotational movement thereto,

an outside flange plate lying in a plane parallel to and below said plane of said second plate,

said outside flange plate having a plurality of openings therein, each of said openings being the input end of a respective one of said output chutes,

said first and second plates being adapted for rotational movement so that their respective apertures can be aligned with one of said plurality of openings in said outside flange plate,

means connected to said first and said second plate for axial movement of said plates, whereby said plates can be moved toward and away from each other and toward and away from said outside flange plate prior to and following said rotational movement of said first and said second plate.

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