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Kauffman

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[54] **IMPACT SCRUBBER**

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[52] **U.S. Cl.**..... **241/40;** 51/8 R; 241/DIG. 10

[51] **Int. Cl.²**..... **B02C 19/06;** B24C 3/00

[58] **Field of Search**..... 51/8 R; 241/DIG. 10, 275, 241/102, 5, 39, 40, 42

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Attorney, Agent, or Firm—Mason, Kolehmainen, Rathburn & Wyss

[57] **ABSTRACT**

An impact scrubber for removing coating materials from the surfaces of particulate matter such as foundry sand and the like comprises a lift tube having an inlet end and an opposite end for containing a high velocity fluidized stream of said matter, fluid injector means spaced adjacent said inlet end for carrying said particulate matter into said inlet end and forming a fluidized stream of said matter in said lift tube, movable deflector means adjacent and in communication with said opposite end for directing said fluidized stream angularly outward with respect to a longitudinal axis of said lift tube for discharging said matter therefrom, support means for rotatively supporting said deflector means for directing said discharge therefrom in a selected one of a plurality of relative rotative positions, and means for separating the coating materials removed by impact from said particulate and said particulate matter.

14 Claims, 5 Drawing Figures

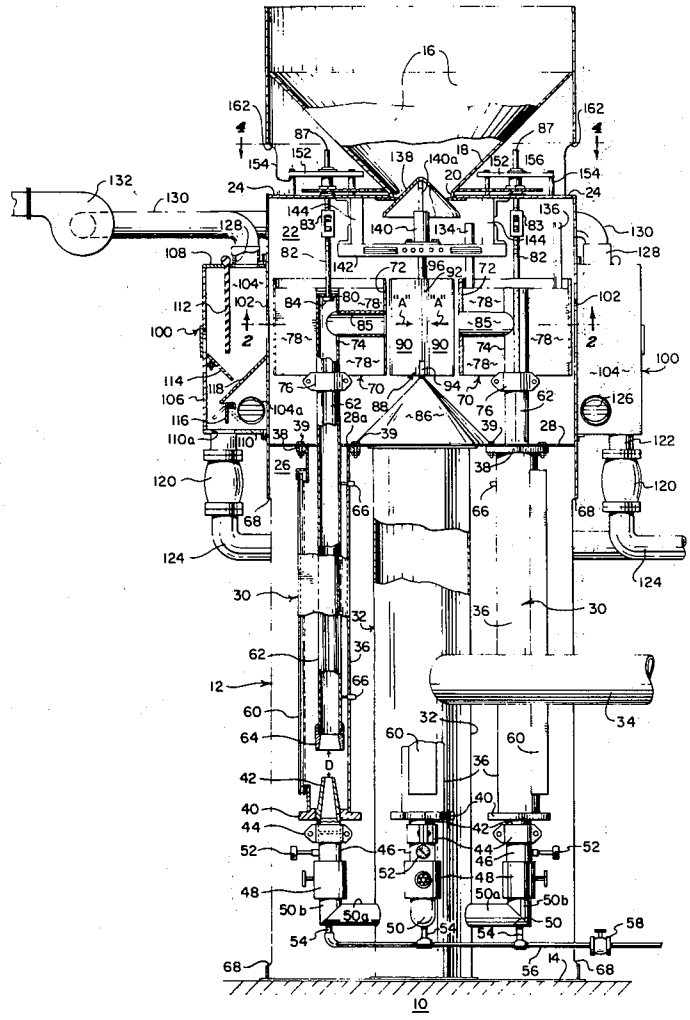

FIG. 1

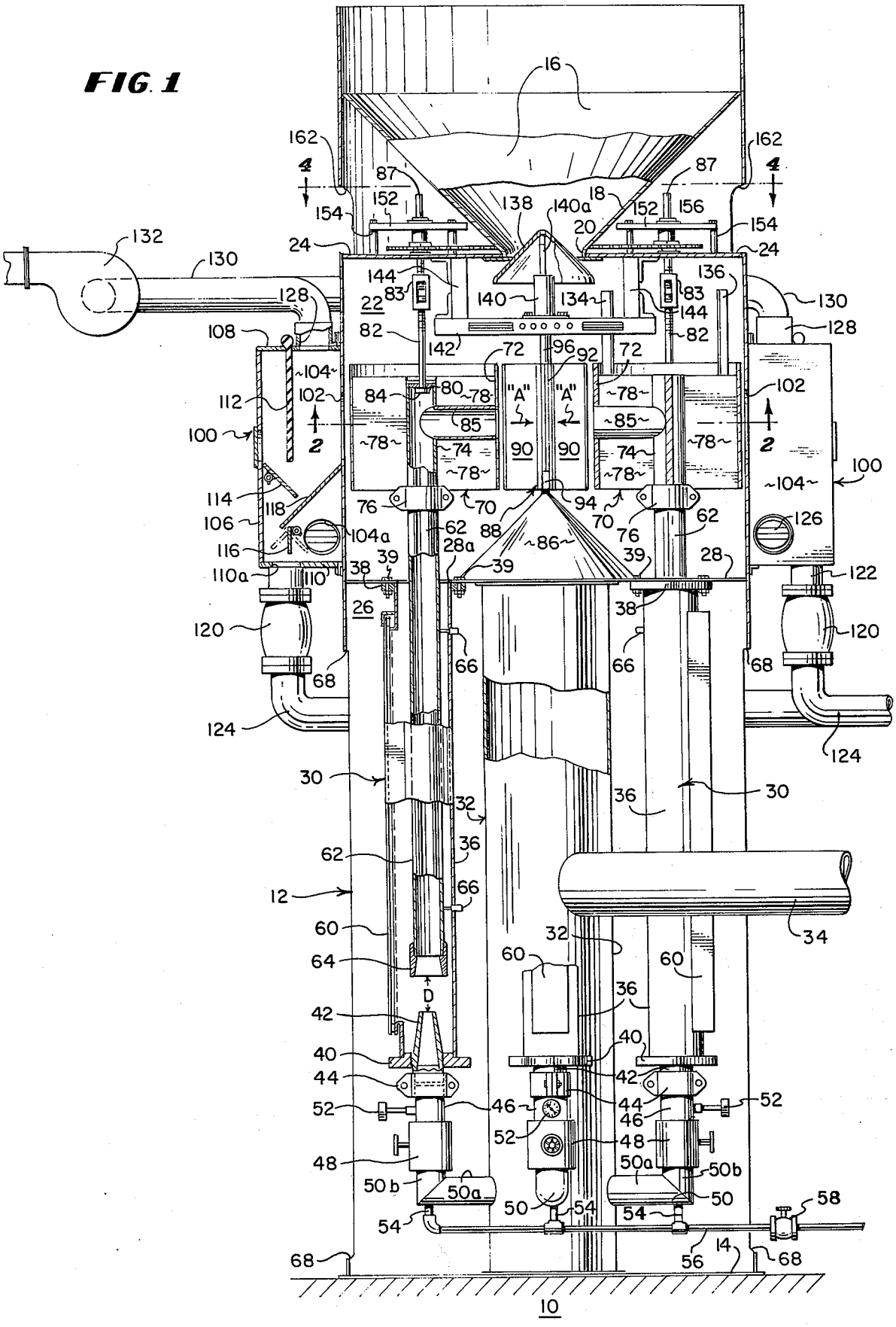
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FIG. 2

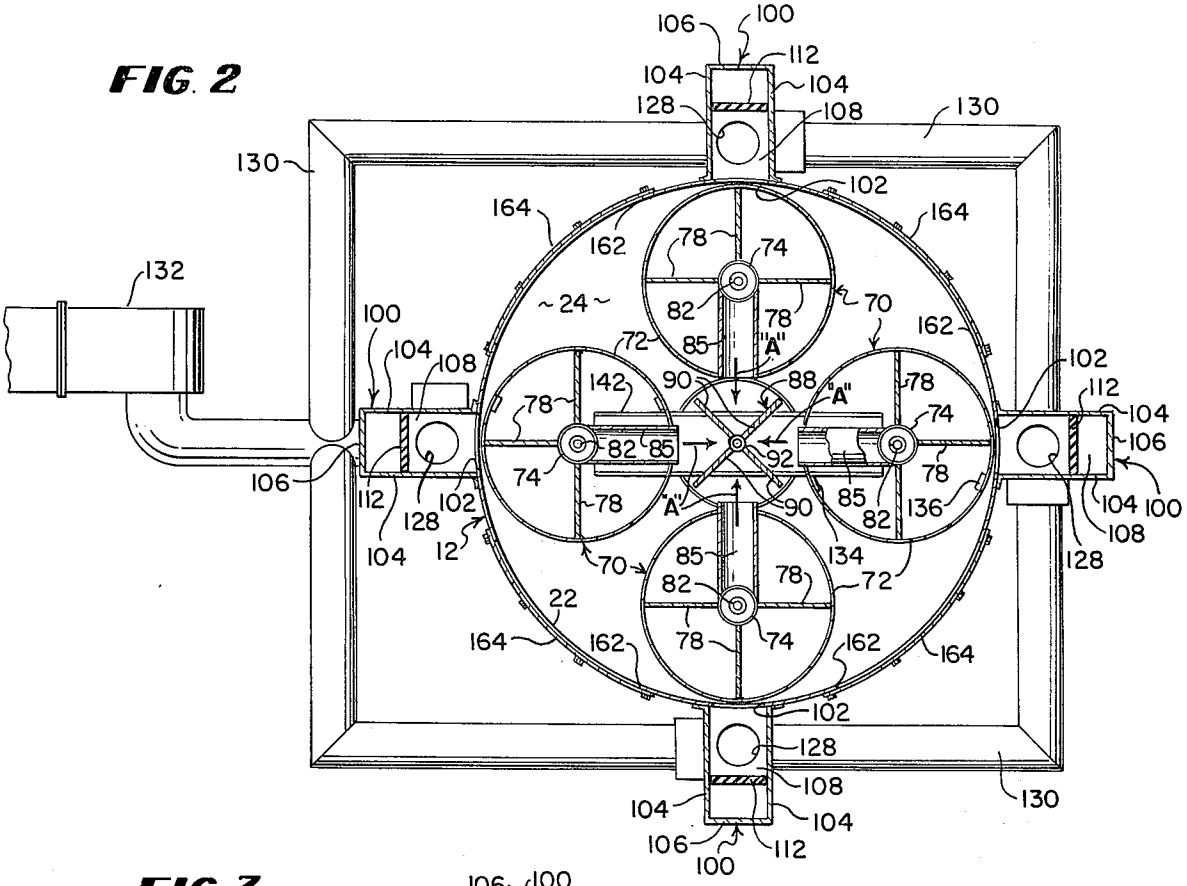
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FIG. 3

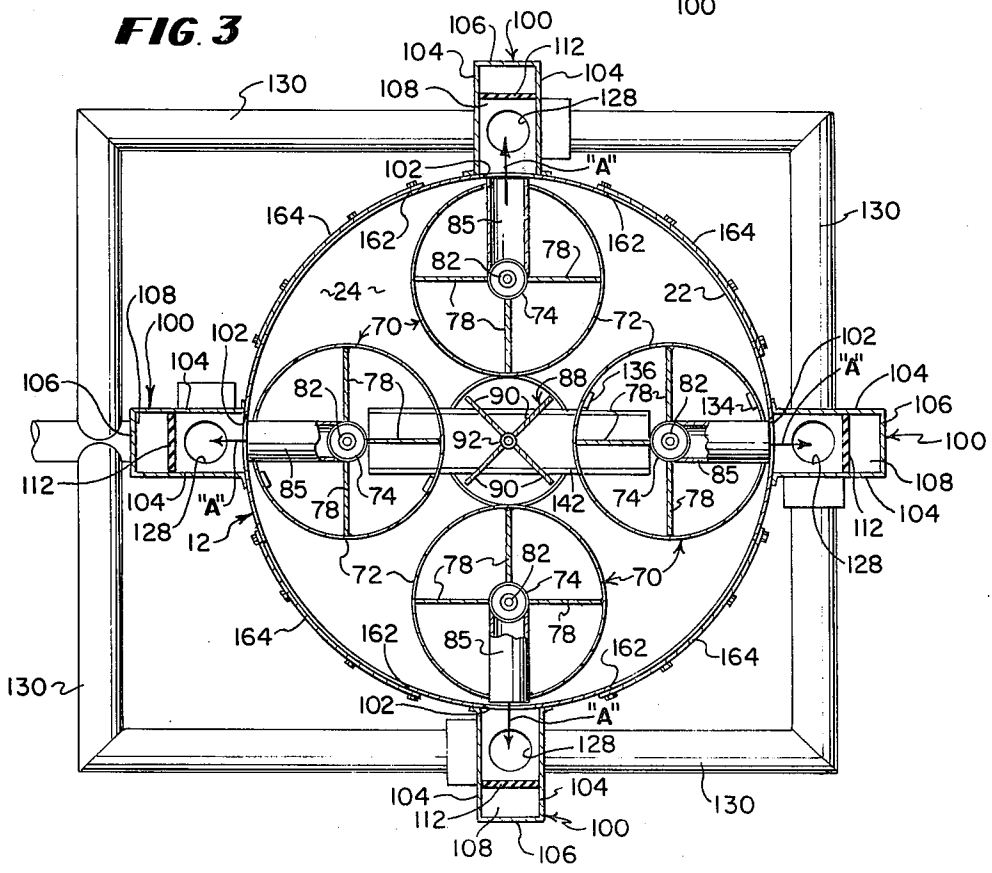
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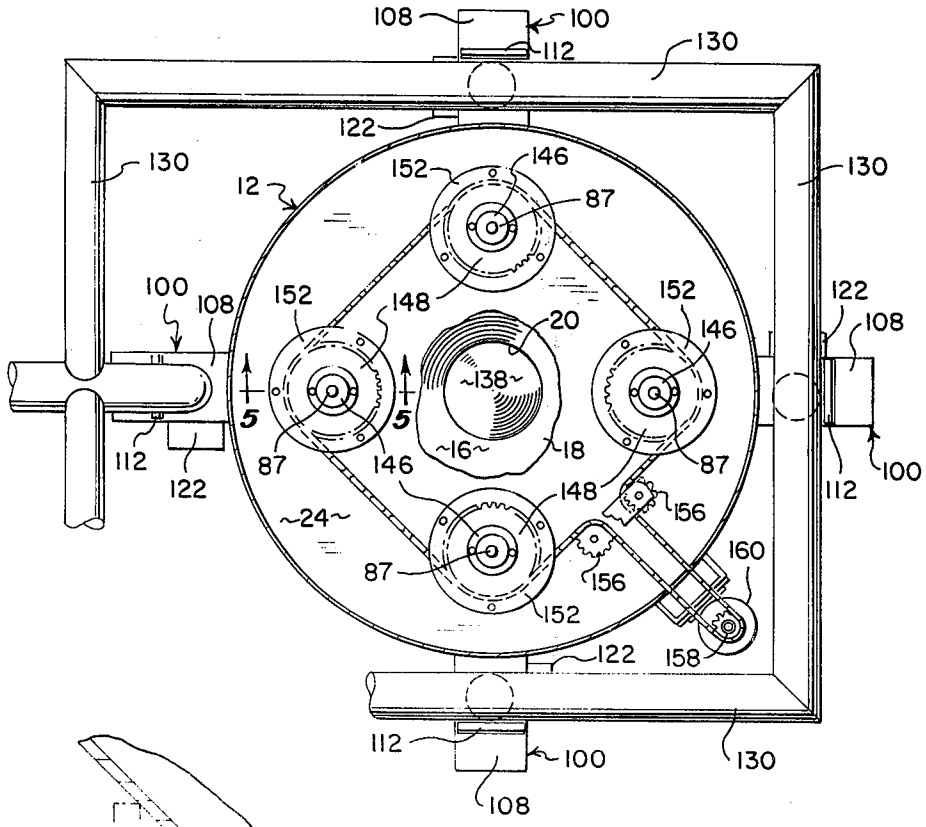
FIG. 4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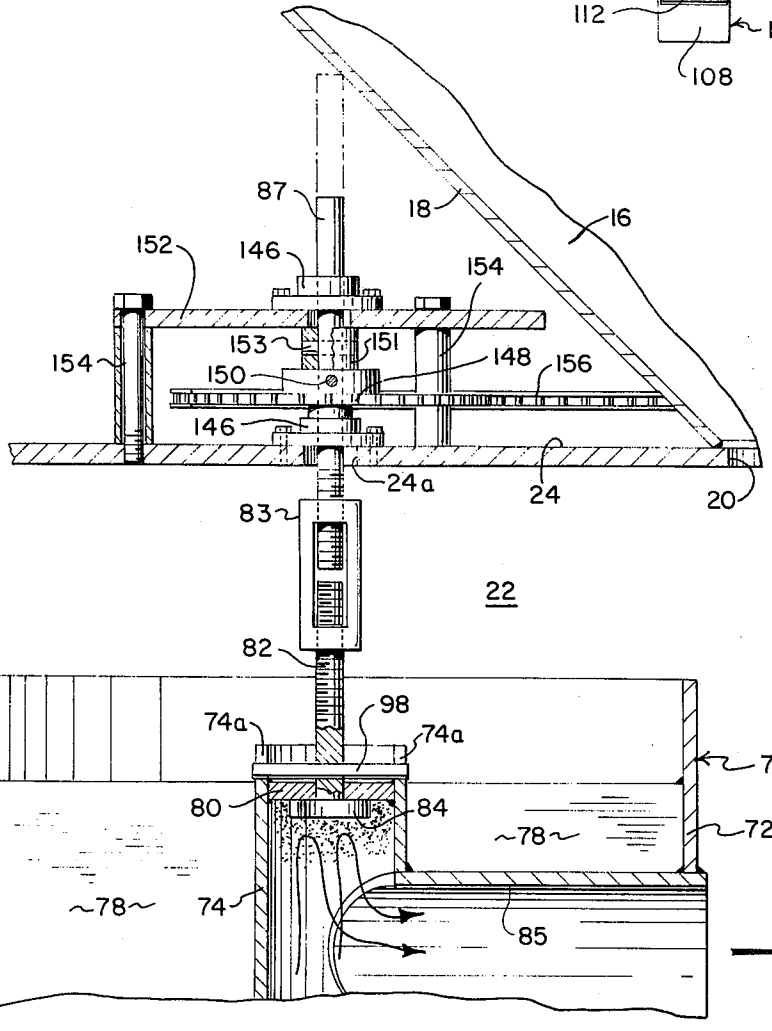
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FIG. 5

IMPACT SCRUBBER

The present invention relates to a new and improved impact scrubber for removing coating materials from particulate matter and more particularly to new and improved apparatus for reclaiming for reuse the granular materials commonly used in foundry operations such as foundry sand and the like. The present invention is an improvement over the apparatus shown and described in copending patent application, Ser. No. 332,415 filed Feb. 14, 1973, now U.S. Pat. No. 3,825,190, invented July 23, 1974, and assigned to the same assignee as the present invention.

In foundry operations granular base materials such as silica sand, zirconia sand and the like are coated with binding products, for example, clays, cereals, resins, and oils and the resulting mixture comprises foundry sand which is shaped and molded into definite shapes around patterns to form mold cavities. Molten metal is poured into the cavities as castings are made. The molding sand is subjected to direct contact with hot molten metal and the binding products which coat the granular sand base materials are oxidized and/or calcined in the molding process by the intense heat involved. In order to recondition the base material for further use in subsequent foundry operations, it is desirable to remove the oxidized coatings from the basic sand granules and subsequently prepare the sand as molding sand in suitable formulations with the necessary binding products required for a mold. The oxidized or calcined coating materials on the used molding sand granules are generally carbonaceous in nature and also are of a generally lower density than the basic sand material itself.

Accordingly, it is desirable to provide a system for removing the encrusted coating material from the sand grains in a dry, mechanical impact scrubbing process and then separate the lighter weight coating materials from the basic sand or particulater matter so that the clean sand may then be reused in subsequent molding operations after reformulation with the necessary binders.

The impact scrubber of the present invention is a self-contained, highly efficient unit, requiring a relatively small floor space, and is automatically controlled to provide the desired scrubbing/cleaning action as may be required for the particulate matter being treated.

It is an object of the present invention to provide a new and improved impact scrubber for treating particulate matter such as foundry sand and the like, and more particularly it is an object of the invention to provide a new and improved scrubber of the character described which is highly efficient in operation, automatically controlled for operation and discharge and which requires a relatively small floor space per unit of capacity in comparison with prior sand scrubbers.

Another object of the present invention is to provide a new and improved impact scrubber for cleaning particulate matter having a plurality of separate impact type sand scrubbing units and means for controlling the direction of discharge from all of said units simultaneously.

Another object is to provide a sand scrubber of the character described including novel means for adjusting the application of the individual scrubbing units for the most efficient operation.

Another object of the present invention is to provide a new and improved impact scrubber for cleaning particulate matter having a novel target system for receiving the impact of the fluidized flow of matter in order to mechanically remove the calcined or oxidized coatings from the individual particles of matter.

Another object of the invention is to provide a new and improved, dry process, mechanical impact type scrubber which includes a novel system for separating the coating materials from the grains of particulate matter.

Another object of the present invention is to provide a new and improved impact scrubber having a plurality of individual lift tube scrubber units and means for automatically controlling the direction of the discharge of particulate matter for impact scrubbing or for discharge from the scrubber itself.

The foregoing and other objects and advantages of the present invention are accomplished in an illustrated embodiment, by way of illustration and not limitation, comprising a dry process, mechanical impact, scrubber for removing coating materials from the surfaces of particulate matter such as foundry sand and the like. The scrubber comprises one or more lift tubes, each having an inlet end and an opposite end for containing a high velocity fluidized stream of said matter and fluid injector means spaced adjacent said inlet end for carrying said particulate matter into said inlet end and forming a fluidized stream in said lift tube. Deflector means is provided adjacent and in communication with the opposite ends of the lift tubes for directing said fluidized stream angularly outward with respect to the longitudinal axes of said lift tubes for discharge therefrom. Support means is provided for rotatively supporting said deflector means for directing said discharge therefrom in a selected one of a plurality of relative rotative positions. Means is provided for separating the coating materials broken away from the grains of particulate matter and the cleaned grains of particulate matter so that the particulate matter may be used again.

For a better understanding of the invention reference should be had to the following detailed description taken in conjunction with the drawings, in which;

FIG. **1** is an elevational view with portions shown in section of a new and improved impact scrubber for treating particulate matter constructed in accordance with the features of the present invention.

FIG. **2** is a transverse, horizontal cross sectional view taken substantially along lines **2—2** of FIG. **1**;

FIG. **3** is another transverse horizontal cross sectional view taken substantially along lines **22** of FIG. **1** but showing the scrubber units in a discharging position.

FIG. **4** is another transverse cross sectional view taken substantially along lines **4—4** of FIG. **1**; and

FIG. **5** is an enlarged fragmentary vertical sectional view taken substantially along lines **5—5** of FIG. **4.**

Referring now more particularly to the drawings therein is illustrated a new and improved impact scrubbing apparatus for the treatment of particulate matter such as foundry sand and the like and constructed in accordance with the features of the present invention. The apparatus as a whole is referred to by the reference numeral **10** and includes an upstanding cylindrical housing **12** having a circular base **14.** At the upper end of the housing **12** there is provided a hopper **16** for holding and receiving the sand or other particulate

matter to be processed by the scrubber. The hopper **16** includes a frustro-conical bottom wall **18** having a circular shaped opening **20** at the lower end for feeding the particulate matter downwardly into a cylindrical, intermediate section of the housing referred to by the numeral **22** and separated from an upper or hopper section of the housing by an annular wall **24.** The intermediate or discharge section **22** of the housing is similarly separate from a lower housing section **26** by an annular wall **28.**

In accordance with the present invention, the scrubber **10** includes a plurality of vertically extending, impact type, lift tube scrubbing assemblies or units generally indicated by reference numeral **30.** As shown in FIG. **1,** each scrubber unit extends upwardly from the lower housing section **26** through an opening in the annular wall **28** and projects upwardly to the intermediate section **22** of the housing. In the lower housing section **26,** the scrubber units **30** are disposed on diametrically opposite sides of an upstanding, cylindrical, air plenum chamber **32** which is centrally positioned in the housing **12** and extends between the circular bottom plate **14** and the circular wall **28.** The plenum chamber **32** is supplied with a high volume flow of pressurized air from a suitable source such as a "Rootes" type blower or equivalent via an inlet duct **34** which extends radially outwardly of the plenum chamber and passes through an appropriately shaped opening formed in the wall of the cylindrical housing **12.**

Each of the lift tube scrubber units **30** includes a cylindrical outer shell **36** having an annular mounting flange **38** adjacent the upper end secured to the wall **28** in concentric relation with a circular opening therein by suitable fasteners such as removable bolts **39.** At the lower end each shell **36** is provided with an annular lower end flange **40,** which flanges provide support for convergent type, high velocity, injection nozzles **42** as shown in FIG. **1.** Each nozzle **42** is removably attached to its supporting flange **40** and is connected at its lower end via a coupling **44** with a conduit structure in communication with the central plenum chamber **32** for receiving pressurized air. As illustrated, the conduit structure includes an intermediate section **46** coupled at its lower end with a control valve **48** which in turn is interconnected with the central plenum chamber **32** by a supply elbow **50.** The supply elbows radiate outwardly from the plenum chamber and each elbow has a lower, horizontal leg **50***a* and a vertical leg **50***b* having its upper end connected to the lower end of a control valve **48.**

In order to individually control and regulate the flow of pressurized air from the central plenum chamber **32** to the nozzle **42** of each scrubbing unit **30,** the individual valves are adjusted and pressure gauges **52** connected to short pipe nipple sections **46** are provided for guiding the operator in adjustment of the valves to secure the desired rate of flow of fluid through the nozzle. The central air plenum chamber **32** provides a high volume source of pressurized air at relatively low pressure (inches of water) for supplying the nozzles **42** of the lift tube scrubber units **30** and the valves **48** are utilized for individually controlling the respective units in accordance with the pressure gauge readings from the gauges **52.**

After periods of inactivity of the scrubber **10,** sand and other materials tend to collect in the lower end of the shells **36** and often tends to plug the nozzles **42** to such a degree the adequate air flow is prevented when the next start up is attempted. A high pressure compressed air starting system is provided and this system includes an upstanding compressed air injector **54** mounted in each elbow **50** and designed to inject high pressure (up to 100 psi) starting air into the material collected in elbows to clear the passage through the nozzles **42** and the lower end of the shells **36.** The air injectors are connected to a common compressed air supply manifold **56** and a control valve **58** is provided. The manifold is connected to a suitable source of high pressure air.

Each cylindrical shell **36** is formed with an elongated, axially extending access opening in the outer side wall thereof and these access openings are sealed during operation by means of removable or hingedly attached access doors **60.** The doors permit servicing of the interior of the shells **36** and clean out of the units if required.

In accordance with the present invention, each lift tube unit **30** includes an elongated, vertical lift tube **62** aligned in coaxial arrangement with an adjacent air supply nozzle **42** and spaced vertically above the outlet of the nozzle by an adjustable distance D. The lower or inlet end of each lift tube **62** is provided with a replaceable annular inlet ring **64** having a slightly tapered internal bore and the ring is adapted to receive and guide a fluidized flow of particulate matter into the tube as it is entrained upwardly by the air jet issuing from the nozzle outlet. The high velocity air flow moving upwardly in the lift tubes forms a high velocity turbulent fluidized flow of particulate matter and air. During the entrainment of the particulate matter in the air jet adjacent the inlet end of the lift tube and during the upward turbulent flow within the lift tube, intense interaction between the individual particles of particulate matter takes place in the form of repeated random collisions. These collisions or impacts aid in breaking up and removing the encrusted coating materials on the sand grains and this material along with the sand is carried upwardly in the turbulent stream.

The lift tubes **62** are adjusted in precise coaxial alignment with the nozzles **42** by means of radial spacers **66** mounted on the shells **36** and adjustable exteriorly thereof. The spacers are provided at upper and lower levels on the shells as shown and at each level a plurality of spacers are provided (three or four) in order to permit precise axial alignment of the nozzle and lift tube.

The circular wall **28** is formed with circular openings **28***a* spaced radially outward of the center and in coaxial alignment with the respective shells **36** of the lift tube assemblies **30.** These openings are substantially the same diameter as the internal diameter of the shells **36** and the particulate matter from the chamber section **22** flows downwardly into the shells around the lift tubes **62** for pick up by the air jets issuing upwardly from the outlet of the nozzles **42.**

The elongated side access openings in the shells **36** permit the lift tubes **62,** nozzles **42** and inlet ring **64** to be serviced on replaced without complete dismantling of the scrubber units **30.** The lower section **26** of the housing **12** is provided with relatively large, vertical, elongated access openings or slots **68** which slots are large enough to permit easy insertion and withdrawal of the complete lift tube unit **30** in both an assembled or disassembled condition.

At the upper end, each lift tube **62** is interconnected with a flow deflector and impact assembly generally indicated by the reference numeral **70.** The deflector assembly includes a cylindrical outer shell **72** and a centrally positioned coaxial lift tube extension **74** connected to the upper end of the lift tube **62** by a coupling **76.** Each lift tube extension **74** is supported within its shell **72** by means of a plurality of vertical rib members **78** extending radially outward from the lift tube extension at right angles to one another as best shown in FIGS. **2** and **3.**

Adjacent the upper end, each lift tube extension **74** is formed with an annular end wall **80,** which wall forms an outer portion of an impact target for the upwardly moving, fluidized particulate matter carried in the lift tube **62.** As best shown in FIG. **5** the end wall **80** is formed with a central aperture therein in order to accommodate the lower end of an elongated support rod **82** extending upwardly therethrough. As best shown in FIG. **1,** the support rods **82** project upwardly through openings provided in the circular wall **24** between the intermediate housing section **22** and an upper housing section adjacent the level of the hopper **16.** At the lower end, each support rod is provided with a large cylindrical head **84,** which head forms the central portion of an impact target for the upwardly moving fluidized particulate matter if the lift tube extension **74.**

As best shown in FIG. **5,** the upwardly flowing particulate matter forms a pad of particulate matter in the upper end of the lift tube extension and the pad of matter itself protects the structural members **80** and **84** from excessive wear. The upwardly flowing matter impacts or strikes the pad of matter formed at the upper end of the lift tube and this causes further the oxidized coatings material to be knocked off of the individual grains of the particulate matter. As shown by the arrows in FIG. **5,** the material rebounds downwardly and is deflected outwardly by the upwardly moving oncoming fluidized stream into a radially extending horizontal discharge tube **85** forming an elbow with the lift tube extension and having an open outer end adapted to discharge the impacted material which now includes relatively clean grains of particulate matter and the lighter in weight coating material which is knocked off or separated from base matter.

As best shown in FIG. **5,** the outer, open ends of the discharge tubes **85** are adjacent the outer surface of the cylindrical deflector shells **72.** From the foregoing it will be seen that the individual granules of particulate matter flowing upwardly in the lift tube units **30** are impacted against one another again and again. Moreover, repeated impacts occur as the matter enters the lower inlet rings **64** on the lift tubes **62** as well as during the upward flow in the tubes. Further impacts occur as the matter strikes the pad of material formed at the closed upper end of the lift tube extension **74.** Moreover, a further impact zone is developed adjacent to the mouth of the discharge tube **85** where the downwardly rebounding material collides with the upwardly moving matter before it moves outwardly toward the outer end of the discharge tubes.

As best shown in FIGS. **1** and **2** when all four of the deflector assemblies **70** of the respective lift tube scrubber units **30** are arranged with the discharge tubes **85** directed radially inwardly toward the center of the housing **12,** an intense, impact scrubbing zone is formed in center of the housing section **22.** The heavier particles of material that are discharged from the tubes **85** in a horizontal direction as shown by the arrows A gravitate downwardly onto a conical structure **86** centered above the air plenum chamber **32.** The sloping surfaces of the cone **86** direct the material outwardly toward the circular openings **28***a* in the wall **28** and the material then flows downwardly into the shells **36** of the respective scrubber units **30** to be recycled in the scrubbing process. The impact scrubbing zone centered above the cone **86** may be formed by the impingement of moving material streams impacting one another from opposite directions as described and set forth in the foregoing copending United States patent application, or in the alternative, a removable target structure **88** may be provided. The target structure includes pairs vertically extending impact vanes **90** which are secured along their inner vertical edges to a central hollow tube **92.** The tube **92** is adapted to be restrained by upstanding support stud **94** which is secured to the apex of the cone **86.** For lifting the target from the stud a handle **96** is provided at the upper end of the tube **92.**

As shown in FIGS. **1** and **2** when the discharge tubes **85** are directed radially inwardly the flow of material (arrows A) strikes the convergent surfaces of the impact vane **90** and the collisions of particles with the vane surfaces causes another intense scrubbing zone to develop immediately above the cone **86.** In this region additional coating materials remaining on the grains are knocked off and removed by the repeated impacts. The heavier grains of particulate matter gravitate downwardly onto the sloping surfaces of the cone **86,** and are directed into the shells **36** of the respective scrubber units **30** through the openings **28a** in the wall **28.** In this manner the particulate matter being handled by the scrubber **10** is continuously recycled through the individual lift tube scrubber units **30** for a selected period of time until the desired degree of cleaning action is obtained.

Each individual deflector **70** is supported by a rod **82** and each rod is provided with an enlarged head **84** at the lower end. The deflectors are rotatable from the normal operational position of FIG. **2** to the discharge position of FIG. **3** wherein the discharge tubes **85** are directed radially outwardly away from the center of the housing **12.** Each support rod is keyed to its deflector for rotation therewith by a cross pin **98** (FIG. **5**) which extends through slots **74***a* provided on diametrically opposite sides of the lift tube extension **74** at the upper end as shown in FIG. **5.** When the support rods **82** are rotated 180° from the position shown in FIG. **2,** the discharge tubes **85** of the respective deflectors **70** will be rotated a like amount to direct the discharge of material outwardly as shown in FIG. **3** by the arrows A.

With the deflectors **70** positioned in the discharge position as shown in FIG. **3** the fluidized stream of particulate matter and coating materials separated therefrom are directed outwardly through the housing wall into a plurality of separate discharge boxes secured to the outer surface of the housing **12** and referred to generally by the reference numeral **100.** Each discharge box is positioned adjacent an elongated vertical slot **102** formed in the wall of the scrubber housing **12** and aligned with the outlet end of the discharge tubes **85** when the deflector assemblies **70** are in the discharge position as shown in FIG. **3.** As best shown in FIG. **1,** the slots **102** are longer in vertical dimension than the diameter of the discharge tubes **85** and the vertical ad-

justment of the lift tubes provided to vary the distance D changes the level of the discharging streams issuing from the outlet ends of the discharge tubes **85** into the respective discharge boxes **100.** The slots **102** are slightly larger in width or horizontal dimension than the outside diameter of the discharge tubes **85** so the precision alignment is not required when rotating the deflector assemblies **70** into the discharge position as shown in FIG. **3.**

Each of the discharge boxes **100** includes a pair of opposite side walls **104,** an outside wall **106,** a top wall **108** and a bottom wall **110** and the outer wall of the intermediate section **22** of the scrubber housing **12** provides an inside wall for the discharge boxes. In order to protect the outer side walls **106** of the discharge boxes from excessive wear and abrasion from the discharging materials of the discharge tubes **85** and further to provide a secondary impact zone for separation of the lighter weight coating materials from the base particulate matter, each discharge box is provided with a relatively thick, heavy, hanging baffle **112** formed of resilient material such as rubber and the like and extending downwardly through a slot formed in the top wall **108.** The baffles hang freely and are positioned directly in front of the discharging streams from the discharge tubes **85.** Each hanging baffle includes an enlarge bulbous upper end portion for supporting the baffle from the top wall of the discharge box and the lower end portion of the baffle is free to swing and may be deflected by the high velocity stream of material impinging thereon. Within each discharge box **102** there is provided a pair of adjustable baffles **114** and **116** supported on shafts rotatably controllable from the outside of the boxes to achieve desired slopes for directing the heavier, cleaned sand grains or other particulate matter downwardly towards the lower end wall **110.** A fixed baffle **118** is also provided to guide the downwardly flowing material as it drops from the hanging resilient baffle **112** onto the adjustable baffle **114.** The material sifts downwardly in a falling stream or curtain from the lower edges of the baffles as it moves toward the lower end of the boxes. The thickness of the streams of material is controlled by the adjustable baffles. Material reaching the bottom wall **110** flows through a bottom discharge outlet **110**a via a short pipe section **122** into the upper end of a pinch valve **120.** The lower end of the pinch valves **120** maybe interconnected to a common discharge manifold **124** so that the cleaned particulate matter from the scrubber **10** may be discharged or transported via a pneumatic transport system or the like such as that shown in U.S. Pat. No. 3,297,366. The pinch valves **120** may be of the type shown in this patent and are normally closed until a sufficient amount or head of material has been collected in the upper portion of the valve housing. The flexible sleeves then open to discharge the material into the pneumatic transport system. The valves may also be positively controlled to open and close.

In order to separate the lighter in weight coating materials removed from the grains or base particles of the particulate matter being treated, each discharge box **100** is provided with an atmospheric damper assembly **122** which permits air to enter the lower end of the discharge box through an opening **104***a* in one of the side walls spaced below the fixed baffle **118** as best shown in FIG. **1.** Air entering through the dampers **122** passes upwardly in a tortuous path moving upwardly through the downwardly flowing curtain of material discharged from the lower edges of the respective baffles **114, 116** and **118.** This upwardly moving draft of air current carries the lighter weight materials upwardly to discharge outlets **128** formed on the upper walls **108.** The discharge outlets **128** on the top walls **108** of the discharge boxes **100** are connected to a suction manifold **130** and a discharge fan **132** is provided to provide the necessary draft for removal of the fine materials as shown in FIGS. **1, 2** and **3.** The amount of fines removed can be controlled by adjusting the negative pressure in the discharge boxes. It will thus be seen that the baffles **112** in discharge boxes **100** provide yet another impact zone and the air draft therein provides means for separating the cleaned sand grains from the lighter weight coating materials that is knocked off of base particulate matter. The cleaned sand is collected in the lower end of the discharge boxes **100** for delivery by a suitable transport system or the like to another location for further use.

In accordance with an important feature of the present invention, as previously described, the lift tube **62,** ring **64** and deflector assembly **70** of each individual scrubber unit **30** is supported by an individual elongated support rod **82** having an enlarged head **84** at the lower end. The rods project upwardly through openings **24***a* in the circular wall **24** (FIG. **5**) into the upper portion of the housing adjacent the level of the hopper **16.** Each support rod **82** is keyed to a lift tube extension **74** by means of a cross pin **98** so that rotation of a support rod will cause the deflector assembly **70** to rotate therewith.. Rotation of all of the support rods **82** by 180° from the position of FIG. **2** causes the discharge assemblies **70** to rotate in unison until the discharge tubes **85** are directed outwardly in the discharge position as shown in FIG. **3.** In order to limit and control the amount of rotation, of the discharge assemblies **70** at least one shell **72** is provided with a pair of upstanding limit stops **134** and **136** secured to the inside surface as best shown in FIGS. **1, 2** and **3.** In order to control the flow of sand or other particulate matter into the scrubber from the discharge opening **20** of the hopper **16,** there is provided a conical valve member **138** adapted to open and close the discharge opening to regulate the flow. The conical valve member **138** is mounted on the outer end of a cylinder rod **140***a* of a vertically positioned, fluid operated valve cylinder **140.** The lower end of the cylinder **140** is supported on a channel-like base **142** positioned in the intermediate housing section **22** and supported from the upper circular wall **24** at opposite ends by depending brackets **144** as best shown in FIG. **1.** As shown in FIGS. **2** and **3,** opposite side edges of the support channel structure **142** cooperate with the upstanding limit stops **134** and **136** on the right hand (FIG. **1**) deflector assembly **70** to provide for alignment of the discharge tubes **85** of the respective deflector assembly in the normal operating position (FIG. **2**) or the discharge position (FIG. **3**).

Referring now more particularly to FIG. **5,** the support rods **82** of the respective deflectors **70** are connected by turnbuckles **83** with upper ends **87** which extend upwardly through the openings **24***a* in the circular wall **24.** The upper end portion of each upper rod is slidably disposed in a pair of flanged bearings **146** spaced on opposite sides of a chain sprocket **148,** which is secured by set screws **150** to a sleeve **151** attached to the support rods **87** by a removable pin **153.**

The lower flanged bearing **146** is attached to the upper surface of the circular wall **24** and the upper flanged bearing is attached to the upper surface of a circular support plate **152** supported in parallel, spaced apart relation above the circular wall **24** by a plurality of support post assemblies **154.** An endless roller chain **156** is entrained around all of the several sprockets **148** in order to drivingly rotate all of the support shafts **82** in unison and thereby rotate all of the deflector assemblies **70** when it is desired to move the deflectors from a discharge to an operating position or vice versa.

As shown in FIG. **4,** the roller chain **156** is passed around all of the sprockets **148** of the respective support rods **82** and in addition, the chain is passed around a pair of idler sprockets **156** into driving engagement with a single drive sprocket on the output shaft of a fluid motor **160.** The fluid motor **160** is reversible and is supplied from a source of compressed fluid. A valve system is used to operate the motor in reverse directions in order to rotate the deflector assemblies **70** back and forth between the normal operating position and the discharge position of FIGS. **2** and **3.** Normally the fluid motor is actuated to rotate the sprocket **158** in a given direction for a selected time interval, which interval is slightly longer than the time required to rotate the deflector assemblies through 180° from one position to the other. Rotation of the deflectors is stopped by engagement of one or the other stop members **134** or **136** with the side of the support channel **142** as previously described.

When it is desired to adjust the spacing distance D between the upper end of the nozzle **42** and its respective entrance ring **64** on the lift tube **62,** the set screw **150** on the sprocket **148** is loosened and the support rod is moved up or down as desired to provide the proper spacing D. After the spacing is set the set screw **150** is retightened to again key the sprocket to the support rod.

The scrubber **10** provides means for adjusting the individual clearance distance D between the lift tube entrance ring and the nozzle in each of the scrubber units **30** and in addition the system provides for simultaneously rotating all of the deflector assemblies **70** of the respective scrubber units to the normal operating or the discharge position as desired.

As shown in FIG. **1,** relatively large access slots **162** are provided in the housing wall **12** so that the chain, sprockets, bearings and set screws may be serviced and adjusted as described. In addition, as shown in FIGS. **2** and **3** the intermediate section **22** of the housing **12** is formed with relatively large access openings **164** in the side wall in order to permit servicing or replacement of the individual deflector assemblies **70.** These may be removed completely from the housing **12** by detachment from the respective lift tubes **62** when the couplings **76** and the set screws **150** are loosened. The access openings **162** are large enough in width and height to permit easy service or complete withdrawal of a deflector assembly **70.** During normal operation, arcuate cover plates **164** are provided to cover the access openings **162** and confine the particulate material and dust within the intermediate section **22** of the housing **12.**

Although the present invention has been described with reference to a single illustrative embodiment thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An impact scrubber for removing coating materials from the surfaces of particulate matter such as foundry sand and the like comprises at least one lift tube unit having a lift tube with an inlet end and an opposite end for containing a high velocity fluidized stream of said matter, fluid injector means spaced adjacent said inlet end for carrying said particulate matter into said inlet end and forming a fluidized stream of said matter in said lift tube, fluid stream deflector means adjacent and in communication with said opposite end of said lift tube, means mounting said deflector means for rotation around a longitudinal axis of said lift tube, said deflector means including a discharge tube for directing said fluidized matter in a single stream angularly outward with respect to said longitudinal axis of said lift tube at different rotative positions, and means for rotating said deflector means for directing said discharge tube in a selected one of a plurality of relative rotative positions.

2. The scrubber of claim **1** including means for supporting said lift tube in a selected one of a plurality of different axial positions relative to said injector means wherein said spacing between said inlet end and said injector means may be selectively adjusted.

3. The scrubber of claim **1** including a plurality of said lift tube units, a common housing for said units having a central axis spaced between said units, said means for rotating said deflector means operable to position a discharge tube for each lift tube in a selected direction facing toward said central axis or away from said axis, and separator means including enclosures spaced on opposite sides of said housing for receiving fluidized streams of material discharged from said deflector means when positioned to discharge away from said central axis, said separator means further including means for separating said particulate matter and said coating materials removed from the surfaces of said particulate matter.

4. The scrubber of claim **3** wherein said supporting means includes means for supporting each of said lift tubes in selectively adjustable axial positions relative to their respective injector means wherein said spacing between said inlet end and said injector means of each unit may be varied.

5. The scrubber of claim **3** wherein said deflector means of each unit includes a lift tube extension having a closed upper end and a discharge tube angularly extended outwardly from said lift tube extension and in communication therewith at a level below said closed end.

6. The scrubber of claim **5** wherein each unit includes removable coupling means for interconnecting a lower end of said lift tube extension and said opposite end of said lift tube.

7. The scrubber of claim **5** wherein said housing includes discharge openings formed on opposite sides in communication between said discharge tubes and said separator enclosures when said deflector means are rotated to discharge in opposite directions away from said central axis.

8. In an impact scrubber for removing coating materials from the surfaces of particulate matter such as foundry sand and the like, an enclosure, flexible target

means in said enclosure, inlet means adjacent an upper level of said enclosure for directing a flow of said matter and material against said target means, said target means including a piece of flexible material supported from an upper end portion to hang generally vertically in said enclosure with a freely deflectable lower end portion spaced in front of said inlet meaans, baffle means in said enclosure below said inlet means for forming a curtain of downwardly flowing matter and material and draft means for moving a flow of air through said curtain for carrying at least a portion of said coating materials upwardly away from said particulate matter.

9. The appartus of claim **8** wherein said draft means includes an air inlet opening in said enclosure spaced below said baffle means and suction means in communication with said enclosure above said baffle means for inducing air pass into said air inlet opening and through said curtain of material flowing downwardly of said baffle means.

10. The apparatus of claim **8** wherein said baffle means includes at least one sloped baffle and means for adjustably selecting the angle of slope thereof.

11. An impact scrubber for removing coating materials from the surfaces of particulate matter such as foundry sand and the like comprises at least one lift tube unit having a lift tube with an inlet end and an opposite end for containing a high velocity fluidized stream of said matter, fluid injector means spaced adjacent said inlet end for carrying said particulate matter into said inlet end and forming a fluidized stream of said matter in said left tube, deflector means adjacent and in communication with said opposite end for directing said fluidized stream angularly outward with respect to a longitudinal axis of said lift tube for discharge therefrom, support means for rotatively supporting said deflector means for directing said discharge therefrom in a selected one of a plurality of relative rotative positions, and means for separating said coating materials and particulate matter including an enclosure for receiving said fluidized stream from said deflector means, flexible target means in said enclosure, inlet means adjacent an upper level of said enclosure for directing a flow of said matter and material against said target means, baffle means in said enclosure below said inlet means for forming a curtain of downwardly flowing matter and material and draft means for moving a flow of air through said curtain for carrying at least a portion of said coating materials upwardly away from said particulate matter.

12. The apparatus of claim **11** wherein said enclosure includes a side wall, said inlet means adapted to direct a horizontal flow of material through said side wall, and said target means comprises a piece of flexible material supported from an upper end portion to hang generally vertically in said enclosure with a freely deflectable lower end portion spaced in front of said inlet means.

13. The apparatus of claim **11** wherein said draft means includes an air inlet opening in said enclosure spaced below said baffle means and suction means in communication with said enclosure above said baffle means for inducing air pass into said air inlet opening and through said curtain of material flowing downwardly of said baffle means.

14. The apparatus of claim **11** wherein said baffle means includes at least one sloped baffle and means for adjustably selecting the angle of slope thereof.

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