Nov. 5, 1957 W. T. PFISTER 2,812,061

AUTOMATIC, PNEUMATIC (PRESSURE-VACUO), OBJECT SORTING MACHINE

Filed Nov. 24, 1953

3 Sheets-Sheet 1

FIG. 1

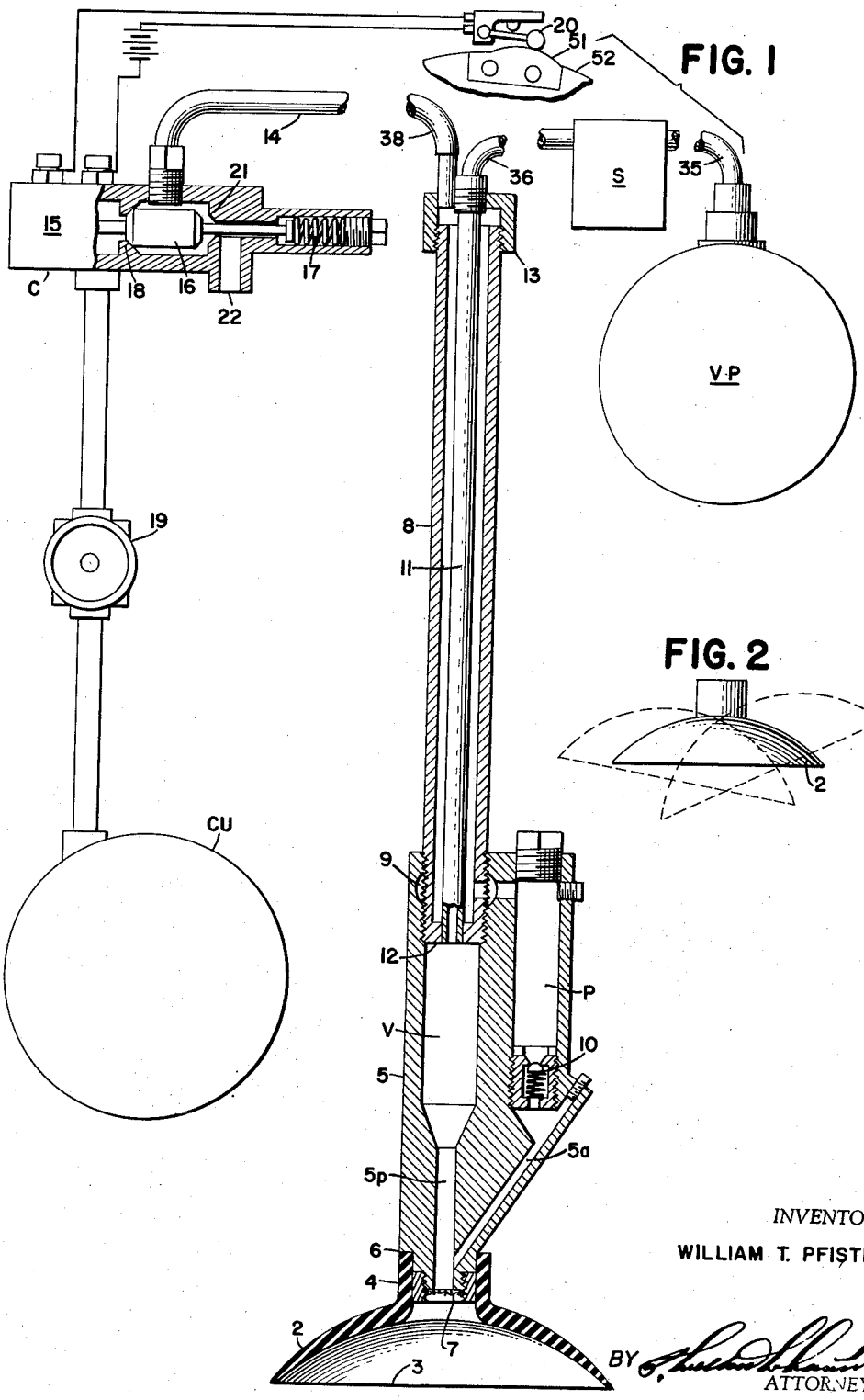


FIG. 2

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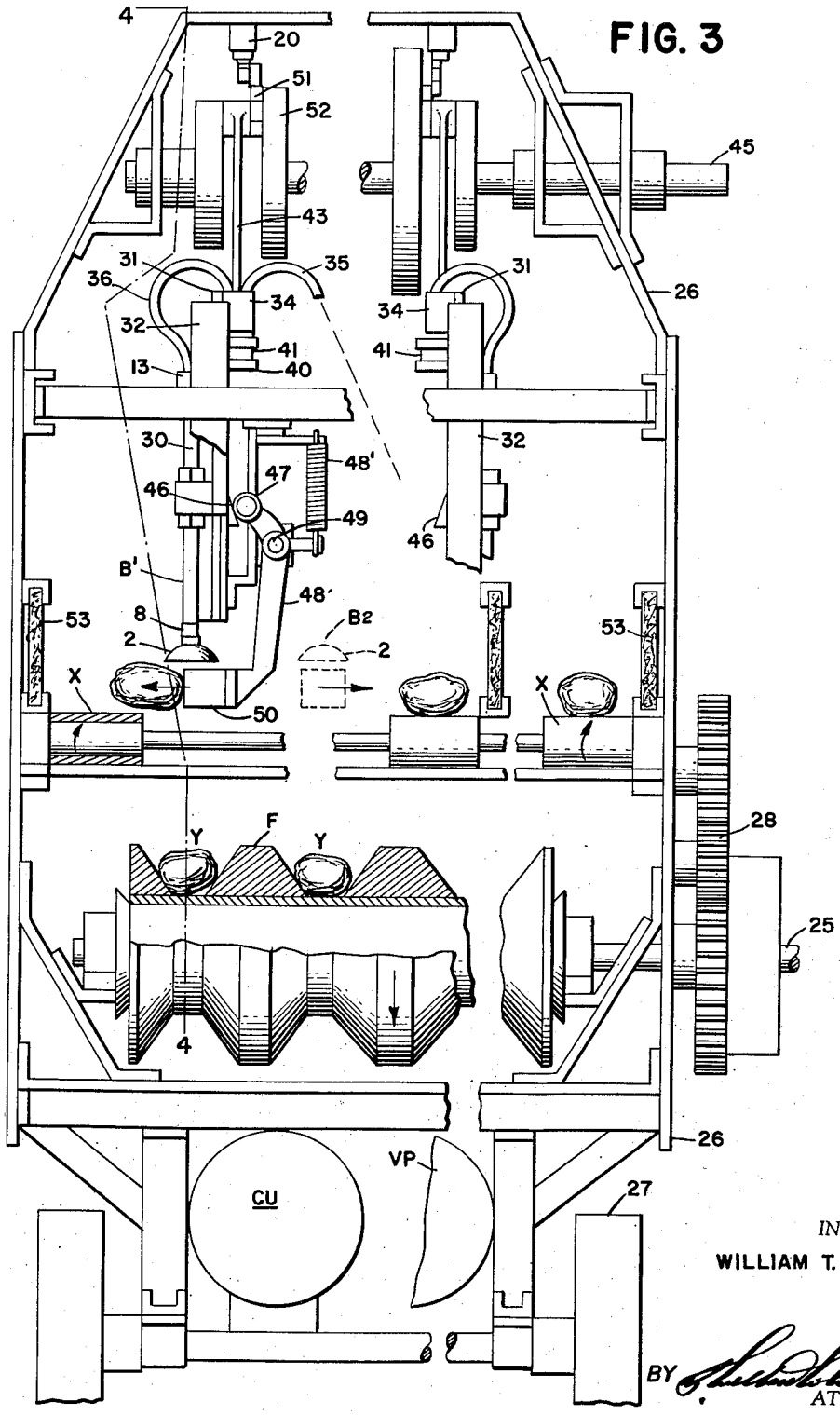
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FIG. 3



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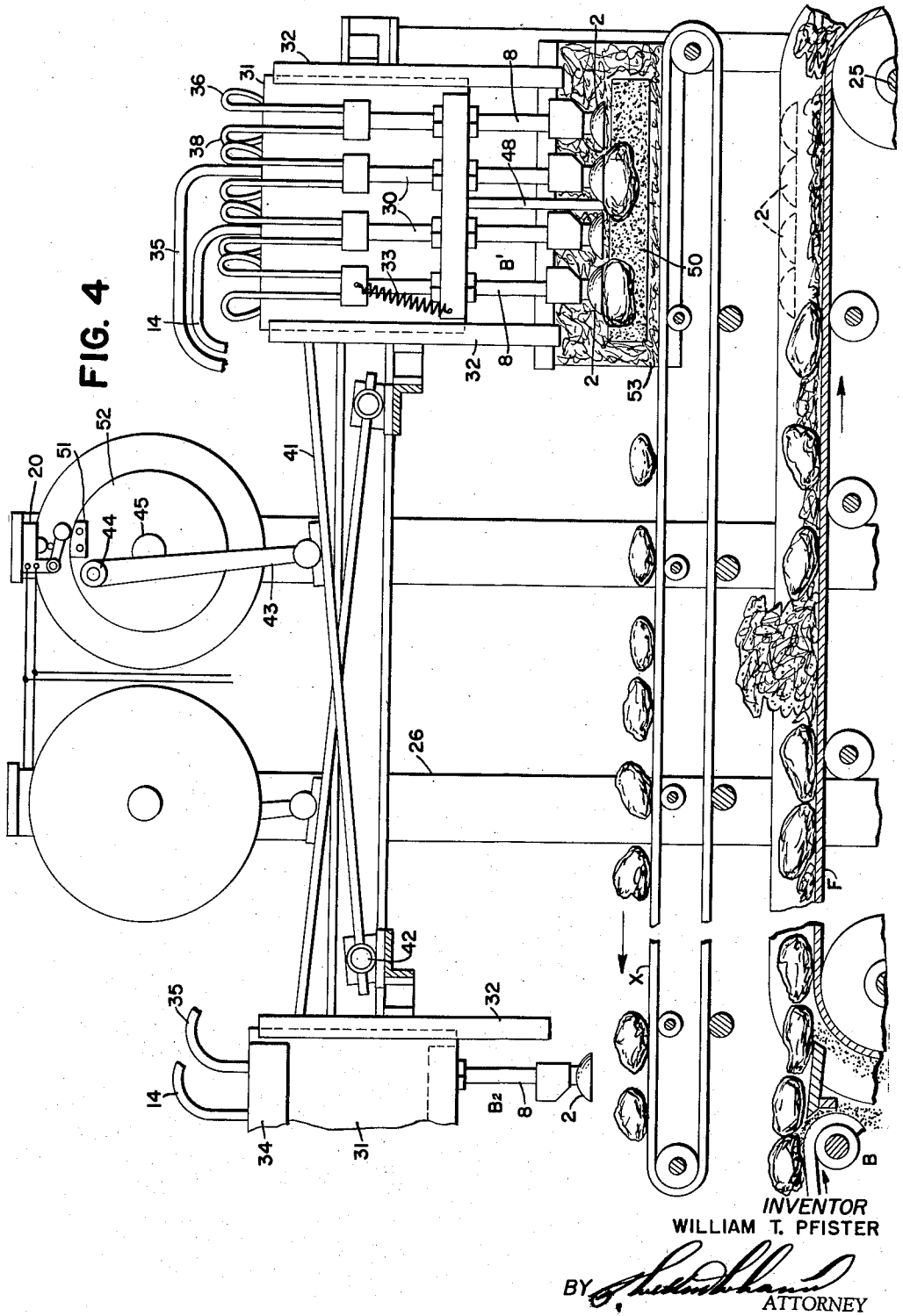
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FIG. 4



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United States Patent Office

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2,812,061

AUTOMATIC, PNEUMATIC (PRESSURE-VACUO), OBJECT SORTING MACHINE

William T. Pfister, Los Angeles, Calif.

Application November 24, 1953, Serial No. 393,996

8 Claims. (Cl. 209—72)

This invention concerns particularly the agriculture industry, and is a machine for the continuous sorting of potatoes from the soil aggregate dug up by a travelling potato digger. It is a variation from the types of machines shown in my Patents Nos. 2,591,194, April 1, 1952, and 2,664,197, December 29, 1953.

A purpose of this invention is to provide a suction cup, in a vacuum assembly, which has capacity for a very considerable tilting function so as to adjust itself instantly to various surface angles of a potato coming into juxtaposition with a given, elevating cup, and, further, an aim is to provide such a cup with a quite flexible wall and mouth lip which will effectively flex to surface irregularities of the engaged potato. The tilting cup is additionally provided with a dust filter so located in the cup as to provide for the free tilting of the cup bodily.

A noticeable provision of the invention resides in the combination with the suction cup of means for substantially constantly holding a suitable degree of vacuum in the cup during given operations thereof to enable the cup to lift an engaged potato from a travelling aggregate of soil and potatoes as dug up, a purpose here being to provide a valveless vacuum cup of utmost simplicity free from control valves. And, here, a special feature of the invention is the provision of means for automatically serving instantaneous jets of compressed air to the individual cups for the effective release of the engaged potato from the cup. At this point it may be stated that another intent of the invention is to provide a simple and practical, automatic means for bumping off the potatoes at the instant that they are released by the compressed air and thrusting them onto a carry-off belt to a suitable discharge locale.

Broadly, it is in the ken of the invention to provide an efficient, continuous-operation, automatic, pneumatic machine for rapidly sorting given objects of different contours and sizes from a running supply in which the objects may or may not be associated with gangue or detritus, said machine having means to hold a generally continuous vacuum in pick-up cups, means to intermittently break the vacuum in the cup, while it is suspending an object, by service of a surge of compressed air to the cup, and means to instantly bleed the unloaded cup of residual compressed air.

The invention has the objective of moving a line of the given objects to a station at which there is located a battery of continuously reciprocating suction cups which have such a speed of action that each of the objects will be presented to one or more of the pick-up cups so that high efficiency of sorting will be kept up and to which the great tilting capacity of the cups is a material factor.

It is a cardinal intent of the invention to provide a vacuo-compression phase machine, which, while involving several critical features in combinative cycles, is still of remarkable simplicity, low cost of construction and operation, is of low power consumption and capable of being provided with its own digger or may be oriented with and receive aggregate discharge from a separate digger. It is to be distinctly understood that while stress is here made of the use of the invention in separation of potatoes in a potato digging train such use is not to be taken in any sense as limitive—there are untold processes in which the invention is useful in sorting or in picking out given, susceptive objects (in many different classes).

The invention resides in certain advancements in this art as set forth in the ensuing disclosure and has, with the above, additional objects and advantages hereinafter developed, and whose constructions, combinations and sub-combinations and details of means will be made manifest in the following description of the herewith illustrative embodiment and its manner of operation; it being understood that modifications, variations, adaptations and equivalents may be resorted to within the scope, spirit and principles of the invention as it is claimed in conclusion hereof.

Figure 1 is a diagram of the pneumatic hook-up and shows in axial section an individual cup assembly. Figure 2 illustrates tilting action positions of the rockable cup. Figure 3 is an elevation of the rear or object-discharge end of the vehicular adaptation of the invention broken away between its sides; some parts being in vertical section. Figure 4 is a vertical section on line 4—4 of Fig. 3 and showing a tandem arrangement of cup batteries for use with side-by-side, object alining, feeder belts.

The cup **2**, Fig. 1, is a spherical segment having a resilient, flexible, feather-lipped wall presenting a chordal mouth **3** of a diameter to cover a goodly area of one of the objects (say a potato) to be picked up by the cup; the cup preferably being of rubber. The cup has an outer, radial hub-like neck **4** the juncture of which, to the cup, permits the cup to bodily, readily, universally tilt to accommodate itself to whatever angle of surface of the object may at the instant be presented to the downwardly moving cup, as later set forth. See Fig. 2. Not only does the cup tilt but its flexible wall permits the thin lip to closely fit onto the engaged surface.

The cup is rigidly affixed to the lower end of a basal, tubular fitting **5** in the bottom of which is screwed a bushing **6** having a suitable screen **7** whose purpose is to prevent dust from being sucked upward into a constricted passage **5***p* leading to a vacuum pocket V in the fitting **5**. From the fitting extends a rigid pipe or stem **8** by which the cup is rapidly vertically reciprocated. The hollow stem is suitably connected at its lower portion by a coupling **9** to a pressure well P in the fitting and in which there is located an upwardly self-closing check valve **10** whose use is to normally sustain the desired degree of vacuum in the fitting and the cup substantially constantly—until the valve **10** is forced open by a flash jet of compressed air by way of the stem.

The well feeds to the cup by way of a small duct **5***d* directed straight toward the dust screen to blow off adhering dust.

For compactness and simplicity there is fixed in the stem a tube **11** which leads through a seal **12** to the pocket V to set up the needed vacuum. Fixed on the top end of the elongated stem is a cap **13** through which the tube leads to a remote vacuum plant VP by which a continuous vacuum is created. Also attached to the cap is a compressed air conduit **14**.

A feature of this invention resides in a means whereby an instantaneous jet of compressed air is supplied to the conduit **14** for flow to the stem cup to be followed immediately by a bleeding cycle of the well P and of the cup for escape of residual compressed air in the well so that the check-valve **10** can again close to hold the vacuum in the cup and the pocket.

Therefore, the conduit **14** connects to a control device C including a shell **15** enclosing a suitable solenoid-operated piston valve **16** thrust in one direction by a spring **17** to a seat **18** to cut off compressed air supplied by a compression unit CU by way of a pressure regulator **19**. The solenoid is controlled by a micro or other electric switch **20**, whose activation will be explained.

When excited the solenoid pulls the piston valve to the right hand end of the shell and closes it onto a valve seat **21** which opens to a normally open port to atmosphere. At this instant the compressed air is passing to the conduit **14**, to the stem and thence to the pocket and its suction cup **2**, Fig. 1, to function as will be related later. When the solenoid is deenergized by opening of its switch **20** the spring **17** instantly throws back the piston and by so doing opens the bleeder port **22** and residual air compressed in the cup assembly is vented to atmosphere, and vacuum is fully restored in the pocket and its cup.

In Figs. 3 and 4 batteries of the suction cups are adapted for use in a potato digging machine having a scoop-fed, dirt screening chain-belt B by which dug-up soil and potatoes as an aggregate are discharged onto a suitable number of longitudinal, V-valley feeder belts F mounted on suitably driven shafts **25** mounted transversely in an appropriate frame structure **26** having ground wheels **27**; the frame being adapted for hitching to an available motor-vehicle not shown. If such a vehicle is in itself a potato digger then its discharged potatoes would be run to the herein feeder belts F.

A plurality of potato carry-off belts X are arranged well above and in juxtaposition to valleys of the feed belt F for receiving sorted out potatoes picked up from the aggregate to leave dirt lumps, stones and other rubbish on the belts to be discharged by them from the travelling machine. The feeder belts F and the carry-off belts are suitably timed and driven by an interconnecting gear device **28**, Fig. 3.

In the interest of simplicity and clarity Fig. 3 is broken-away from top to bottom between its sides thus omitting some of the valley-belts, but a pair of the valleys Y—Y is shown at the left hand side. To insure a high rate of pick-up function in the machine there is arranged vertically over the center of each valley an assembled battery, in suitable number, a plurality of coplanar suction stems **8** best shown at the right hand end of Fig. 4. This battery of stems with their cups **2**, elevate adhering potatoes to a height to be catapulted to the left side carrier belt X while another battery of cups and stems, shown at the left hand end of Fig. 4, functions to elevate potatoes from the next adjacent valley to a dotted line position, Fig. 3, whence the potatoes are catapulted onto the next carry-off belt X; these belts being laterally spaced to provide operational space for the reciprocating cups of the batteries. Thus battery B′ operates over the first valley (at the left side) while battery B2 operates over the next (right side) valley. Means to be described thrust the potatoes to the left side from battery B′ and to the right side from battery B2.

The battery assembly

The cup stems of a battery are slidably mounted in a set of fixed guide bearings **30** provided on an elevating plate **31** operative in channel columns **32** fixed on the machine frame to properly locate the cups of the stems over the respective aggregate valleys of the feeder belt means. If desired light-tension springs **33**, only one of which is shown in Fig. 4, may be used to pull the stems to stop position on the bearings **30**, but offering but little resistance to repression of the cups and their stems when they engage the potatoes (if they are the given objects) or bump other impediments on the feeder belt. The length of the stems of the cups permit for safety recession of the cups should they ram down against bulky dirt lumps or stones which cannot be suctionally engaged to the cups.

On the upper end of the elevating plate there is provided a suitable manifold block **34** having a vacuum chamber served by a tube **35** from the vacuum unit VP, and from said chamber goose-neck tubes **36** connect to the top ends of the several vacuum tubes to hold the constant vacuum in the cup stem tubes at all positions thereof. Likewise the block is provided with an air pressure chamber connected by a supply tube **14** directly to the aforesaid solenoid valve. The manifold pressure chamber has goose-necks **38** to the several cup stems by way of the stem caps **13**.

The elevator driver

Each elevator plate has on its back a yoke or other suitable device **40** which receives the oscillating, outer end of a power lever **41** (of the third order) whose opposite end has a fulcrum **42** on the machine frame and at about midlength the lever is connected to a pitman link **43**, Fig. 4, which connects to a relative crank **44** of crank shaft **45** journalled in the machine frame. Obviously, the rotating crank oscillates the lever arm **41** and thereby the slide is vertically motivated in its guides. The stroke of the slide is sufficient to move the cups from a lower (dotted line) position Fig. 4, to the upper limit, full line position, Fig. 3, so that an adhering potato is just above the top stretch of the respective carry-off belt X. Since battery B′ unloads potatoes to the left side, Fig. 3, the battery B2 is mounted in reverse position, Fig. 4, to discharge potatoes to its right side carry-off belt. This same manner of arrangement is used to serve the other (not shown) belts.

The catapult means

On the back of each slide there is a fixed track having an inclined face **46** which is engaged by a roller **47** mounted in the adjacent end of a rocking lever **48** having a fulcrum **49** on the machine frame and whose lower, swinging end is provided with a suitable bumper cushion **50**, which as seen in Fig. 3 sweeps inwardly under the relative row of cups **2** when at their highest position and therefore rapidly pushes interposed potatoes laterally over the respective carry-off belt; the potatoes having been at this instant released by a jet of compressed air to the individual cups as served by automatic action of the respective solenoid valve. This valve action is timed by means of a cam **51** fixed to a respective crank-shaft momentum disc **52**, Fig. 4, which closes the respective micro-switch of a battery of the cup stems. When this switch again breaks the magnet circuit the piston valve is instantly thrust to cut off air pressure and to open the bleeder port so that vacuum is again obtained in the battery of cups for a repeat pick-up action as the slide moves the cups down to potato engaging position (dotted lines Fig. 4).

Potatoes catapulted from the cups are intercepted by curtain cushions **53** supported near the carry-off belts.

The catapult levers have springs **48′** to operatively hold their rollers onto the actuating tracks on the slides.

An efficient, appropriate dust separator S in the conduit **35** protects the vacuum plant VP.

What is claimed is:

1. A vacuum cup assembly including a cup, and a hollow, compressed air stem to which the cup is communicatively attached and which has an inner vacuum tube, and a by-pass connection between said stem and the cup for delivery of compressed air to the cup against the vacuum therein.

2. The assembly of claim 1, and a spring-set, normally closed valve, openable by air pressure, interposed in said by-pass.

3. The assembly of claim 1, said stem including an enlarged vacuum pocket between said tube and the cup.

4. A vacuum cup assembly including a cup; a hollow, compressed air stem to which the cup is communicatively attached, said stem having an inner vacuum tube; an enlarged vacuum pocket between the tube and the cup; a

constriction between said pocket and said cup; and a bypass connection between said stem and said cup for delivery of compressed air to the cup against the vacuum therein.

5. An object sorting machine including an aggregate-load belt; means disposed over said belt for picking up given objects from the belt, said means including a movable battery of suction cups to engage the surface of the objects at various angles and contours; pneumatic means connected with said cups for releasing elevated objects from the cups; and means including object engaging means located adjacent the cups for laterally catapulting the released objects.

6. An object sorting machine including an aggregate-load belt; means disposed at said belt for picking up given objects from the belt, said means including a movable battery of suction cups to engage the surface of the objects at various angles and contours; means connected with said cups for intermittently feeding jets of compressed air to the cups to release picked up objects therefrom; and means bleeding residual compressed air from said cups when compressed air has been cut off from said cups.

7. An object sorting machine including an aggregate-load belt; means disposed above said belt for picking up objects from the belt, said means including a movable battery of suction cups to engage the surface of the objects at various angles and contours; pneumatic means connected with said cups for releasing elevated objects from said cups; means including a part located adjacent said cups for laterally catapulting the released objects; and an

actuating slide on which the cups are operatively mounted, said catapulting means being actuated by said slide.

8. A potato digging and sorting machine, including: an aggregate-load belt system having V-valleys to arrange potatoes, in the aggregate, in alignment; vacuo-compression cups mounted above the valleys; means for vertically shifting the cups to and from the load in the valleys; means for alternately creating a vacuum status or pressure status in the individual cups for pick-up or release of engaged potatoes; carry-off belts adjacent to but in a plane below the cups in the latter are positioned away from the load; and means including a movable part adjacent the cups when in the last mentioned position, for catapulting the potatoes as released, from the cups onto respective carry-off belts.

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