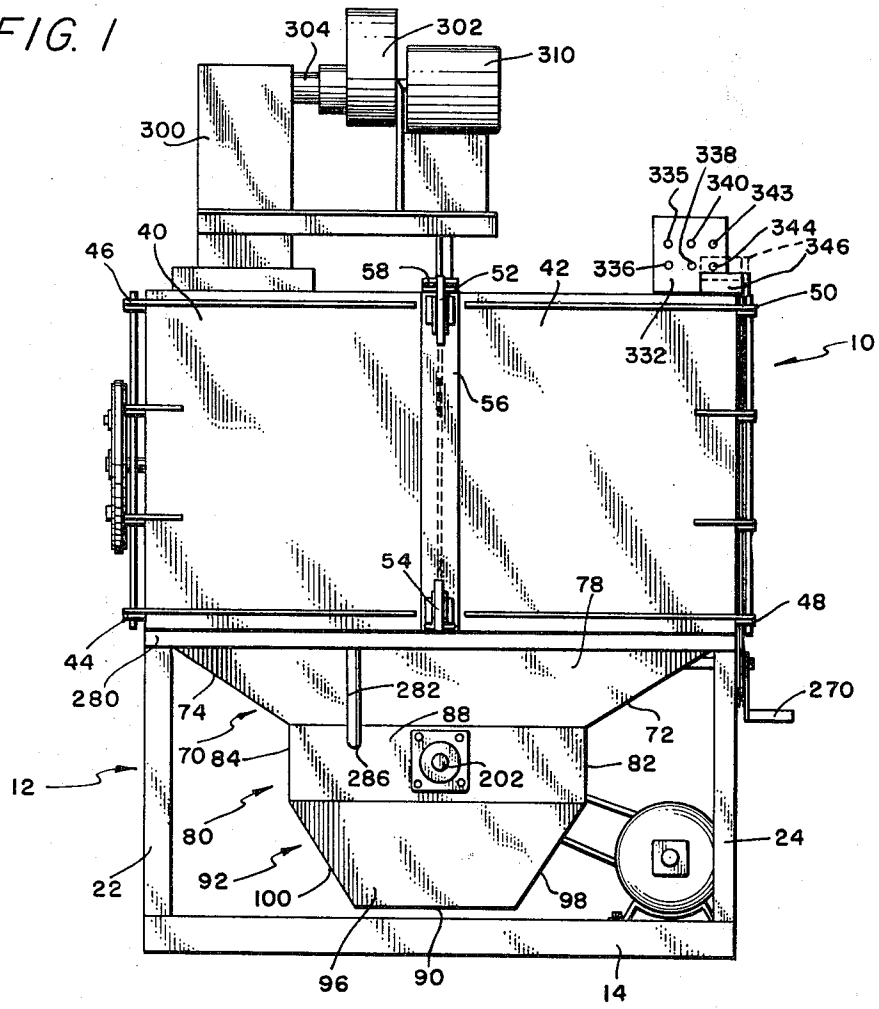
Dec. 15, 1970 P. L. ENEGREN 3,546,816

CLEANING MACHINE

Filed Oct. 25, 1967 4 Sheets-Sheet 1

FIG. 1



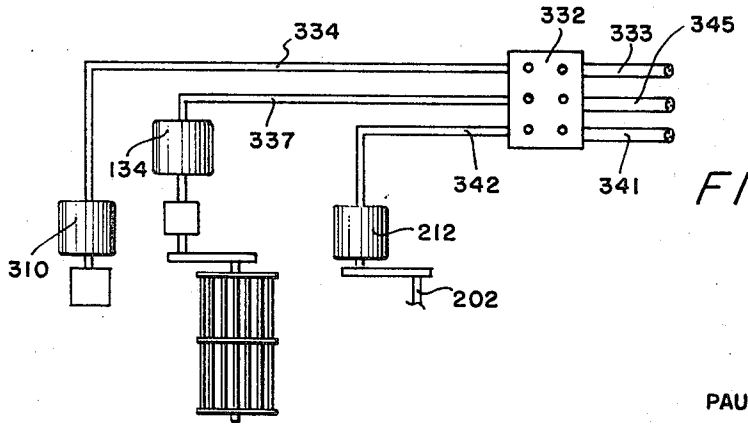


FIG. 15

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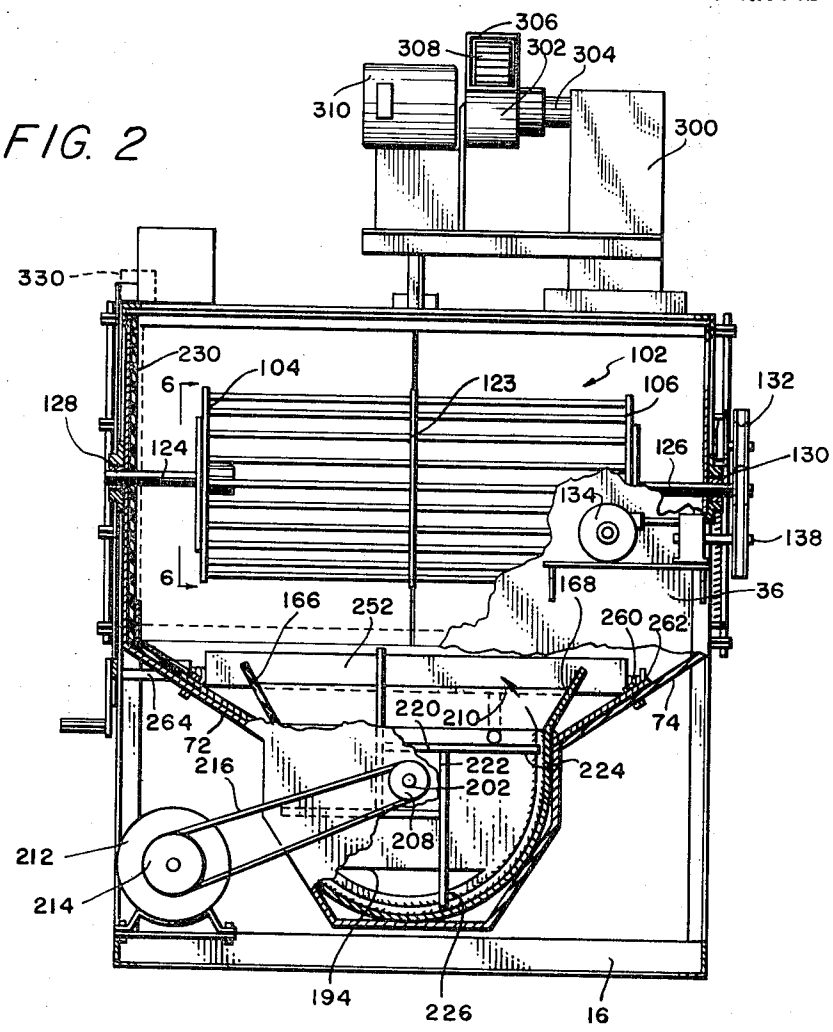
ATTORNEY

Dec. 15, 1970 P. L. ENEGREN 3,546,816

CLEANING MACHINE

Filed Oct. 25, 1967 4 Sheets-Sheet 2

FIG. 2



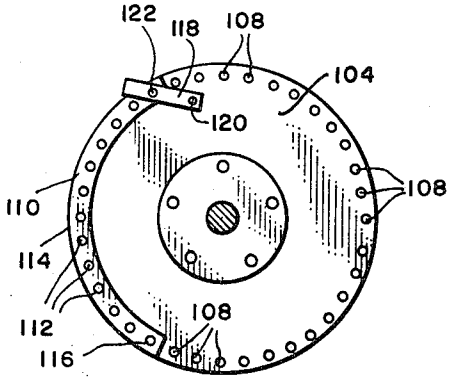


FIG. 6

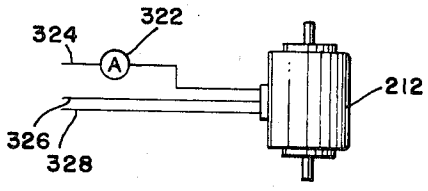


FIG. 16

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Dec. 15, 1970 P. L. ENEGREN 3,546,816

CLEANING MACHINE

Filed Oct. 25, 1967 4 Sheets-Sheet 3

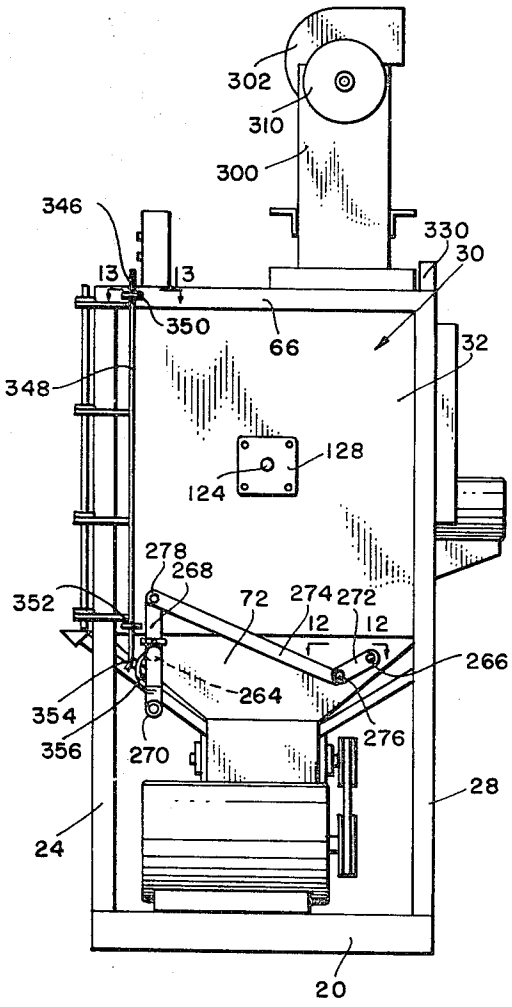


FIG. 3

FIG. 12

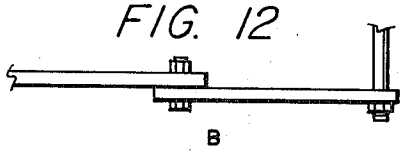
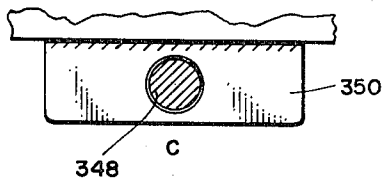


FIG. 13



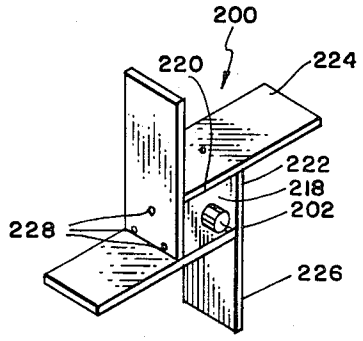


FIG. 11

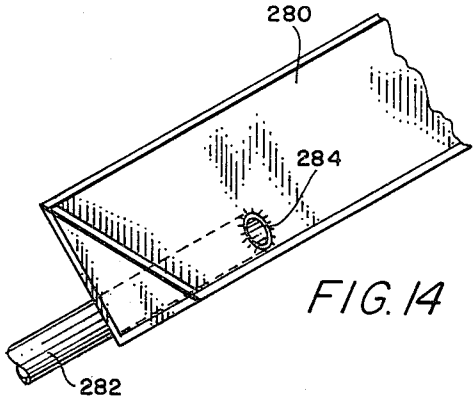


FIG. 14

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Dec. 15, 1970 P. L. ENEGREN 3,546,816

CLEANING MACHINE

Filed Oct. 25, 1967 4 Sheets-Sheet 4

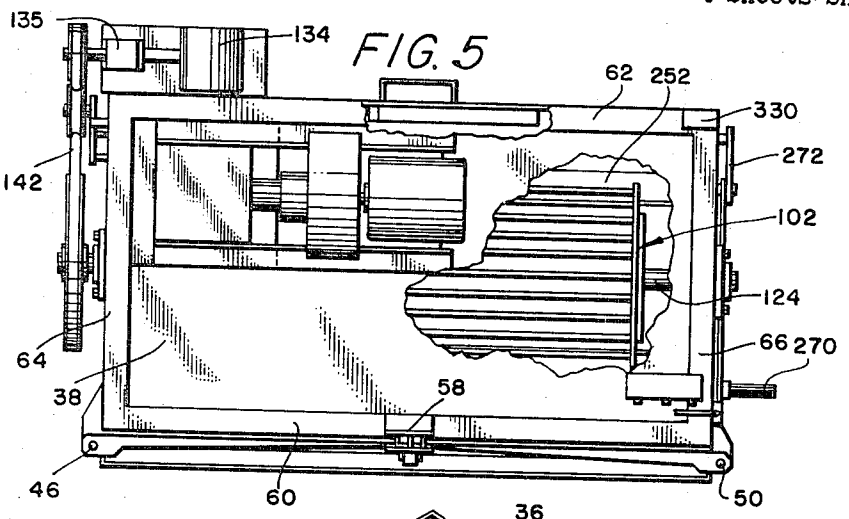


FIG. 5

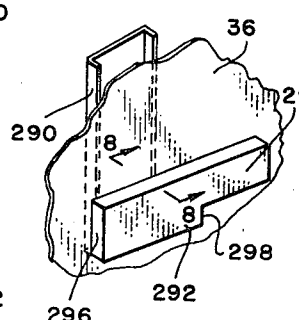


FIG. 7

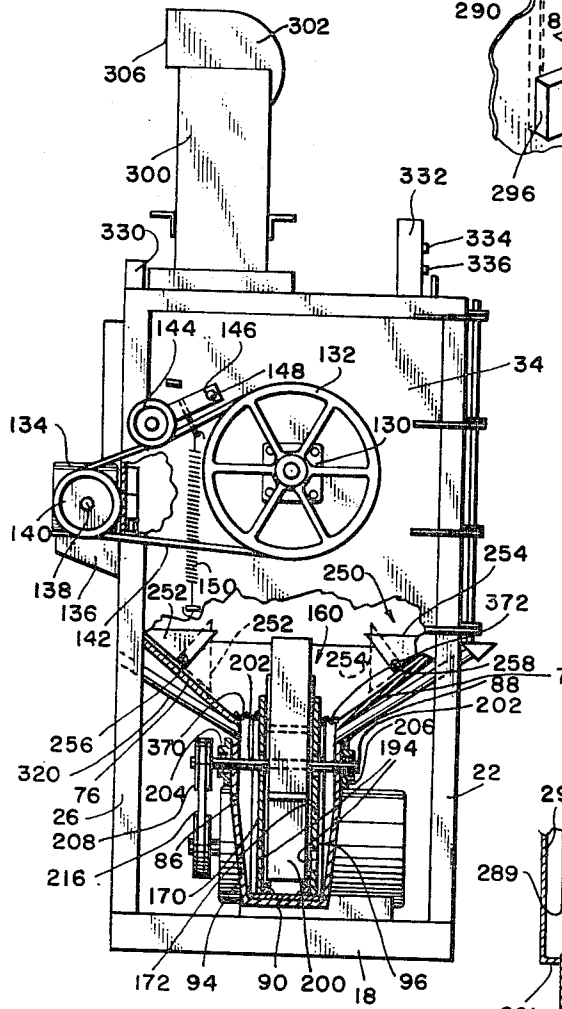


FIG. 4

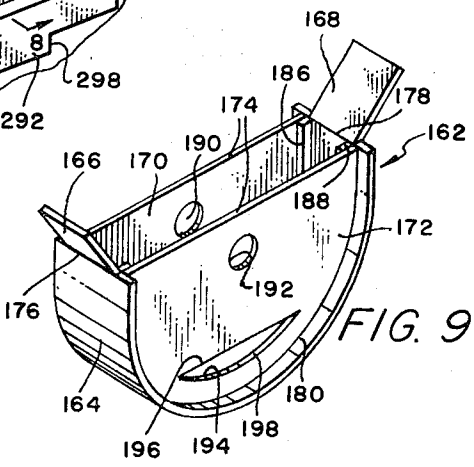


FIG. 9

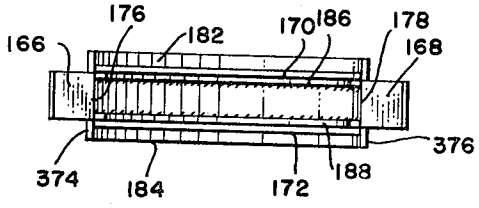


FIG. 10

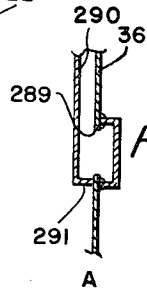


FIG. 8

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United States Patent Office 3,546,816
Patented Dec. 15, 1970

3,546,816

CLEANING MACHINE

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Filed Oct. 25, 1967, Ser. No. 677,899
Int. Cl. B24c 3/30
U.S. Cl. 51—9 15 Claims

ABSTRACT OF THE DISCLOSURE

A cleaning machine of the abrading or shot cleaning type wherein the articles to be cleaned are contained in an elongated grated basket of cylindrical configuration driven to rotate about a horizontal axis with shot impelling means disposed below the basket for propelling shot to impinge upon the basket and the contents thereof from below, said impelling means including an impeller rotatable about a horizontal axis normal to the vertical plane of the basket's axis. The machine has a housing for gravitationally directing spent shot into an inlet of the impelling means for recirculation. Means is provided for selectively sequestering spent shot against continued circulation in the machine, whereby the shot can be sequestered prior to stopping the impelling means and the latter can then be restarted at a subsequent time with little or no shot presenting a high starting load thereto, and previously sequestered shot can then be slowly released after the impeller has been started for gravitational movement to the inlet of the impeller. The machine also includes an ammeter to indicate electric current being fed to an electric motor driving the impeller, whereby an amount of shot can be introduced into the housing through a baffled opening provided for this purpose sufficient to constitute a desired load on the impeller. The baffled opening additionally serves as an air inlet whereby dust and fine material within the housing can be entrained and removed from the machine by a filtered suction cleaner coupled to a baffled or screened air exhaust opening in the top of the housing. Finally, in order to lessen the likelihood of the operator operating the stop switch of the impeller electric motor without having sequestered the shots, means is associated with the sequestering means control to partially impede access to the stop switch when the sequestering means is inoperative or the control therefor is in its sequestered shot releasing position.

The present invention relates to new and useful improvements in cleaning machines of the type that clean articles, usually metallic, of rust or oxides and of adhering welding flux or the like by impinging shot thereon, whereby the cleaned articles are placed in a condition suitable for use or painting or the like with little or no subsequent cleaning or surface treating procedures.

Prior art proposals are subject to one or more shortcomings amongst which may be mentioned that considerable difficulty is encountered in providing the cleaning machine with the proper amount of shot, it being understood that for any given machine optimum performance is realized when the machine is loaded with a more or less well defined range of amount of shot. In other words, loading a machine with a quantity of shot substantially less or substantially greater than the optimum amount results in undesirable operation in that a greater period of machine operation may be necessary to achieve a particular degree of cleaning action, or a sufficient degree of cleaning may be entirely unobtainable. Furthermore, excessive loading can result in damage to an electric motor driving the shot impelling means or at the least result in blown fuses or the opening of circuit breakers. It is quite inconvenient with cleaning machines heretofore proposed to maintain a proper amount of shot in the cleaning machine, and adjustment can ordinarily only be made when the machine is shut down, at which time the shot in the machine is removed, frequently with considerable inconvenience, and sufficient shot added thereto to bring the total amount of shot up to an optimum amount of total shot.

Another very objectionable shortcoming of many proposals is that it is essential that all or at least most of the shot be actually removed from the machine prior to commencing a cleaning cycle for the reason that the presence of all the shot in the machine at the commencement of a cleaning cycle results in severe overloading of the impeller means when first commencing to operate the impeller. The situation is most aggravated when the total amount of shot employed is of the optimum amount.

The primary purpose of the present invention is to provide a cleaning machine of the type described wherein the machine can be maintained loaded wiht the optimum amount of shot at all times, and wherein it is not necessary to remove the shot from the machine and weigh the same in order to determine whether an excessive amount or an insufficient amount of shot is present in the machine.

Still another chief purpose of the present invention is to provide a cleaning machine of the type described wherein it is possible without removing shot from the machine between cleaning cycles to start the impeller without the latter being excessively loaded.

The present invention is also directed to the provision of a cleaning machine of the type described such as to minimize the possibility of the operator operating the machine in such a manner that the impeller will be overloaded on initiating a subsequent cleaning cycle.

Another purpose of the present invention is to provide a cleaning machine of the type described wherein spent shot is gravitationally directed to an inlet of the impeller means that is disposed at a position substantially below the axis of rotation of the impeller and adjacent the outermost radial extent of the impeller.

It is an object of the present invention to provide sequestering means disposed vertically intermediate the basket containing articles to be cleaned and the inlet of the impeller means such as to be selectively operable to intercept and collect spent shot descending toward the inlet of the impeller means so that all or at least a substantial proportion of the total amount of shot present in the machine can be effectively withdrawn from recirculation through the impeller means prior to stopping the impeller on conclusion of a cleaning cycle, such sequestering means being controllable on a subsequent cleaning cycle to slowly release sequestered or collected shot for gravitational descent to the inlet of the impelling means after the impeller has been started.

A broad aspect of the invention involves, for use in a cleaning machine, an improved shot impeller means comprising an open topped impeller casing, said casing including parallel vertical side plates joined by an upwardly concaved arcuate end wall, an impeller wheel disposed in said casing and extending above the open top of the latter, said impeller wheel being mounted for rotation about a horizontal axis normal to the side plates and defining a surface of revolution closely spaced to the side plates and the arcuate end wall with free running clearance therebetween, said side plates each having an opening therethrough at positions closely adjacent the lowermost extent of the surface of revolution defined by the impeller wheel, and the arcuate end wall having integral opposite end portions that extend upwardly and outwardly from said surface of revolution.

Another broad aspect of the invention involves, in a

cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means; the improvement comprising selectively operable means for intercepting and sequestering spent shot descending in the housing, and means disposed intermediate the intercepting and sequestering means and the impeller means for guiding shot released from sequestration into the impeller means at a position adjacent the bottom of the latter.

Yet another broad aspect of the invention involves, in a cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means, and an electric motor for driving the impeller means; the improvement comprising an electric motor drivingly connected to the impeller means, means for indicating a parameter of the electric power being provided with shot inlet means for enabling the introduction of shot during operation of the impeller means, whereby an amount of shot may be introduced sufficient to obtain a desired amount of load on the impeller means.

An important feature of the invention resides in the provision of a pair of troughs mounted to oscillate between upright and dumping positions, such troughs being interconnected for movement in unison intermediate their upright and dumping positions, and such troughs being disposed at positions vertically intermediate the basket and the impeller means, and at horizontal positions disposed on opposite sides of the impeller means.

Another important feature of the invention resides in the means for controlling the oscillation of the troughs being operatively connected to a movable indicator of the position of the troughs, such indicator moving into a position partially impeding manual access to the stop switch of the impeller motor when the troughs are in their dumping position.

Still another important feature of the invention resides in the provision of an ammeter in the power circuit of the impeller motor, whereby an indication of the load of the impeller may be obtained.

Yet another important feature of the invention resides in the proviison of an ammeter as set forth in the preceding paragraph in combination with the housing being provided with an inlet through which shot may be introduced into the machine housing during operation of the impeller, whereby an amount of shot may be introduced sufficient to increase the loading of the impeller to a desired degree.

Still another important feature of the invention resides in the provision of an ammeter as previously described in conjunction with the provision of sequestering means, whereby it may be ascertained when the impeller has been sufficiently unloaded by the sequestration or retention of shot in the troughs to permit the impeller to be stopped, and also whereby the operator can judge the rate at which the troughs should be dumped on restarting operation of the machine.

These and other purposes, aspects and features of the invention of importance will become manifest during the ensuing description of a preferred embodiment of the invention, such preferred embodiment of the invention being illustrated in the accompanying drawings, wherein:

FIG. 1 is a front elevational view of the cleaning machine with the front doors thereof being shown in the closed position;

FIG. 2 is a rear elevational view of the machine shown in FIG. 1, with portions of the housing and impeller casing being shown broken away and shown in section;

FIG. 3 is an end elevational view of the machine shown in FIGS. 1 and 2, this view being taken from the right-hand end of the machine;

FIG. 4 is an end elevational view of the machine taken from the lefthand end of the machine as viewed in FIG. 1, portions of the housing and impeller casing being broken away to reveal internal details of construction;

FIG. 5 is a top plan view of the machine, a portion of the top of the casing being broken away to reveal internal details of the machine;

FIG. 6 is an enlarged end elevational view of the grated basket, this view being taken upon the plane of the section line **6—6** in FIG. 2;

FIG. 7 is an enlarged fragmentary isometric detail view of the shot inlet means provided in the rear wall of the housing;

FIG. 8 is a vertical sectional detail view taken upon the vertical plane of the section line **8—8** in FIG. 7;

FIG. 9 is an enlarged isometric view of the impeller casing;

FIG. 10 is a top plan view of the impeller casing shown in FIG. 9;

FIG. 11 is an isometric view of the impeller;

FIG. 12 is an enlarged fragmentary detail view taken from above in the plane of the section line indicated at **12—12** in FIG. 3 of a portion of the same interconnecting the oscillatable troughs disposed in the machine housing;

FIG. 13 is an enlarged top plan view of a portion of the structure for indicating the position of the troughs and for selectively impeding access to the impeller stop switch, this view being taken from the plane of the section line indicated at **13—13** in FIG. 3;

FIG. 14 is an enlarged fragmentary isometric detail view of spilled shot return means mounted externally on the housing below the housing doors;

FIG. 15 is a diagrammatic view of a portion of the electrical control means for the basket drive and the exhaust blower; and,

FIG. 16 is a diagrammatic view of the electric power supply for the impeller motor with an ammeter provided therefor, and the operative connection of the motor to the impeller.

Referring now to the drawings where like numerals designate like parts throughout the various views, the reference numeral **10** designates the cleaning machine generally, the same comprising an open support frame **12** including a rectangular base formed of front and rear members **14** and **16** connected at opposite ends by base side members **18** and **20**. The frame **12** additionally includes upstanding support members **22**, **24**, **26** and **28** disposed at the corners of the rectangular base portion of the frame **12**.

The machine **10** also includes a housing carried by the frame **12**, such housing designated generally at **30** comprises opposite side walls **32** and **34**, and a rear wall **36**. The housing **30** has a top wall **38**, and the housing has an open front that is selectively opened and closed by means of doors **40** and **42** that are respectively hinged for swinging movement about vertical axes as indicated at **44** and **46**, and at **48** and **50**. Means is provided at **52** and **54** for selectively latching the doors **40** and **42** in closed position. The door **42** includes a plate **56** which overlaps the adjacent edge of the door **40** when the doors **40** and **42** are closed, the latching means **52** and **54** being carried by the plate **56** and coacting when in latching position with latchkeepers such as the one indicated at **58** which are rigidly fixed to the frame **12** and the housing **30**.

The side walls **32** and **34**, the rear wall **36** and the top wall **38** of the housing **30** are fixedly secured to the frame **12** as are the hinge means **44**, **46**, **48** and **50** for the doors **40** and **42**. Such support for the housing **30** is enhanced by the frame **12** including as an integral part thereof an upper rectangular framework comprised of front and rear members **60** and **62**, respectively, and side members **64** and **66**, such members **62–66** being attached to the upper ends of the vertical frame members **22** through **28**. The vertical extent of the portion of the housing **30** consti-

tuted by the side walls 32 and 34, the rear wall 36 and the doors 40 and 42 are identical, and such vertical extent occupies the upper portion of the interior of the frame 12.

The housing 30 for an intermediate portion of its vertical extent extends downwardly from the end walls 32 and 34 and the rear wall 36 as well as from the lower inside marginal portions of the doors 40 and 42 (when the latter are in their closed positions) in the form of an inverted truncated pyramid designated generally at 70. Such truncated pyramid portion 70 of the housing 30 is comprised of sloping bottom walls 72 and 74 that are sloped to converge downwardly and have their upper edges secured respectively to the end walls 32 and 34. The truncated pyramid portion 70 of the housing 30 also includes sloping bottom walls 76 and 78 extending respectively between the rear and front edges of the bottom walls 72 and 74. The sloping bottom walls converge downwardly with the upper edge of the sloping bottom wall 76 being secured to the lower edge of the rear wall 36. The upper marginal edge portion of the bottom wall 78 is disposed to seat against the inner side of the doors 40 and 42 adjacent their lower edges when such doors 40 and 42 are closed. Preferably, the forwardmost and uppermost edge of the sloping bottom wall 78 as well as the forwardmost edges of the end walls 32 and 34, and the top wall 38 are provided with rubber or neoprene sealing members, not shown, against which the doors 40 and 42 seat and seal when the doors 40 and 42 are closed.

The lower end of the sloping bottom wall portion or truncated pyramid poriton 70 of the housing 30 terminates in a common plane and is connected to a depending shot sump designated generally at 80. The arrangement is such that shot disposed upon the sloping bottom wall or truncated pyramid portion 70 of the housing 30 will gravitationally slide into the open upper end of the shot sump 80, it being noted that the shot sump 80 is centrally disposed with respect to the uppermost part of the housing 30, and that the horizontal dimensions of the open upper end of the shot sump 80 are substantially less than those of the upper part of the housing 30.

The upper portion of the shot sump 80 depends from and is attached to the truncated pyramid portion 70 of the housing 30, and is comprised of parallel vertical end walls 82 and 84 depending from the lower edges of the sloping bottom walls 72 and 74 respectively, and parallel vertical side walls 86 and 88 depending respectively from the sloping rear and front sloping bottom walls 76 and 78 respectively. The lower portion of the shot sump 80 is in the form of a truncated pyramid that is closed at its lower end by a bottom wall 90, the truncated pyramid constituting the lower portion of the shot sump 80 being designated generally at 92 and being comprised of steeply sloped side walls 94 and 96 which are respectively integral with the side walls 86 and 88. The truncated pyramid portion 92 of the sump pump also includes end walls 98 and 100 which are integral with the end walls 82 and 84.

A grated basket, preferably formed of hardened steel components, is designated generally at 102 and is disposed within the upper portion of the housing 30, the basket 102 being generally in the form of an elongated cylinder comprised of circular end plates 104 and 106. Identical peripheral portions of the discs or circular end plates 104 and 106 somewhat greater than 180° in extent are fixedly secured together by spaced parallel rods such as those indicated at 108. As best shown in FIG. 6, the basket 102 includes a door 110 whereby the basket 102 can be opened and closed and latched in its closed position. The door 110 is carried by the end plates 104 and 106, and since the door 110 bears identical relationship to each of the plates 104 and 106, a description of the relationship of the door 110 to the plate 104 will suffice for both. The door 110 is comprised of a plurality of spaced parallel rods 112 which occupy positions, when the door 110 is closed, constituting a continuation of the generally cylindrical distribution of the rods 108. The ends of the rods 112 adjacent the plate 104 are fixedly secured to an arcuate strap 114, such arcuate strap 114 having one end pivotally mounted at 116 about one of the rods 108. As mentioned previously such structural relationship is duplicated at the end of the basket 102 opposite the arcuate strap 114, whereby the door 110 including the rods 112 can be swung outwardly from the closed position shown of the same in FIG. 6 about the pivotal connection 116. A latch 118 is pivotally connected to the plate 104 at 120, and the latch 118 is movable to be selectively engageable over a protruding end of one of the rods 122 extending between the arcuate straps 114, it being understood that the latch bar 118 is provided with an opening for receiving the protruding end of the rod 122 and is sufficiently resilient to be disengaged from the rod 122.

Intermediate the plates 104 and 106, the sets of rods 108 and 112 can be provided with arcuate braces welded thereto such as indicated at 123.

The opposite ends of the basket 102 are provided with oppositely extending trunnion shafts 124 and 126, such trunnion shafts being coaxial with the axis of the basket 102 and journaled through bearings 128 and 130 fixed in suitable openings provided in the end walls 32 and 34. The trunnion shaft 126 extends through the bearing 130 to project outwardly from the housing 30, and the trunnion shaft 126 has a pulley 132 fixed therethrough by means of which the basket 102 can be rotated. An electric motor 134 and a gear reduction box 135 driven thereby are mounted on a bracket 136 fixed to the rear of the frame 12, and the output shaft 138 of the gear reduction box 135 is provided with a driving pulley 140. An endless pulley belt 142 is entrained over the pulleys 132 and 140, whereby the electric motor 134, when energized, rotates the pulley 132 and the basket 102. The pulley belt 142 is maintained under proper tension by means of an idler pulley 144, the idler pulley 144 being rotatably mounted on the free end of a lever 146 which is in turn pivotally mounted at 148 on the housing wall 34, a spring 150 serving to bias the pulley 144 against the belt 142.

As will be evident on inspection of the drawings, the upper portion of the housing 30 is rectangular, and the axis of the cylindrically shaped basket 102 extends centrally within such upper portion of the housing 30 along the major extent of the rectangular configuration of the housing 30. The central portion of the basket 102 directly overlies the center of the shot sump 80. It will be noted that the vertical position of the basket 102 is such that the lowermost extent of the basket is preferably disposed at or above the uppermost extent of the truncated pyramid portion 70 of the housing 30.

An impeller means of hardened steel is designated generally at 160 and the same is disposed directly below the center of the basket 102 for the purpose of impelling shot upwardly against the bottom of the basket 102 for the entire axial extent of the latter, whereby articles disposed within and being tumbled within the basket 102 during rotation of the latter are cleaned. The impeller means 160 is comprised of an impeller casing 162 formed of an arcuate plate 164 of hardened steel. The arcuate extent of the plate 164 is generally a circular arc of approximately 180°, and has its concave surface facing upwardly. The opposite and uppermost end extremities of the arcuate plate 164 are bent so as to define upwardly diverging integral portions 166 and 168.

The casing 162 additionally includes spaced vertical side plates 170 and 172. The plates 170 and 172 have straight upper edges 174 that terminate in a horizontal plane that is coincident with the positions 176 and 178 at which the arcuate plate 164 is bent outwardly to define the straight upwardly divergent portions 166 and 168. Except for the straight upper edges 174 of the side plates 170 and 172, the peripheral edges 180 of the plates conform to the internal concave configuration of the arcuate hard-

ened plate **164** and are seated against and welded to the internal concave surface of the arcuate plate **164**. In the preferred construction, the transverse width of the arcuate plate **164** is greater than the spacing of the opposite sides of the plates **170** and **172** so that the arcuate plate **164** has side portions **182** and **184** projecting laterally from the opposite sides of the plates **170** and **172** as best shown in FIG. 10.

In order to prevent excessive wear at the juncture of the plates **172** and **174** with the arcuate plate **164** and in order to strengthen the structure additionally, arcuate strips or bars of hardened steel **186** and **188** are fitted along such junctures and welded to both the arcuate plate **164** and to the plates **170** and **172**. The plates **170** and **172** are respectively provided with aligned openings **190** and **192** to accommodate the shaft of an impeller wheel which will be presently described, it being noted that the openings **190** and **192** are disposed at the center of the circular arc defined by the arcuate plate **164**. Also, each of the plates **170** and **172** is provided with a small opening such as the opening **194** shown in association with the plate **172** in FIG. 9 to constitute shot inlet openings into the casing **162**. It will be noted that the openings **194** are disposed so as to have a limited vertical height terminating in a straight upper edge **196** and having an arcuate lower edge closely spaced above the arcuate extent of the arcuate plate **164**, the curved edge **198** of the opening **194** being directly above the welded connections of the plates **170** and **172** to the hardened steel wear strips **186** and **188**. It will be noted that in the preferred construction the casing end plates **170** and **172** are otherwise imperforate.

The impeller casing **162** is disposed within the shot sump **80**, and the bottom of the casing **162** rests directly upon the bottom wall **90** of the shot sump **80**. The vertical height of the impeller casing **162** is such that the horizontal plane defined by the upper edges **174** of the side plates **170** and **172** is above the lowermost extent of the truncated pyramid portion **70** of the housing **30**. The axis of alignment of the openings **190** and **192** is normal to the spaced vertical planes defined by the spaced side walls **86** and **88** of the shot sump **80**.

As thus far described, it will be apparent that the open upper end of the shot impeller casing **162** is disposed above the open upper end of the shot sump **80**. Furthermore, the transverse dimensions of the impeller casing **162** are such that the side plates **170** and **172** of the latter are spaced from the corresponding sides of the shot sump **80**. In the preferred construction, the longitudinal extent of the upper portion of the shot sump is such that the upper and opposite arcuate portions of the hardened steel plate **164** seat against the internal surfaces of the end walls **82** and **84** of the shot sump **80**, and such seated portions are welded so as to maintain the impeller casing **162** fixed in its assembled position.

It will be evident that shot gravitationally sliding upon the bottom wall of the hopper **30** (that is upon the sloping surfaces defined by the truncated pyramid portion **70** of the housing **30**) slide into the shot sump **80** in the space external to the casing **162** rather than through the open top of the latter because of the vertical height of the impeller casing **162**. Accordingly, shot sliding into the shot sump **80** can enter into the impeller casing **162** solely through the openings **194** provided in the lower portions of the plates **170** and **172**.

The shot impeller means **160** includes an impeller wheel **200** fixed to a shaft **202**. The shaft **202** extends through the openings **190** and **192** with free running clearance and is journaled through openings in and bearings **204** and **206** fixed to the side walls **86** and **88** respectively of the short sump **80**. The outer free end of the shaft **202** extending through the bearing **204** is provided with a pulley **208** by means of which the impeller wheel **200** is driven in rotation in the direction indicated by the arrow **210** shown in FIG. 2. An electric motor **212** of the three-phase

type is provided, the latter being disposed within and carried by the open framework **12** at a position below the upper portion of the housing **30**. The output shaft of the motor **212** is provided with a driving pulley **214**, and an endless pulley belt **216** is entrained over the pulleys **208** and **214**.

The impeller wheel **200** is comprised of a square hub **218** rigidly fixed to the shaft **202** for rotation therewith, the hub **218** having a cylindrical external configurataion that is a square in transverse section so as to define four external flat faces such as those indicated at **220** and **222** in FIGS. 2 and 11. It is not essential that the hub **218** be of hardened steel. The impeller wheel **200** is provided with impeller paddles or blades of hardened steel, four in number, which have their radially inner-most portions seated against the flat external faces of the hub **218**, as indicated with respect to the impeller blades **224** and **226** seated against the flat faces **220** and **222**. Such arrangement of the impeller blades of the impeller wheel **200** is more or less in the nature of a pin-wheel configuration, it being noted that each of the blades extends radially outward from the hub **218**. The impeller blades may, if desired, be welded to the hub **218**, but are preferably detachably secured to enable convenient replacement thereof by means of threaded fasteners **228** (which can be hardened) extending through the blades into the hub **218** in an arrangement such as shown in FIG. 11. It will be noted that the radially innermost ends of each of the impeller blades abuts one of the blades adjacent thereto, as for example the radially innermost end of the impeller blade **226** abuts one side of the impeller blade **224**. The impeller blades of the impeller **200** are formed of hardened steel such as that employed in the arcuate plate **164** of the impeller casing **162**, and the impeller hub **218** can be mild steel. The length of the impeller blades are such as to terminate in close proximity to the radially innermost edges of the arcuate wear strips **186** and **188**, and the transverse extent of the blades is such that free running clearance is afforded between the impeller blades and the plates **170** and **172** of the impeller casing **162**.

As thus far described, the operation of the machine **10** will be readily understood. Shot entering the impeller casing **162** through the openings **194** are picked up by the blades of the impeller wheel **200** and thrown upwardly in a fan shaped pattern that diverges upwardly to impinge along the entire length of the underside of the basket **102** with the result that a very large proportion of the shot thus propelled with pass between the rods **108** and **112** of the basket **102** to impinge upon articles being tumbled within the roating basket **102**. The upwardly diverging portions **166** and **168** of the hardened arcuate plate **164** serve to aid in defining such fan shaped pattern, and it will be noted that such upwardly divergent portions **166** and **168** serve to define a dihedral angle subtended by the grated basket **102**. Inasmuch as it may be possible for some of the shot to pass from the impeller means **160** to impinge directly against the end wall **34** of the housing **30**, a sheet of rubber **230** is secured against the inner side of such side wall **34** to protect the latter and absorb the energy of the impinging shot. Spent shot will fall within the housing **30**, and the majority of such spent shot will fall upon the sloping bottom of the housing **30** constituted by the truncated pyramid portion **70** thereof, and upon falling upon such sloping bottom wall will be gravitationally directed into the shot sump **80** to descend within the shot sump between side plates **170** and **172** and the shot sump side walls adjacent thereto. Shot descending within the shot sump **80** will thence enter the impeller casing **162** through the openings **194** for again being propelled upwardly by the impeller means **160** against the contents of the basket **102**. Thus, the shot continues to circulate in the manner described so long as the impeller wheel **200** is driven by the electric motor **212**.

It will be obvious that the load upon the impeller wheel **200** and correspondingly upon the electric motor **212** is a function of the rate at which shot enters the impeller

casing 162 through the openings 194. The quantity of the shot within the housing preferably is such as to optimize the cleaning effect produced by the shot upon the contents of the basket 102 without overloading the impeller wheel 200 and the driving motor 212. Whereas a given quantity of shot circulating in the system will produce a substantially constant load upon the impeller wheel 200 and the electric driving motor 212 during continuous operation, stopping of the impeller wheel 200 by deenergization of the electric motor 212 will allow, excepting for the provision of special means hereinafter described, all the shot within the system to come to a position of rest at the bottom of the housing 30 and within the shot sump 80 about the exterior of the impeller casing 162, and additionally a considerable quantity of shot will enter into the impeller casing 162 through the openings 194 due to the tendency of shot to flow to a considerable extent in the manner of a liquid. Except for the special means subsequently to be described, such accumulation of shot in the bottom of the housing 30 and within the lower part of the interior of the impeller casing 162 results in an excessive load or at least a load much greater on the motor 212 than would occur during continuous operation of the impeller wheel 200. This excessive loading is the consequence of the blades of the impeller wheel 200 encountering the mass of shot within the lower part of the impeller casing 162 as well as the substantial quantity of shot that immediately enters the lower portion of the casing 162 as soon as the impeller blades move any of the shot upwardly from the lower portion of the casing 162. Accordingly, the high starting load, except for the special means subsequently to be described, necessitates the use of a much smaller quantity of shot in the system than that which will optimize the rate of cleaning, or an electric motor 212 having a much higher power rating will be required than is necessary to deliver the amount of power sufficient to circulate the optimum quantity of shot during continuous full speed operation of the impeller wheel 200.

The specially provided means alluded to in the preceding paragraph comprises means for sequestering shot during an interval of continuous operation of the shot impelling means. In other words means is provided for selectively collecting and withholding shot from circulation whereby the total quantity of shot circulating in the system can be reduced to a sufficiently low level that on discontinuance of operation of the shot impelling means, very little shot, if any, is available to pass into the bottom of the shot pump 80 and particularly into the bottom of the impeller casing 162. With such quantity of the shot collected and sequestered, the electric motor 212 can be started without being subjected to the excessive starting loads mentioned previously, and after the impeller wheel 200 has been brought up to its normal speed of rotation, the sequestered shot can be released from sequestration for resuming its normal gravitational course to the inlet of the shot impelling means, the rate of release being such that excessive loading of the electric motor 212 can be avoided.

The selectively operable means for collecting and sequestering circulating shot from continued circulation is designated generally at 250, such means taking the form of a pair of elongated V-shaped troughs 252 and 254 which have their longitudinal extents parallel to the axis of the basket 102, and which are respectively disposed above the upper portions of the sloping bottom walls 76 and 78. The lengths of the troughs 252 and 254 are such that their extremities are disposed adjacent the sloping bottom walls 72 and 74. The opposite extremities of each of the troughs 252 and 254 are closed as may be seen on inspection of FIG. 4. The troughs 252 and 254 are mounted respectively about axes 256 and 258 for oscillation between an upright or shot collecting position shown in full lines in FIG. 4 and tipped or shot releasing or dumping positions shown in dashed outline in FIG. 4. The axes 256 and 258 parallel the longitudinal extents of the trough 252 and 254, and such axes are adjacent the apices of the V-shaped troughs 252 and 254. The axes 256 and 258 are spaced sufficiently above the sloping bottom walls 76 and 78 so that the troughs 252 and 254 will not block the movement of shot between the troughs 252 and 254 and their respective adjacent sloping bottom walls 76 and 78 when the troughs are in their dumping positions shown in dashed outline in FIG. 4.

It will be appreciated that when the troughs 252 and 254 are in their collecting and sequestering positions shown in full lines in FIG. 4, a portion of the shot circulating in the machine 10 having spent itself in the upper portion of the housing 30 will fall into the troughs 252 and 254 and be retained therein. Continued operation of the shot impelling means 160 with the troughs 252 and 254 disposed in their collecting and sequestering positions will result after a period of time in substantially all or at least a major proportion of all the shot within the machine 10 having been collected in and having come to rest within the troughs 252 and 254, it being noted that the troughs 252 and 254 have sufficient capacity or volume for holding all the shot within the machine 10. It will be apparent in view of the foregoing that the shot impelling means 160 can be operated if desired until substantially all shot circulating in the system by which is meant shot free to flow into the impeller casing 162 through the opening 194 has come to rest within the troughs 252 and 254. With virtually all or at least a sufficiently major proportion of the shot in the system collected and sequestered in the troughs 252 and 254 so that no shot or very little shot is entering the lower portion of the impeller casing 162, the motor 212 can be deenergized and subsequently re-energized with the shot constituting no load at all or a very little load upon the impeller wheel 200 and the electric motor 212. With the electric motor 212 re-energized and the impeller wheel 200 brought up to operating speed, the troughs 252 and 254 can be by means hereinafter described oscillated toward their dumping positions to release the shot contained thereby for gravitational descent into the shot sump 80 and entry into the impeller casing 162 through the openings 194.

The means for oscillatably mounting the troughs 252 and 254 and the means for controlling the oscillation of the troughs 252 and 254 will now be described. The opposite ends of each of the troughs 252 and 254 are provided with trunnions, with the trunnion shafts at the righthand ends of the troughs (as viewed in FIG. 2) being journaled in bearings carried by the bottom wall 74, the trunnion shaft and the bearing therefor provided in association with the trough 252 being designated respectively at 260 and 262 in FIG. 2. It will be understood that the trough 254 is provided with a trunnion shaft and bearing similar to the shaft and bearing 260 and 262. The trunnion shafts provided at the lefthand ends of the troughs 252 and 254 (as viewed in FIG. 2) are journaled through suitable openings and bearings in the bottom wall 72 so as to project outwardly from the housing 30. Such outwardly projecting trunnion shafts for the troughs 252 and 254 are designated respectively by the reference numerals 264 and 266. It will be noted that the troughs 252 and 254 oscillate in opposite directions in moving from their upright collecting positions to their dumping positions, and the control means for the troughs 252 and 254 include provision for effecting oscillatory movement of the troughs in opposite directions. Such control means comprises an operating lever 268 (see FIG. 3) having an intermediate portion thereof fixed to the trunnion shaft 264. One end of the operating lever 268 is provided with a handle 270, whereby the operator of the machine 10 can actuate turning movement of the trunnion shaft 264. The trunnion shaft 266 has an actuating arm 272 fixed thereto, and a link 274 has its opposite ends pivotally connected at 276 and 278 to the free end

of the arm 272 and to the end of the lever 268 opposite the handle 270. The arrangement is such as will be evident on inspection of FIG. 3 that movement of the lever 268 by use of the handle 270 such as to effect turning movement of the trunnion shaft 264 in one direction will actuate through the link 274 and the arm 272 a turning movement of the trunnion shaft 266 in the direction opposite to that in which the trunnion shaft 264 is turned. Thus, the operator of the machine 10 can by use of the handle 270 cause movement of the troughs 252 and 254 back and forth between their collecting and dumping positions, it being noted that the rate at which the troughs are oscillaed between such positions is governed by the rate at which the operator turns the handle 270. Accordingly, the operator can dump sequestered shot at a rate under his control. Means, not shown, are provided to limit the oscillatory movement such that the full and dashed lined positions shown thereof constitute the limiting positions of oscillatory movement of the troughs 252 and 254. In this regard it will als be noted that each of the two illustrated positions of the troughs 252 and 254 are stable positions. In other words, the weight distribution of the roughs with respect to their axes 256 and 258 is such that when the troughs are in their collecting position, they will remain so until the operator exerts a turning force upon the handle 270. Similarly, it will be evident that when the troughs are in their dumping position, the operator must actuate the lever 268 in order to restore the troughs 252 and 254 to their collecting positions.

The electric motor 212 is of course de-energized so as to stop the impeller wheel 200, the shot having been previously collected and sequestered prior to opening the doors 40 and 42 of the housing and the door 110 of the basket 102 for removal of articles that have been cleaned and the basket then refilled or rather partially refilled when tumbling is desired prior to initiation of another cleaning cycle.

It is quite important in the interest of safety that spillage of shot on the floor about the machine 10 be minimized. It will be appreciated that the round character of the shot makes the same act as minute ball bearings such as to afford very precarious footing to operating personnel. Virtually all the shot which may fall upon the floor on the opening of the doors 40 and 42 is such shot as may have become wedged about the edges of the doors 40 and 42 and where the doors seat against the previously described rubber or neoprene seals. Shot which may become freed in such a manner as to fall upon the floor when the doors 40 and 42 are opened will tend to fall immediately in front of the machine 10, a trough 280 is fixed to the front of the machine 10 directly below the doors 40 and 42 in such a position that such a shot that would otherwise fall to the floor on the opening of the doors 40 and 42 will fall into the trough 280. The trough 280 is provided with a drain tube or pipe 282, the pipe 282 having its upper end opening into the lower interior of the trough 280 as indicated at 284, and the lower end of the pipe 282, which is inclined downwardly from the trough 280 is connected to the interior of the shot sump 80 through the side wall 88 to which the pipe 282 is connected at 286. On the accumulation of an appreciable amount of shot in the trough 280, the operator can take a brush or merely use his hand to move the shot along the trough 280 so that such shot will drain downwardly through the pipe 282 into the shot sump 80 so as to be returned to the system.

Means is provided for adding shot to the system during operation of the impeller means 160. Such means comprises the back wall 36 of the housing 30 being provided with an opening 289 therethrough affording communication between a short vertical chimney 290 in the rear exterior of the wall 36 and a horizontal baffle structure 292 fixed on the internal side of the back or rear wall 36. The chimney 290 is defined by the open side of a section of channel iron being welded to the rear of the wall 36 so as to be disposed about and to extend upwardly from the opening through the wall 36. A small steel plate 291 is welded to the lower end of the channel member constituting in conjunction with the rear wall 36 the chimney 290 so as to close the latter below the opening through the rear wall 36. The baffle structure 292 is comprised of a horizontally extending piece of channel iron 294 having its open side facing toward the inner surface of the rear wall 36 and welded thereto, with a small steel plate 296 being welded to close one end of the space provided between such channel section 294 and the rear wall 36. The end of the channel section 294 opposite the plate 296 is open, and a portion 298 of the channel 294 is cut away as clearly shown in FIG. 7 to further facilitate communication between the interior and the exterior of the baffle structure 292 at a position laterally remote from the opening through the rear wall 36 affording communication between the interiors of the channels constituting the chimney 290 and the baffle structure 292.

The opening 289 together with the chimney 290 and the baffle structure 292 constitutes a tortuous passageway from the exterior to the interior of the housing 30, and such passageway affords means whereby shot may be introduced into the upper open end of the chimney 290 for passage into the housing 30, and additionally, such passageway affords a path for the entry of air into the housing 30 for a purpose to be presently explained. It will be appreciated that the tortuous character of the passageway through the rear wall 36 described is such that shot propelled by the impeller means 160 will not be discharged from the machine 10 through the chimney 290.

Inasmuch as the operation of the machine 10 will generate substantial quantities of dust and small foreign particles during operation by the removal of rust scale, flux deposits, and the like, from the objects being cleaned, and inasmuch as it is desirable that such dust and light foreign materials be removed from the machine 10 so as to prevent an accumulation of the same therein and also to preclude or at least minimize loose adherence of the same to the articles removed from the machine 10, an exhaust system is provided for continuously withdrawing air and entrained dust and light foreign objects from the interior of the housing 30. Such exhaust means comprises the top wall 38 being provided with an opening communicating with an upstanding chimney or conduit 300. The open lower end of the duct 300 which communicates with the hollow interior of the housing 30 through the top wall 36 may be provided with baffles (not shown) for preventing or deflecting shot from passing upwardly from within the housing 30 into the duct 300. The upper end of the duct 300 has communication with the inlet of an exhaust fan 302 by way of a lateral duct 304, and the outlet port 306 of the fan 302 is adapted to be connected to a large air filter bag, not shown. The rotating element 308 of the fan 302 is connected to be driven by an electric motor 310 in a conventional manner.

When the fan 302 is driven by the energized motor 310, air is drawn into the housing 30 through the opening 289 in the rear wall 36, and air is additionally drawn into the housing 30 through the shot drain pipe 282, such air being drawn into the housing 30 thence passing with entrained dust and small particulate materials through the ducts 300 and 304 to be discharged through the outlet port 306 of the fan 302 into the filter bag, not shown. The entrained dust and light particulate materials are of course retained within the filter bag for subsequent removal and disposal.

Since air entering the housing 30 through the pipe 282 in the vicinity of the impeller means 160 is particularly effective in the entrainment of dust and undesired light particulate materials, a further air inlet is provided, the latter comprising a ventilation pipe 320 having one end communicating with the interior of the shot sump 80

through the side wall **86**, and the other end being open to afford for the free entry of air thereinto. Preferably, the ventilation pipe **320** is inclined upwardly from the shot sump **80** as clearly shown in FIG. 4.

In view of the foregoing, whenever the electric motor **310** is energized to drive the exhaust air pump or exhaust fan **302**, air is drawn into the housing **30** through the shot inlet means partially defined by the opening **289** in the rear wall **336** and through the pipes **282** and **320**, such air drawn into the housing **30** together with air already in the housing **30** entrain dust and fine particulate materials in the housing **30** and proceed outwardly from the machine **10** through the ducts **300** and **304** and the exhaust fan **302** to an air filter, not shown. As mentioned previously, the opening through the top wall of the housing **30** through which the duct **300** has communication with the interior of the housing **30** can be provided with baffies, not shown, for the purpose of preventing escape of shot through the duct **300**. Obviously, if it is found to be necessary to provide such baffles, they will be of conventional character and arranged such as to not restrict air flow to such an extent that the entrainment of dust and light particulate materials is substantially affected. Clearly, the fan **302** is operated at a rate such that the air flow upwardly through the duct **300** will not entrain sizeable dense materials such as the shot itself.

Means is provided whereby the operator of the machine **10** can judge the rate at which the shot sequestered in the hoppers **252** and **254** should be released so as not to over-load the impeller wheel **200** and the electric motor **212**. For this purpose means is provided for indicating the magnitude of a parameter as to the rate of power consumption by the motor **212**. Means of various character can be provided for this purpose such as, for example, a watt meter, not shown, in the electrical power leads for the motor **212**. Inasmuch as the current flow in an electrical power lead for the electric motor **212** has a magnitude related to the rate of power consumption by the electric motor **212**, and inasmuch as such harmful effects of overload of the motor **212** is a direct function of the rate of current flow in its power leads, the preferred form of the invention illustrated provides an indicating means of the character specified, the same taking the form of an alternating current ammeter **322** provided in one of the three electrical supply leads **324**, **326** and **328** of the electric motor **212** (see FIG. 16), it being recalled that in the preferred construction the electric motor **212** is a three-phase motor. It is deemed well within the skill of the art that equivalent indicating means can be provided for use with single phase motors or with direct current motors.

In the preferred construction, the ammeter **322** is housed in a box **330** mounted on the top of the machine **10** and is preferably faced toward the front of the machine **10** so as to be readily viewable by the operator manipulating the control handle **270** of the collecting and sequestering means. Thus, the operator will on starting the electric motor **212** and after allowing the impeller wheel **200** to come up to speed, turn the control handle **270** at a rate slowly tilting the troughs **252** and **254** to release the shot contained therein, and such rate of release will be controlled in such a manner that the indication by ammeter **322** will not exceed a prescribed level or value commensurate with the power rating of the electric motor **212**.

The ammeter **322** also serves an additional function in that the operator can employ the same to judge when the motor **212** has been energized for a sufficiently long interval after the troughs **252** and **254** have been moved to their upright or collecting positions by use of the handle **270**. It will be apparent to those skilled in the art that as the shot is progressively collected the indication of current flow by the ammeter **322** will continue to decrease to indicate a final current flow corresponding to little or no shot entering the impeller casing through the openings **194**. After having apprised himself of such lower limit of current draw, the operator of the machine **10** simply defers de-energizing the electric motor **212** after the hoppers or troughs **252** and **254** have been placed in their collecting positions until the current flow indicated by the ammeter **322** has diminished to such previously ascertained value, and the operator can then de-energize the electric motor **212**, open the doors **40** and **42**, and then open the basket **102** (the electric motor **134** driving the basket **102** having been de-energized when the door of the basket **102** has reached a convenient position), and remove the articles having undergone cleaning therefrom. After the cleaned articles have been removed from the basket **102**, articles then to be cleaned are placed therein, the basket **102** is closed, the doors **40** and **42** closed, the basket **102** driven to rotate, the electric motor **212** energized, and the shot is then released as previously described from the troughs **252** and **254**.

After all the shot has been released from the troughs **252** and **254**, it may be that the indication of current flow by the ammeter **322** may be less than that indicative of the rate of power consumption by the electric motor **212** corresponding to the machine **10** being loaded with the optimum amount of shot. The operator of the machine **10** will then upon becoming apprised that the machine **10** is not loaded with sufficient shot proceed while the shot within the machine is in circulation with the impeller wheel **200** rotating to add increments of shot to that contained within the machine **10** through the chimney **290** while checking the indication of the ammeter **322**. The addition of shot in this manner will be continued until the current flow corresponds to the machine **10** being loaded with the optimum quantity of shot.

The fan **302** may be left in continuous operation if desired, or the operation thereof may be curtailed during intervals that cleaned articles are being removed from the machine and articles to be cleaned are being charged into the same.

In order to preclude inadvertent or careless de-energization of the electric motor **212** at any time other than when the shot is sequestered in the troughs **252** and **254**, except in the case of an emergency, means is provided to partially impede manual access to the control switch that controls de-energization of the electric motor **212** whenever the troughs **252** and **254** are in other than in their upright collecting positions.

The means mentioned in the last paragraph for partially impairing access to the switch control means for the electric motor **212** is employed in conjunction with a conventional switch control box **332** of the starter type which includes separate start or on and stop or off manually actuable push buttons for controlling the energization of the electnic motor **212**, the electric motor **134**, and the electric motor **310**. Specifically, the electric switch means for controlling energization of the electric motor **310** from a three-phase supply line **333** through a three-phase supply line **334** comprises start and stop buttons **335** and **336**, respectively. The electric switch means for controlling the energization of the electric motor **134** from a three-phase supply line **345** through a line **337** comprises start and stop control buttons **338** and **340**, respectively. Similarly, the electric control switch means for controlling the eneryization of the electric motor **212** from a three-phase supply line **341** through a three-phase supply line **342** (inclusive of the conductors **324**, **326** and **328**) comprises start or on and stop or off push control buttons indicated respectively at **343** and **344**.

In the preferred construction each of the three-phase supply lines **333**, **345** and **341** is conventionally individually protected by a circuit breaker, not shown.

As mentioned, the electric switch means described above for controlling each of the three motors is con-

ventional, and, for example, the electric motor **212** is started by manually depressing the on button **343**, and the electric motor **212** will remain energized until the stop or off button **344** is manually depressed. The means for partially obstructing or partially impeding manual access to the manual stop or off button **344** comprises a flag **346** that is movable vertically between the full and dashed outline positions shown thereof in FIG. 1. It will be noted that when the flag or obstruction plate **346** is disposed in the position indicated in dashed outline the same is disposed directly in front of the stop button **344**, and that when the flag **346** is disposed in the position depicted in full lines the same is disposed below being directly in front of the stop button **344**. The flag or obstruction plate **346** is spaced forwardly of the stop button **344** by an interval sufficient for the operator to readily interpose his finger between the flag and the button **344** so as to manipulate the latter so as to stop the electric motor **212**, but such spacing is such that the flag **346** cannot escape notice and also requires at least a minor degree of dexterity on the part of the operator in order to actuate the stop button **344**. Preferably also the flag or obstruction plate **346** is red in color or at least painted in some color contrasting with its background and may have printed thereon instructions relating to necessity for properly sequestering the shot within the machine **10** prior to actuation of the stop button **346**.

The flag or obstruction plate **346** is fixed upon the upper end of a vertical push rod **348**. The push rod **348** is slidable vertically through vertically spaced, apertured guides **350** and **352** fixed to the exterior of the machine **10**. If desired, the aperture through one of the plates **350** and **352** can be noncircular with the portion of the push rod **348** slidable therethrough having a corresponding configuration so that rotation of the push rod **348** is prevented. This detail is not shown as it is considered well within the skill of the art. The lower end of the push rod **348** is bent forwardly as indicated at **354**, and such bent portion **354** of the push rod **348** is adapted to coact with an arcuate cam element **356** fixed to the lever **268** adjacent the control handle **270**. The relationship of the push rod **348** to the cam element **356** is such that when the control lever **268** is in the position shown thereof in FIG. 3, the push rod **348** together with the flag **346** at its upper end descends gravitationally to the position such that the flag **346** is in its nonobstructing position, it being noted that the position of the control lever **268** shown in FIG. 3 corresponds to the troughs **252** and **254** being in their shot collecting and sequestering positions. When the control lever **268** is actuated in a clockwise direction as viewed in FIG. 3 so as to oscillate the troughs **252** and **254** toward their shot dumping or releasing positions, the cam element **356** engages the lower end portion **354** of the push rod **346** so as to actuate the push rod **348** upwardly so as to position the flag or obstructing plate **346** at its obstructing position which is shown in dashed outline in FIG. 1.

While it is to be expected that most articles to be placed within the basket **102** for cleaning will be of such size even as to the smallest separable components thereof as not to pass through the spaces between the rods **108** and **112** thereof, such may not always be the case through inadvertence or possible breakage or disassembly of articles during their tumbling within the rotating basket **102**. It is, of course, important that any small article falling from within the basket **102** not enter the impeller **160**. Usually, the close spacing of the impeller casing **162** to the shot sump **80** or the small dimensions of the openings **194** will suffice to prevent entry of all but quite small foreign objects; however, it is preferred that a further limitation as to the size of such falling objects that can enter the shot sump be established. Accordingly, in the preferred construction a pair of rectangular screens **370** and **372** are provided of a mesh to readily pass the shot but to deny passage of objects of much greater size. The screens **370** and **372** are removably disposed on opposite sides of the impeller means **160** and extend respectively between the sloping bottom walls **76** and **78** and adjacent side plates **170** and **172** of the impeller casing **162**. The arcuate plate **164** is relatively enlarged with respect to its end portions **166** and **168** to define shoulders such as those indicated at **374** and **376** to support the opposite ends of the screens **370** and **372**.

Manifestly the screens **370** and **372** will not prevent objects falling directly into the impeller wheel, but the likelihood of this happening twice to the same object is remote, and in any event the object will not get into a position materially obstructing the flow of shot.

It is believed that the nature of the materials and the technique of fabrication thereof to obtain the machine **10** will be evident to those having a modest degree of acquaintance with machines of this general character. Suffice to say, excepting such obvious items as the electric motors and pulley belts, the machine **10** is preferably constructed of steel throughout, and is preferably of welded construction. For example, the frame **12** is conveniently fabricated of angle iron, and the housing **30** can be of mild sheet steel, though harder steel can be used. It has been mentioned previously that the impeller means is of hardened steel.

The illustrated and described embodiment of the invention shows the vertical medial plane of the impeller to be coincident with the horizontal axis of the basket; however, this is not essential as the relative positions of the basket and the impeller can be such that the horizontal axis of the basket is displaced laterally from the vertical medial plane of the impeller; this being particularly true when the axial extent of the impeller is substantially less, as shown, than the diameter of the basket. The extent of such horizontal displacement of the horizontal axis of the basket should be limited to an amount such that virtually all or at least most of the shot propelled upwardly will impinge upon the basket and its contents. In other words, the area of projection of the basket on a horizontal plane should include all or most of the corresponding area of projection of the impeller.

In use, the basket preferably should only be filled to such an extent that at least some degree of tumbling of the articles therein will occur, whereby articles can migrate or cyclically circulate to positions in the basket exposed to the impingement of shot. Noting that partial filling of the basket results in the articles in the basket preferentially occupying positions displaced laterally from the vertical plane of the axis of the basket, such displacement being toward the side of the basket that is rising or moving upwardly on rotation of the basket. Accordingly, any horizontal displacement of the basket relative to the impeller as mentioned above, should be such as to move the axis from the median plane in the direction toward the descending portion of the basket, whereby the center of mass of the articles in the basket can be brought into or at least closer to the vertical medial plane of the impeller. For example, if the direction of rotation of the basket is such that the rearmost portion is descending, the basket can be rearwardly displaced, and if necessary the rear wall of the housing can be rearwardly offset to such extent as may be necessary to accommodate such basket displacement, as will be evident to those familiar with the art. It has been found that such relative positions of the basket and impeller in relation to the direction of basket rotation can materially increase the rate of cleaning.

I claim:

1. In a cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means; the improvement comprising means selectively operable for intercepting and sequestering spent shot descending in the

housing and to release sequestered shot, means disposed intermediate the intercepting and sequestering means and the impeller means operative to quide shot released from sequestration into the impeller means at a position adjacent the bottom of the latter, an electric motor drivingly connected to the impeller means, means including a manually actuable control for controlling the energization of the electric motor, means selectively operable for limiting manual access to said control, and operatively connecting the limiting means to the intercepting and sequestering means for alternate selective operation of the limiting means and the intercepting and sequestering means.

2. In a cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means; the improvement comprising means selectively operable for interception and sequestering spent shot descending in the housing and to release sequestered shot, means disposed intermediate the intercepting and sequestering means and the impeller means operative to guide shot released from sequestration into the impeller means at a position adjacent the bottom of the latter, an electric motor drivingly connected to the impeller means, means including a manually actuable control for controlling the energization of the electric motor, and indicating means operatively connected to the intercepting and sequestering means to indicate the selective condition of operation of the latter, and indicating means being disposed at least sufficiently close to said control as to be within the visual field of view of anyone seeking to visually locate and manually actuate said control, whereby the likelihood of inadvertent deenergization of the electric motor is lessened.

3. The combination of claim 2, wherein said intercepting and sequestering means includes a movably mounted member disposed in the housing with such means being operative to intercept and sequester descending shot when the member is in a first position thereof and being operative to release previously intercepted and sequestered shot on said member being moved ot a second position thereof, said indicating means including an indicator element movable between first and second positions, and a common actuator means for moving said member and said element in unison intermediate their respective first and second positions.

4. The combination of claim 3, wherein the indicating element in its first position affords free manual access to the manually actuable control and in its second position partially obstructs manual access to the manually actuable control.

5. The combination of claim 3, wherein said member is an oscillatably mounted trough which is upright in its first position and at least partially inverted in its second position, said common actuator means including a rock shaft journaled through a wall of said housing, and an actuator handle fixed to the shaft on the outside of the housing.

6. In a cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means; the improvement comprising means selectively operable for intercepting and sequestering spent shot descending in the housing and to release sequestered shot, means disposed intermediate the intercepting and sequestering means and the impeller means operative to guide shot released from sequestration into the impeller means at a position adjacent the bottom of the latter, said housing including a pair of downwardly converging walls disposed on opposite sides of the impeller means for directing shot descending thereon toward the impeller means, said intercepting and sequestering means comprising a pair of troughs disposed above the bottom walls, said troughs being oscillatably mounted to oscillate between upright and dumping positions, means for oscillating said troughs including a pair of rock shafts journaled through an end wall of the housing, means interconnecting the shafts for synchronous oscillation of the troughs intermediate their upright and dumping positions, and a handle fixed to one of the shafts enabling manual oscillation of the troughs.

7. The combination of claim 6, wherein the means interconnecting the shafts comprises a pair of radially extended arms fixed to shafts, and a link having its opposite extremities pivoted to the arms.

8. The combination of claim 6, including an electric motor drivingly connected to the impeller means, means including a manually actuable switch for controlling energization of the electric motor, an indicator movable between first and second positions respectively affording free manual access and partially impeding free manual access to the electric switch, and means operatively connecting one of said shafts to said indicator to move the latter to its first and second positions when the troughs are oscillated to their upright and dumping positions respectively.

9. The combination of claim 8, wherein the last recited means is a cam means.

10. In a cleaning machine of the class including a housing, rotatable grated basket means for containing articles to be cleaned, a shot impeller means for receiving spent shot descending in the housing and impelling the same upwardly to impinge upon the basket means; the improvement comprising means selectively operable for intercepting and sequestering spent shot descending in the housing and to release sequestered shot, means disposed intermediate the intercepting and sequestering means and the impeller means operative to guide shot released from sequestration into the impeller means at a position adjacent the bottom of the latter, said housing including a pair of downwardly converging walls disposed on opposite sides of the impeller means and having lower adjacent edges spaced from the opposite sides of the impeller means, said housing having a lower end portion that is relatively reduced in its transverse dimensions to define a shot sump having substantially vertical side walls which are connected to and depend from said adjacent edges of the downwardly converging walls, said impeller means comprising an impeller casing disposed in said sump, said casing having an open upper end and being comprised of an arcuate end wall and spaced parallel side plates fixed to the arcuate end wall, said side plates of the casing being substantially parallel to and spaced from the side walls of the sump, an impeller disposed within the casing and disposed for rotation about a horizontal axis normal to the side plates, said side plates having openings coincident with said axis, said impeller being fixed to a drive shaft rotatably extending through said openings, said side plates and opposite end portions of the arcuate end wall having upward extents terminating above said lower adjacent edges, whereby shot directed by the converging walls toward the impeller means is precluded from entering the casing through the open upper end of the casing, and said side plates each being provided with a shot inlet opening adjacent the lowermost extent thereof whereby shot may flow into the lowermost portion of the casing.

11. The combination of claim 10, wherein the side walls of the sump have openings aligned with the impeller shaft and the latter is journaled in said openings, an electric motor disposed externally of said housing and is drivingly connected to the shaft, means for indicating a parameter of electrical power consumed by the electric motor, and said housing having an inlet for introducing shot thereinto during operation of the impeller means.

12. The combination of claim 10, wherein the opposite upper end portions of the arcuate end wall are upwardly

divergent, and wherein said impeller comprises a solid hub centrally fixed to the shaft, said hub being of a regular polygon configuration in transverse section normal to the impeller shaft, and having a plurality of flat rectangular faces, and each of said hub faces having fixed thereinto an end portion of a flat rectangular blade.

13. For use in a cleaning machine, an improved shot impeller means comprising an open topped impeller casing, said casing including parallel vertical side plates joined by an upwardly concaved arcuate end wall, an impeller wheel disposed in said casing and extending above the open top of the latter, said impeller wheel being mounted for rotation about a horizontal axis normal to the side plates and defining a surface of revolution closely spaced to the side plates and the arcuate end wall with free running clearance therebetween, said side plates each having an opening therethrough at positions closely adjacent the lowermost extent of the surface of revolution defined by the impeller wheel, and the arcuate end wall having upwardly divergent integral opposite end portions that extend upwardly and outwardly from said surface of revolution.

14. The combination of claim **13**, wherein the arcuate end wall is of hardened steel, and arcuate wear strips of hardened steel disposed within the casing and secured along the junctures of the side plates with the arcuate end wall.

15. In a machine of the class wherein an impeller means is disposed at the bottom of a housing for impelling shot upwardly to impinge upon articles to be cleaned disposed in the housing above the impeller means, and wherein means guides the gravitational descent of spent shot to return the latter to the impeller means, whereby shot is circulated by being cyclically impelled upwardly by and from the impeller means, and thence moves gravitationally along a descending return path to the impeller means; the improvement comprising the provision of means selectively operable to reduce the quantity of shot undergoing circulation, said last means comprising means disposed along the return path of descending shot and mounted for selective movement between a first position wherein the same is operative to intercept and sequester descending shot against return to the impeller means and a second position wherein the same is operative to release sequestered shot for return of the latter to the impeller means, whereby initiation of operation of the impeller means can be undertaken when a substantial portion of the shot is sequestered and the load initially presented to the impeller means by the shot is minimized.

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