Oct. 14, 1969 O. H. RAMO 3,471,890

VACUUM CLEANING APPARATUS FOR REMOVING INDUSTRIAL WASTE FROM MACHINERY SUCH AS TEXTILE MACHINERY

Filed Sept. 29, 1967 2 Sheets-Sheet 1

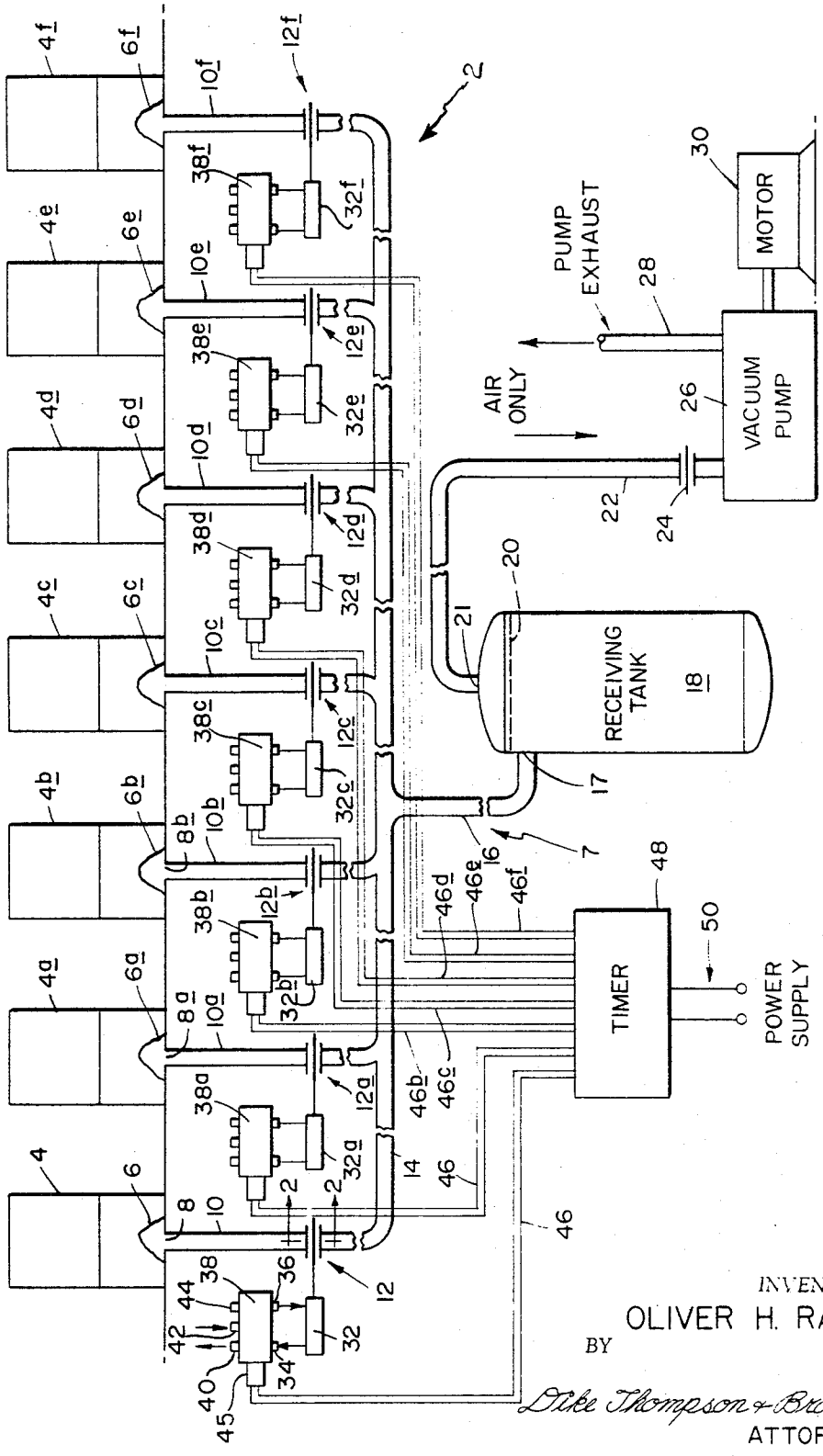


FIG. 1

INVENTOR.
OLIVER H. RAMO
BY
Dike Thompson & Bronstein
ATTORNEYS

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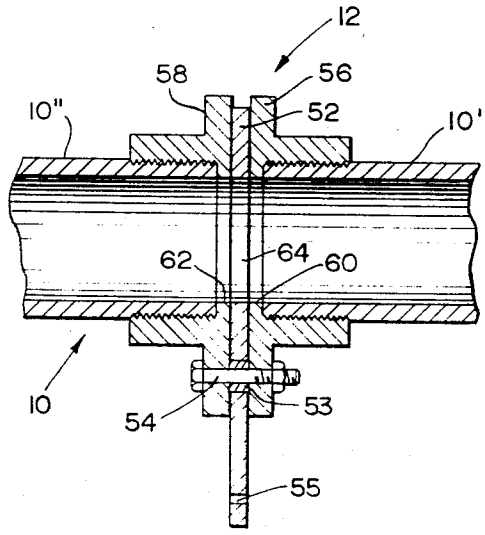


FIG. 2

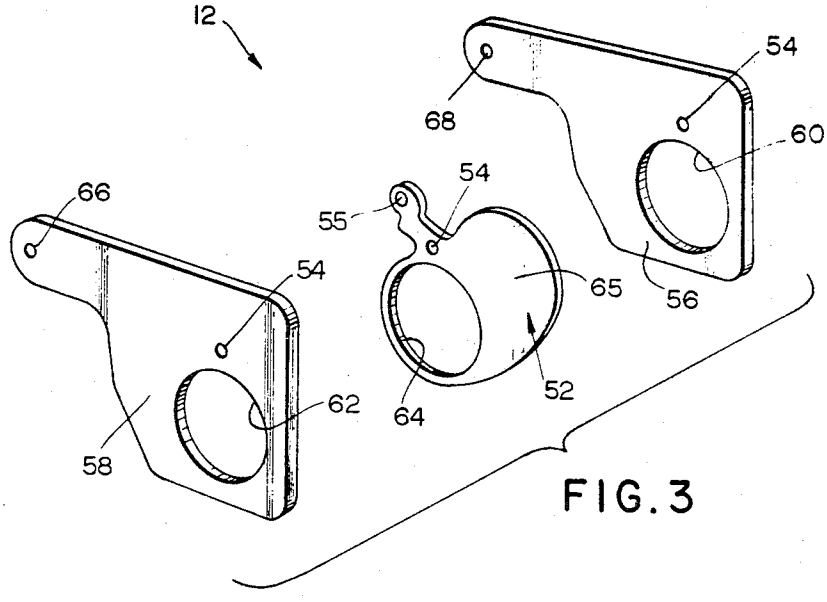


FIG. 3

INVENTOR.
OLIVER H. RAMO
BY
Dike Thompson & Bronstein
ATTORNEYS

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VACUUM CLEANING APPARATUS FOR REMOVING INDUSTRIAL WASTE FROM MACHINERY SUCH AS TEXTILE MACHINERY

Oliver H. Ramo, North Abington, Mass., assignor to Abington Textile Machinery Works, Inc., North Abington, Mass., a corporation of Massachusetts

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Int. Cl. A47l 5/38; D01g 15/76
U.S. Cl. 15—301 23 Claims

ABSTRACT OF THE DISCLOSURE

Electropneumatic controlled vacuum cleaning apparatus for periodically removing industrial wastes, such as waste fibers and trash, from a plurality of processing units, such as textile machinery, as such wastes accumulate at a plurality of accumulation points. The apparatus comprises a continuously operating air pump which periodically sucks the accumulated wastes from the accumulation points through a conduit system, having an individual inlet at each accumulation point, and into an enlarged receiver tank, where the waste is removed from the air stream, with the air stream being sucked from the tank by the pump. The conduit system is provided with a waste valve for each inlet or group of inlets, both of which may be referred to as a station so that there is a valve for each station Actuation of the valves is controlled to individually open and close them one at a time, automatically, successively and repetitively according to a predetermined time program in which each valve remains open for a predetermined first time interval and is closed for a predetermined second dwell time interval before the next succeeding valve is opened and during which all the valves are substantially closed, to thereby build up the vacuum in the conduit system so that when the next succeeding valve is opened, a sudden violent implosion of waste and air occurs into the inlet of, and through, such next succeeding valve.

Each of the waste valves is an improved shutter type valve comprising an oscillating shutter plate pivotally mounted for oscillation about an axis, which is perpendicular to the plane of the shutter plate and parallel to the longitudinal axis of the pipe, and between two fixed plates, each with an aligned hole therethrough. The shutter plate also has a single hole therethrough spaced from the pivotal axis thereof. The shutter plate hole is oscillated, by oscillation of the shutter plate, into and out of alignment with the aligned holes in the two fixed plates on either side of the shutter plate to open and close the valve.

BRIEF SUMMARY OF THE INVENTION

This invention relates to an improved novel and economical cleaning apparatus for, and method of, periodically removing and conveying, by vacuum implosion, accumulated wastes, particularly fiber and trash wastes, from one or a plurality of waste accumulation points at veying accumulated fibrous wastes from such textile machinery.

Present day vacuum methods of removing and conveying accumulated fibrous wastes from such textile machinery, e.g. the cotton combers, to the waste house consists of:

(1) A conduit (piping) system with a plurality of valved inlet openings located in close proximity to, or at,

the plurality of waste accumulation points at the textile machines;

(2) An enlarged receiver tank located in the waste house and in the conduit system, the function of which is to remove and collect waste, which is sucked in an air stream into the piping system at the valved inlet openings when they are opened, and which is thence conveyed through the conduit system by the air stream under vacuum (below atmospheric pressure) to the receiver tank;

(3) A multistage, centrifugal or positive displacement type vacuum pump connected to the air outlet connection of the receiver tank by a conduit pipe to create the vacuum, which sucks the waste into and through the conduit system to the receiver tank, where the waste is removed from the air stream, e.g. by a screen, and which sucks the remaining air stream from the receiver tank through the pump to the pump exhaust.

There has been, for many years, a need in this type of textile vacuum cleaning system to substantially reduce power requirements, i.e. the power consumed by the vacuum pump, and to more effectively remove the waste from the textile machines.

Accordingly, it is an object of the present invention to provide an improved vacuum cleaning apparatus for, and method of, removing and conveying industrial wastes, particularly fiber wastes, from a plurality of processing units, particularly textile machines, in which the power requirements, i.e. the power required by the pump, are sharply reduced to provide a substantial savings while at the same time, the waste is removed from the machines much more effectively.

This is achieved in accordance with the present invention by controlling the plurality of waste valves of the valved inlet waste openings automatically by means of a timer so that each waste valve closes and remains closed for a controlled short interval of time, hereinafter sometimes referred to as dwell time, before the next succeeding valve is opened. During this dwell time, all the waste valves are closed so that air flow into the system is substantially zero. Consequently, the pump, which is running constantly, rapidly evacuates the air out of the closed system downstream of the valves, i.e. between the valves and the pump and including the receiver tank, to thereby rapidly and substantially increase the vacuum in the system by as much as three or more times what is usually experienced in a normal system where the equivalent of one or more valves is open continuously. Therefore, when the next succeeding valve is opened after this vacuum build-up, i.e. after the dwell time has elapsed, a sudden violent implosion or inrush of waste and air into and through such next succeeding valve opening occurs. The time required for this implosive effect is very short, e.g. less than a second. It is practically instantaneous. The valve is then automatically closed and the pump again builds up a high vacuum during the dwell time, after which the next succeeding valve is opened for its implosive waste removal, until all the valves have been successively opened and closed in this manner. After the last valve has been closed for the dwell time interval, the first valve is automatically reopened and the cycle is repeated.

The dwell time required for the vacuum in the conduit system and receiver tank to be built up may be relatively short, e.g. two to three seconds but, of course, depends on the pump capacity, the volume of the conduit and receiver

tank system downstream of the valves, i.e. between the closed valves and the pump inlet, etc.

The removal and conveying of the waste by this novel implosive technique is much more effective because of the added sudden and violent "punch," provided by the vacuum build-up, when each valve is opened. This not only more effectively removes and conveys the waste, but does so in a relatively short valve-open time interval, which, as will be discussed more fully hereinafter, effects a substantial economy in power requirements.

To achieve a maximum implosive effect, each timer operated valve is preferably located closely adjacent to its waste material inlet or group of inlets into the conduit system, i.e. the inlet into which the waste and air is sucked from the waste accumulation point at the machine. The closer the valve to the inlet the better so that preferably they should be as close as possible. A relatively long conduit (pipe) between the waste inlet and the valve reduces the effective sudden "punch" of the implosion because the air contained in this pipe acts as a cushion when being removed by the vacuum upon opening of the valve. Also, with such a relatively long conduit between inlet and valve, the impact of the rapidly moving air within such conduit against the suddenly closed valve causes a compression wave, which, in turn, causes a sudden reversal or "bounce back" in air flow with a resultant sudden undesired outrush of air from the waste inlet.

The actual work of pulling the waste through the inlet and valve into the conduit system occurs during the initial moment of each implosion when the rate of air flow through the valve is at its maximum. Preferably, each valve should not be left open any longer than the instant it takes for the implosion to suck the waste through the valve, since a valve that is left open for a longer period is not doing any useful work, and consequently, the power required to move the additional air through the valve is wasted. Although the momentary opening of the valve to achieve an implosion is sufficient to pull the waste into and through the inlet and valve and into the conduit system, as aforesaid, it is not usually enough to move the waste entirely through the conduit system into the waste receiver tank. However, subsequent, succeeding implosions at the other valves and at the same valve provide an intermittent air flow in the conduit system, which ultimately conveys the waste to the receiver tank with a miniumum of power. Thus, the same power for imploding subsequent waste accumulations from subsequent machines functions to intermittently convey, through the conduit system to the receiving tank, the waste pulled into the system by a preceding implosion.

Since the power required by the pump is roughly proportional to the total amount of air moved through the valves and since the use of the aforesaid implosion technique in accordance with the present invention, in which each valve is open only momentarily with a substantial dwell time interval between each opening during which substantially no air is being moved through the valves, reduces substantially the total air flow through the valves, it is apparent that the amount of power required by such technique is held at a minimum so that substantial savings in power can be realized. For this reason, it is preferred to hold each valve open only for the instant required for the implosion to suck the waste through the valve. As aforesaid, if the valve remains open thereafter, the further movement of air therethrough during this additional time the valve is kept open, does not perform any useful work but increases power consumption.

Preferably, the dwell time interval should be long enough to permit the maximum vacuum producable by the pump to be built up in the conduit system and receiver tank, i.e. until the increase in vacuum after a valve is closed commences to stabilize or level off. However, it will be apparent that shorter dwell time intervals will provide substantial benefits so long as they are long enough to build up a substantial vacuum in the system

In a preferred embodiment, the dwell time interval is substantially longer than the valve-open time interval.

Thus, it may be seen that the present invention provides a novel control to automatically, successively and repetitively open and close the plurality of waste valves according to a predetermined time program in which each valve is open for a first predetermined time interval and is closed for a second predetermined dwell time interval before the next succeeding valve is opened and during which all th valves are closed, to thereby build up the vacuum in the closed conduit system and tank downstream of the valves so that when such next succeeding valve is opened a sudden, violent implosion of waste and air occurs into and through such next succeeding valve.

Put more simply, the invention provides a novel means to automatically, successively and repetitively create a sudden, violent sucking implosion at each waste inlet of a plurality of waste inlets at a plurality of machines according to a predetermined time program.

The present invention also provides an improved waste valve in the form of a shutter valve comprising a flat shutter plate which reciprocates back and forth with respect to a fixed plate to uncover and cover a passage through such fixed plate and thereby open and close the valve. Preferably, the shutter plate oscillates between the fixed plates to move a hole in the shutter plate into and out of alignment with two aligned holes, one in each of the fixed plates. Such a valve has the advantage that it clears itself of any fibers caught between the reciprocating and fixed plates while, at the same time, affording straight, through flow.

It is pointed out that the vacuum implosive technique of removing and conveying industrial wastes in accordance with the present invention is not limited to fibrous wastes and trash in the textile industry but can also be employed in other industries where granular or other loose bulk material must be removed and conveyed from a plurality of processing stations.

The invention, together with its benefits and advantages, will be more clearly understood from the accompanying drawings and following description thereof.

In the drawings:

FIG. 1 is a diagrammatic view of a waste removal and conveying system embodying the implosive technique of the present invention and applied to the waste noils accumulations at a plurality of textile cotton comber machines;

FIG. 2 is a section taken along the line 2—2 of FIG. 1; and

FIG. 3 is an exploded view in perspective of the valve of FIG. 2.

In the figures, **2** represents a vacuum system embodying the invention and applied to a Saco-Lowell cotton comber Model 140 having a plurality of comber heads **4**, **4***a*, **4***b*, **4***c*, **4***d*, **4***e* and **4***f*, to remove from the situs of the heads the accumulations **6**, **6***a*, **6***b*, **6***c*, **6***d*, **6***e* and **6***f* of cotton noils as they accumulate at accumulation points at the heads, such points being also represented as **6**, **6***a*, **6***b*, **6***c*, **6***d*, **6***e* and **6***f* in FIG. 1. Located closely adjacent to, or at (under in the case of FIG. 1), each accumulation point is the waste inlet opening **8**, **8***a*, **8***b*, **8***c*, **8***d*, **8***e* and **8***f*, respectively, of a conduit (piping) system **7** made up of a branch **10**, **10***a*, **10***b*, **10***c*, **10***d*, **10***e* and **10***f*, respectively, for each waste inlet, a manifold portion **14** into which all the branches **10**–**10***f* feed, and a portion **16** which extends from the manifold portion **14** to the air inlet **17** of a conventional, enlarged waste receiver tank **18**. Tank **18** has a conventional screen **20** extending thereacross between the air inlet **17** of the tank and the air outlet **21** of the tank to remove waste noils from the air stream passing through the tank from inlet **17** to outlet **21**. The waste noils collect in tank **18**. The air outlet **21** is connected to the suction inlet of a conventional, multi-stage, centrifugal air (vacuum) pump **26** by means

of a second conduit system **22**, in which is located close to the pump inlet, a conventional blast gate **24** to control total air flow through the pump. The exhaust **28** from pump **26** is returned to the atmosphere and the pump is driven by a motor **30**.

Located in each of the branches **10–10*f*** of conduit system **7**, as close as possible to the waste inlet **8–8*f*** of such branch, is a shutter valve **12**, **12*a***, **12*b***, **12*c***, **12*d***, **12*e*** and **12*f***, respectively, each of which is of like construction and is pneumatically actuated by a conventional air cylinder (and piston) **32**, **32*a***, **32*b***, **32*c***, **32*d***, **32*e*** and **32*f***, respectively, e.g. the air cylinder and piston assembly sold by Reidy Corporation under the trade name Miller Air Cylinder. Reciprocal movement of the piston inside the cylinder reciprocally pivots the shutter valve **12–12*f*** controlled thereby about an axis perpendicular to the plane of shutter and parallel to the axis of the branch pipe **10–10*f*** in which the valve is located to open and close positions, the shutter valve being pivotally moved in one direction by movement of the piston in one direction to open the valve and in an opposite direction by movement of the piston in an opposite direction to close the valve. The shutter valve comprises a flat shutter plate **52** (FIGS. 2 and 3) with a hole **64** in it having a diameter equal to the internal diameter of the branch pipe **10–10*f*** in which it is located. The valve is opened by pivoting the shutter plate in the aforesaid one direction to align the hole in the shutter plate with the internal pipe diameter, and is closed by pivoting the shutter plate in the aforesaid opposite direction to block the pipe by a solid part of the valve plate. The valve will be described in greater detail hereinafter.

The operation of each air cylinder is controlled by a conventional solenoid operated pneumatic pilot valve **38**, **38*a***, **38*b***, **38*c***, **38*d***, **38*e*** and **38*f***, respectively, one example of such a solenoid controlled pilot valve being the one sold by Modernair Corporation under the name Modernair. Each solenoid controlled pilot valve **38–38*f*** has a solenoid controlled spool (not shown), which controls flow of control air through ports **34**, **36**, **40**, **42** and **44** of the pilot valve and into and out of the air cylinder controlled by such pilot valve. Movement of the spool by energizing its solenoid **45** in one direction to shutter valve open position directs air from air supply port **42** through port **36** to one side of the piston in the cylinder to move the piston in a direction to open its shutter valve, exhaust air from the other side of the piston being exhausted through ports **34** and **40**. Movement of the spool by deenergizing its solenoid **45** in an opposite direction to shutter valve close position directs control air from port **42** through port **34** to the aforesaid opposite side of the piston to move the shutter valve to close position, exhaust air from the aforesaid one side of the cylinder being exhausted through ports **36** and **44**.

The solenoids **45** of the solenoid controlled pilot valves **38–38*f*** are controlled, i.e. energized and deenergized in a controlled manner, by a conventional, electric, multi-cam switch programmed repeat cycle timer **48**, e.g. a timer sold by Eagle Signal Corporation under the name Multipulse Repeat Cycle Timer, the multi-cam operated switches of which are operably connected to the individual solenoids **45** of the pilot valves **38–38*f*** by electric leads **46**, **46*a***, **46*b***, **46*c***, **46*d***, **46*e*** and **46*f***, respectively, and which is supplied by electric power at **50**. The timer **48**, which is adapted to be programmed as desired by programming the closing and opening of the multi-cam switches thereof, is programmed to control (through leads **46–46*f***) the individual solenoids **45** of pilot valves **38–38*f***, and hence shutter valves **12–12*f***, to automatically open and close the shutter valves, one at a time, successively (first valve **12**, next valve **12*a***, next valve **12*b***, next valve **12*c***, next valve **12*d***, next valve **12*e*** and next valve **12*f***) and repetitively (after valve **12*f*** is opened and closed, valve **12** is opened and closed and the cycle repeated) in accordance with a predetermined time program, in which each shutter valve is open during a first predetermined time interval (e.g. one second) and is closed for a second predetermined dwell time interval (e.g. 3 seconds) before the next succeeding shutter valve is opened and during which all the shutter valves are closed, to therby build up the vacuum in the conduit system **7**, tank **18** and conduit **22** (e.g. up to 6 or 7 inches of mercury below atmospheric pressure) all downstream of the closed shutter valves **12–12*f***, so that when such next succeeding shutter valve is opened, a sudden, instantaneous, violent implosion (inrush) of waste noils **6–6*f*** and air into and through such next succeeding valve and its inlet **8–8*f*** occurs. The vacuum is thus built up during the dwell time interval because the pump **26** continues to operate while all the valves are thus closed to thereby evacuate the conduit system **7**, tank **18** and conduit **22**, all downstream of the closed shutter valves **12–12*f***.

The first instantaneous time interval, during which each shutter valve is open and the sudden implosion at the inlet **8–8*f*** of such shutter valve occurs to suck the accumulated waste **6–6*f*** at such inlet through the inlet and valve into the conduit system, is too short for the pump to convey the imploded waste material entirely through the conduit system **7** into the receiver tank **18**. However, the subsequent intermittent flow of air through such conduit system caused by the subsequent implosions which occur when the subsequent valves are opened or when the same valve is subsequently opened convey the waste to the receiver tank **18**, where it is removed from the air stream by the screen **20** and collects in the tank **18**. The remaining air stream, with the waste removed therefrom, is pulled through conduit **22** and pump **26** out the pump exhaust **28**.

The implosion at each inlet **8–8*f*** occurs instantaneously during the aforesaid first time interval after the valve **12–12*f*** is opened. The waste **6–6*f*** is sucked through the valve **12–12*f*** during the initial moment of each implosion when the vacuum in the conduit system **7** is at its maximum, thereby causing the rate of air flow through the valve to be at its maximum. The first time interval is selected so that the valve is closed immediately after such waste is sucked therethrough because if the valve is left open for a longer time, no useful work is being accomplished so that the power required to move air through the valve for such longer time is wasted, as well as pump capacity.

The strongest implosion occurs by selecting the dwell time interval so that the pump builds up in the conduit system **7** and tank **18** the maximum vacuum it is capable of building up before the next succeeding valve is opened. The maximum vacuum is achieved when the increase in vacuum, after closing the preceding valve, commences to stabilize, and the dwell time is preferably adjusted so that the next succeeding valve opens when or shortly before this condition is achieved. The actual dwell time as well as the first valve-open time interval depends on the pump capacity, the size of the conduit systems **7** and **22** and the tank **18**, the size and number of the valve openings, the amount of waste accumulations at each inlet **8–8*f***, etc.

Preferably, each of the valves **12–12*f*** is placed as close as possible to its inlet **8–8*f*** so that the vacuum built up during the dwell time will not be dissipated in moving a substantial amount of air in the branch **10–10*f*** between the valve and inlet to thereby decrease the punch of the implosion at such inlet when the valve is opened. Another reason for placing each valve as close as possible to its inlet is to prevent the development of a compression wave in the high velocity air between valve and inlet when the valve is suddenly closed with consequent "bounce back" of air and possibly waste out of the inlet.

As aforesaid, each of the electric leads **46–46*f***, and hence each of the solenoids **45**, is controlled by a cam

operated switch in the timer, the switches being set to open and close to energize and deenergize the solenoids **45** of pilot valves **38–38***f* according to the aforesaid program.

Because the power required by the pump **26** depends on total air flow through valves **12–12***f* and because such total air flow is reduced by use of the implosion technique of FIG. 1, since the valves **12–12***f* are closed a relatively long total time as compared to the total time during which they are opened, this technique provides a substantial savings in power. Also, the sudden violent suction "punch" or "jolt" of the relatively large vacuum at inlet **8–8***f* provided by each implosion more effectively removes and conveys the waste, as compared to a constant lesser vacuum applied to the inlets **8–8***f* at all times.

Furthermore, the use of the implosive technique of the present invention permits larger valve openings without reducing the total number of such openings, because the same relatively high vacuum is delivered automatically to one valved opening at a time regardless of the number of, and distance between, the valved openings and regardless of the distance between such openings and the receiver tank. For example, if all the valves are open at one time with a constant vacuum at all times, it is necessary to reduce the size of each opening in order to maintain sufficient vacuum. On the other hand, reduction in the size of the valve openings may cause choking with waste. If, in order to increase the size of the valved openings without serious decrease in vacuum, one valve is opened at a time, with each succeeding valve opening while the preceding valve is closing so that the net result is the equivalent of having one valve open at all times with a resulting constant vacuum and with no implosive effect, power consumption is substantially higher and the waste is not removed nearly as effectively and efficiently as compared to the implosive technique of the present invention.

The implosions clear away the comber noils instantaneously and the rapid frequency of the implosion cycle prevents noils pile up. Manual handling of the waste noils is completely eliminated since the entire collection and disposal operation is under automatic control. Accordingly, the noils are delivered to the receiving tank or tanks in cleaner and better condition for reworking and salvage.

Additional benefits to be gained, are a lessening of the comber tenders' area of responsibility, a releasing of manpower to other tasks by eliminating manual pick-up and carting, a positive step forward in mill automation, and improved plant traffic as a result of eliminating the need for cumbersome waste carts.

In one commercial Saco-Lowell comber installation using a 50 HP, 3-phase, 60 cycle, 440 volt, 3350 r.p.m., 60 amp. full load motor, the motor pulled 76 amps. with a peak load of 69.1 HP when each valve was open for one second (69.1 HP seconds) and 20 amps. with a no load of 18.2 HP when each valve was closed for 2.75 seconds (50.05 HP seconds), giving an average load of 50.05+69.1 or 119.15 HP seconds divided by 3.75 seconds (total open and close times for each valve per cycle)=31.7 HP. Thus, compared to a system in which the equivalent of one valve is open at all times so that the motor has a load of 69.1 HP on it at all times (average load of 69.1 HP) there is a savings of 69.1 HP—31.7 HP (the average HP for the system of FIG. 1) or 37.4 HP. Thus, the power required was almost halved. Furthermore, the peak load condition (when the valve is open) is not a prolonged one and is too short in duration to cause any damage to the motor so that a motor of less load capacity can be safely used.

Although in FIG. 1, the implosion technique is applied to a plurality of waste accumulation points, it can also be applied with advantage to a single waste accumulation point. For example, in some cases, the waste accumulations from a number of comber heads are channeled to a single point, e.g. in the case of the new Saco-Lowell High Speed Comber. In such case, the conduit system may have a single valved inlet, the valve of which is alternately and repeatedly opened to provide an implosion and closed for a dwell period, according to a predetermined time program. Furthermore, the same technique can be used for a number of Saco-Lowell High Speed Combers by providing a valved inlet for each comber waste accumulation point. It has been discovered that the relatively large volume of waste which collects at each of these accumulation points fed from a number of comber heads on each comber are sucked through the valve into the conduit system by the initial implosive rush of air through the valve when it is opened.

Whereas in FIG. 1, each inlet comprises a station serviced by a valve, in the aforesaid arrangement of the Saco-Lowell high speed comber, each station comprises a plurality of inlets serviced by a single valve.

Referring now to FIGS. 2 and 3 which disclose the construction of each of the shutter valves **12–12***f*, **52** represents the oscillating shutter plate having a hole **64** therein, as shown. The shutter plate **52** is located between the two fixed plates **56** and **58** having aligned holes **60** and **62** therein, which are also aligned with the internal passages of pipe sections **10'** and **10''** making up the conduit branch **10–10***f*. Holes **60** and **62** in fixed plates **56** and **58** and the hole **64** in shutter plate **52** are all of the same diameter as such passage in pipe sections **10'** and **10''**. The fixed plate **56** is secured to the end of pipe section **10'** and the fixed plate **58** is secured to the end of pipe section **10''**, e.g. by threading or some other suitable means.

Shutter plate **52** is pivotally mounted between and on the fixed plates **56** and **58** by a suitable pivot pin at **54** (also bushing **53**) so that it can be oscillated in one direction about pivot **54** into open position in which the hole **64** thereof is aligned with holes **60** and **62** of fixed plates **56** and **58**, and reciprocally in an opposite direction into closed position in which solid portion **65** thereof is located between the holes **60** and **62**. The bushing **53** has an axial dimension slightly greater than the thickness of shutter plate **52** for free oscillation.

The head end of the cylinder of the cylinder and piston assembly **32–32***f* for the valve is pivotally mounted on a pin extending through holes **66** and **68** in fixed plates **56** and **58** and the piston rod end is pivotally fastened to the shutter plate **65** at **55** by a clevis and pin (not shown).

Thus, it can be seen that retraction of the piston rod by compressed air controlled by pilot valve **38–38***f* will oscillate the shutter plate **52** in one direction into open position, and extension of the piston rod will reciprocally oscillate the shutter plate in an opposite direction into close position.

When the shutter plate is moved from open to close position, it is possible for fibers in transit to be caught between the shutter plate and the fixed plates. If this occurs, then, on the subsequent opening of the shutter plate, these fibers are freed to be pulled away by the air stream.

It is not intended that the invention be limited to or by the aforesaid description and drawings but only to the apparatus claimed hereinafter and their equivalents.

Although in the above description, only one valve is opened and closed at a time, it is possible to have two or more smaller sized valves, the total cross-sectional area of which is equivalent to the cross-sectional area of one larger valve, to open and close together followed by opening and closing of another or plurality of valves together, with a dwell time between the closing of one set and the opening of the other to build up the vacuum as described in order to achieve the aforesaid implosions.

I claim:

1. Apparatus for removing and conveying industrial wastes from an accumulation point at which said wastes accumulate, comprising means for sucking said accumulated wastes away from said accumulation point, and

means controlling said sucking means to automatically and repetitively create a sudden, violent sucking implosion at said accumulation point to suck accumulated wastes away therefrom according to a predetermined time program, said sucking means comprising a vacuum pump and a conduit system having an inlet located at said accumulation point and providing communication between said inlet and said pump, a valve associated with said inlet and means for actuating said valve, said control means comprising means to open and close said valve automatically and repetitively and to substantially close said conduit system to the atmosphere at least for a substantial dwell time interval prior to each opening of said valve and while said valve is closed according to said predetermined time program, said dwell time interval being sufficient to permit the vacuum in said conduit system to be built up by the pump so that when said valve is subsequently opened a sudden and violent implosion occurs at said inlet to suck said accumulated wastes into said inlet and through said valve.

2. Apparatus for removing and conveying industrial wastes from a plurality of stations, each station comprising at least one waste inlet at which wastes accumulate, vacuum pump means, conduit means providing communication from each of said inlets to said pump means, whereby said wastes accumulated at said inlets are adapted to be sucked by said pump in an air stream into said inlets and said conduit means, a valve for each of said stations to individually open and close communication between said stations and said conduit means and means for actuating said valves, the improvement comprising control means for controlling said actuating means to automatically open and close said valves successively and repetitively in accordance with a predetermined time program in which each valve is open during a first predetermined time interval and is closed for a second predetermined dwell time interval before the next succeeding valve is opened and during which all said valves are closed, to thereby build up the vacuum in said conduit means downstream of said valves so that when said next succeeding valve is opened, a sudden and violent implosion of said wastes and air stream air into and through said next succeeding valve and its station occurs.

3. Apparatus according to claim 2, said first predetermined time interval being substantially less than said second predetermined dwell time interval.

4. Apparatus according to claim 2, said second predetermined dwell time interval being greater than one second.

5. Apparatus according to claim 2, said pump means having a capacity to develop a vacuum in said conduit system of at least six inches of mercury during said second predetermined dwell time interval.

6. Apparatus according to claim 2, said second predetermined dwell time interval being sufficient for the increase in vacuum in said conduit system to at least commence to level off after said preceding valve has been closed but before said next succeeding valve is opened.

7. Apparatus according to claim 2, said pump means being a multi-stage centrifugal pump, said second predetermined dwell time interval being sufficient to permit to be built up in said conduit system substantially the maximum vacuum of which said pump means is capable.

8. Apparatus according to claim 2, said second predetermined dwell time interval being sufficient to permit said pump means to develop substantially its maximum vacuum.

9. Apparatus according to claim 2, said second predetermined dwell time interval being sufficient to permit flow in the conduit system to become substantially static.

10. Apparatus according to claim 2, said first time interval being not substantially greater than about a second.

11. Apparatus for removing and conveying industrial wastes from a plurality of stations, each station comprising at least one waste inlet at which wastes accumulate, means for removing said wastes from an air stream containing the same, vacuum pump means, first conduit means providing communication from each of said inlets to said wastes removing means, second conduit means providing communication between said wastes removing means and said pump means, whereby said wastes accumulated at said inlets are adapted to be sucked by said pump in an air stream into said inlets and through said first conduit means to said wastes removing means where said wastes are removed from said air stream, the remaining air stream from said wastes removing means being sucked through said pump; a valve in said first conduit means for each of said stations to individually open and close communication between said stations and said wastes removing means and means for actuating said valves, the improvement comprising control means for controlling said actuating means to automatically open and close said valves, successively and repetitively in accordance with a predetermined time program in which each valve is open during a first predetermined time interval and is closed for a second predetermined dwell time interval before the next succeeding valve is opened and during which all said valves are closed, to thereby build up the vacuum in said first conduit means downstream of said valves so that when said next succeeding valve is opened, a sudden and violent implosion of said wastes and air stream air into and through said next succeeding valve and its station occurs.

12. Apparatus according to claim 11, each of said valves being located closely adjacent its waste inlet, said wastes removing means comprising a waste receiver tank.

13. Apparatus according to claim 11, said next succeeding valve being closed immediately after said wastes are sucked therethrough and before the rapid implosive decrease in vacuum in said first conduit means caused by opening of said next succeeding valve levels off, whereby power requirements are reduced.

14. Apparatus according to claim 11, said first predetermined time interval being substantially less than said second predetermined dwell time interval.

15. Apparatus according to claim 11, said first time interval, during which each valve is open, being sufficient for the pump to suck the waste through said inlet and valve and through only part of the length of said first conduit means between said valve and said wastes removing means, said wastes thereafter being sucked in stages through the remainder of said length of said first conduit means into said wastes receiving means by subsequent successive openings of the same and succeeding valves.

16. Apparatus according to claim 11, said second time interval being sufficient to build up the vacuum in said conduits and tank substantially to the vacuum capacity of said pump to achieve said implosion, whereby the vacuum utilized for removing said wastes when each valve is opened is substantially increased with decreased power consumption and whereby the same high vacuum is delivered to all of said inlets regardless of varying distances from said pump.

17. Apparatus according to claim 16, said first time interval being not substantially greater than the time required for the implosion to suck said accumulated wastes through said valve.

18. Apparatus according to claim 11, said wastes being fiber wastes and said processing stations comprising textile machinery.

19. Apparatus according to claim 11, said first time interval being not substantially greater than the time required for said implosion.

20. Apparatus according to claim 11, said second predetermined dwell time interval being greater than one second.

21. Apparatus according to claim 11, said pump means having a capacity to develop a vacuum in said conduit system of at least six inches of mercury during said second predetermined dwell time interval.

22. Apparatus according to claim 11, said second predetermined dwell time interval being sufficient for the increase in vacuum in said conduit system to at least commence to level off after said preceding valve has been closed but before said next succeeding valve is opened.

23. Apparatus according to claim 11, said second predetermined dwell time interval being sufficient to permit flow in the conduit system to become substantially static by virtue of the pump means having developed its maximum vacuum.

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19—107