United States Patent [19]

McDonald

[11] **3,769,752**

[45] **Nov. 6, 1973**

[54] **APPARATUS FOR SHOT BLASTING WORK MEMBERS**

[75] Inventor: **Alexander McDonald,** Tamworth, New South Wales, Australia

[73] Assignee: **Blastmaster Company, Division of Tekology Limited,** Granville, Australia

[22] Filed: **Nov. 4, 1971**

[21] Appl. No.: **195,593**

[30] **Foreign Application Priority Data**

Nov. 11, 1970 Australia ..... P.A. 3158
Sept. 17, 1971 Canada 123,087

[52] **U.S. Cl.** ..... **51/5,** 51/15, 51/216 ND
[51] **Int. Cl.** **B24c 3/04,** B24c 3/32
[58] **Field of Search** ..... 51/5, 8, 11, 14, 51/15, 16, 216 ND

[56] **References Cited**

UNITED STATES PATENTS

2,696,910	12/1954	Ljungdell et al.	51/14 X
2,883,113	4/1959	Horuath	51/11 UX
2,935,820	5/1960	Mead	51/8
3,055,150	9/1962	Greenberg et al.	51/14
3,109,262	11/1963	Weaver et al.	51/8
3,142,942	8/1964	Celousky	51/216 ND X
3,690,066	9/1972	Rowe	51/9
3,716,947	2/1973	Carpenter et al.	51/14

Primary Examiner—Donald G. Kelly
Assistant Examiner—Howard N. Goldberg
Attorney—Walter Becker

[57] **ABSTRACT**

An apparatus for shot or grit blasting work members, particularly the insides of hollow members, such as cylinders, when the work members are supported open end downwardly and move into and out of a treatment enclosure in which is disposed a vertically moveable rod like probe having nozzles thereon supplied with air and blasting medium, such as shot. The installation includes a blower arrangement for exhausting dust from the treatment enclosure, and a further arrangement for conveying therefrom sand and spent blasting medium, while separating the sand from the blasting medium and, further, separating trash from the blasting medium and then conveying the separated fractions to respective points of delivery with the point of delivery of the blasting medium comprising a storage arrangement operatively connected with a hopper for the blasting medium from which the medium is supplied to the nozzles on the probe.

18 Claims, 9 Drawing Figures

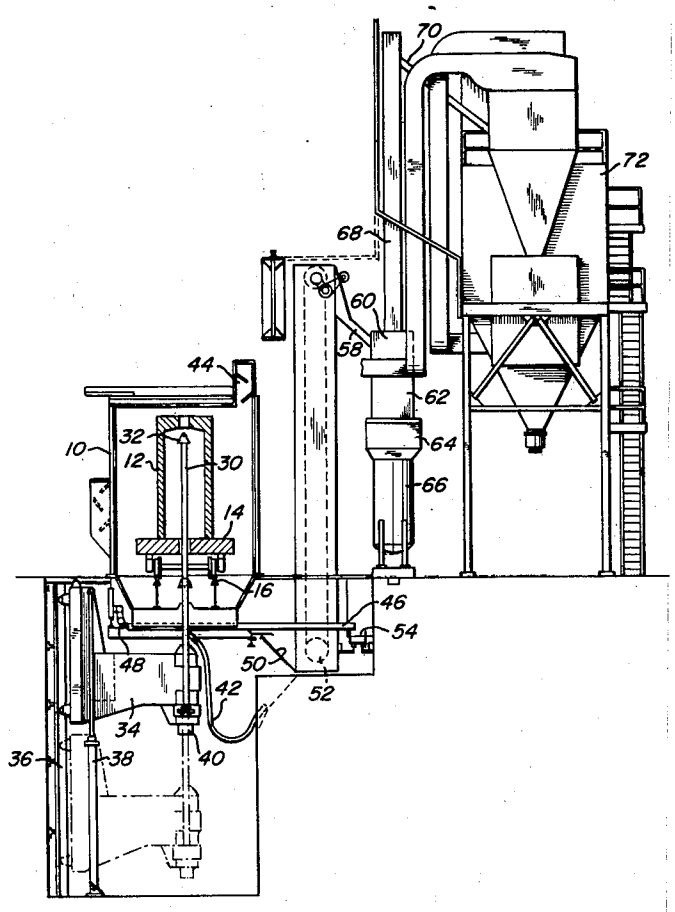
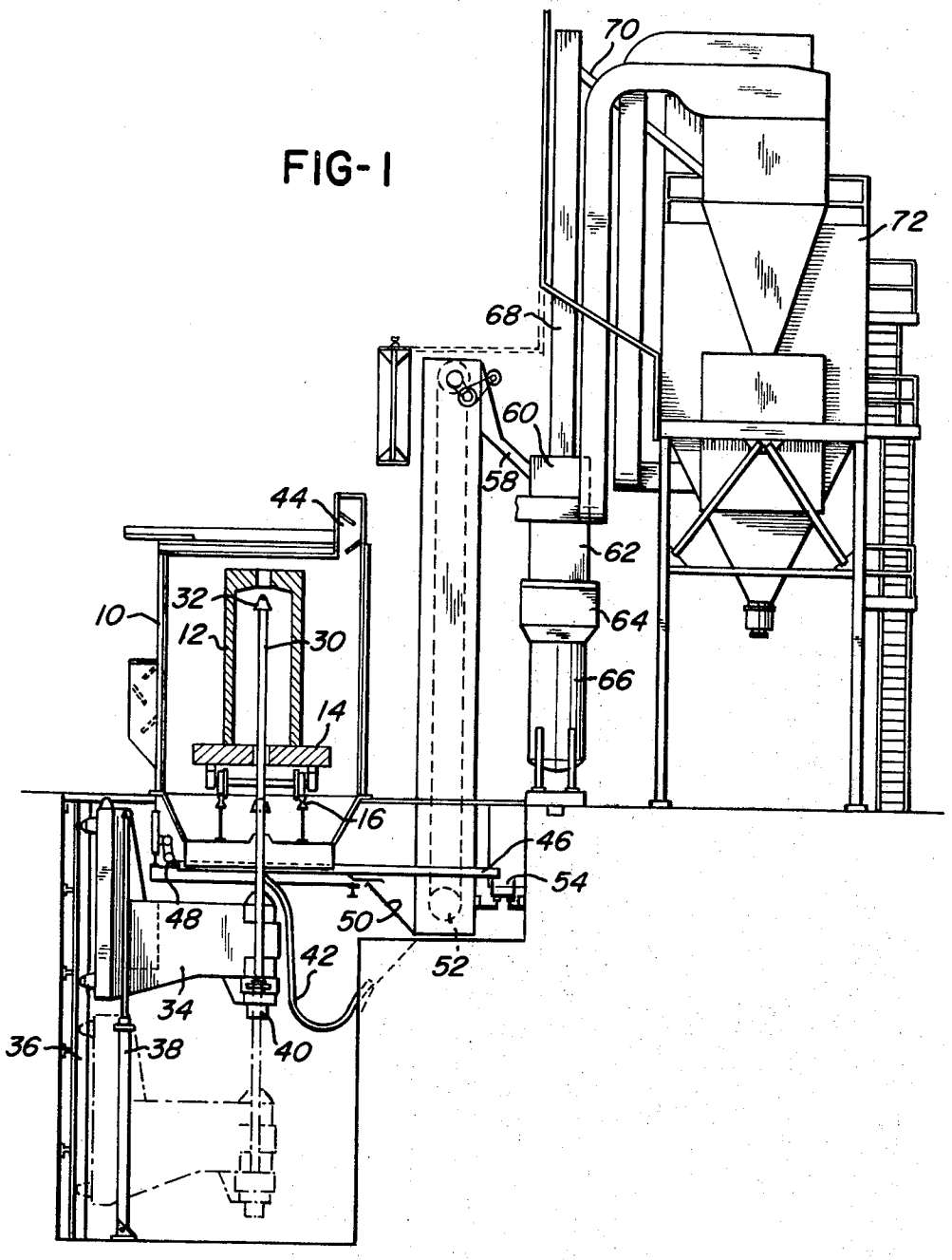
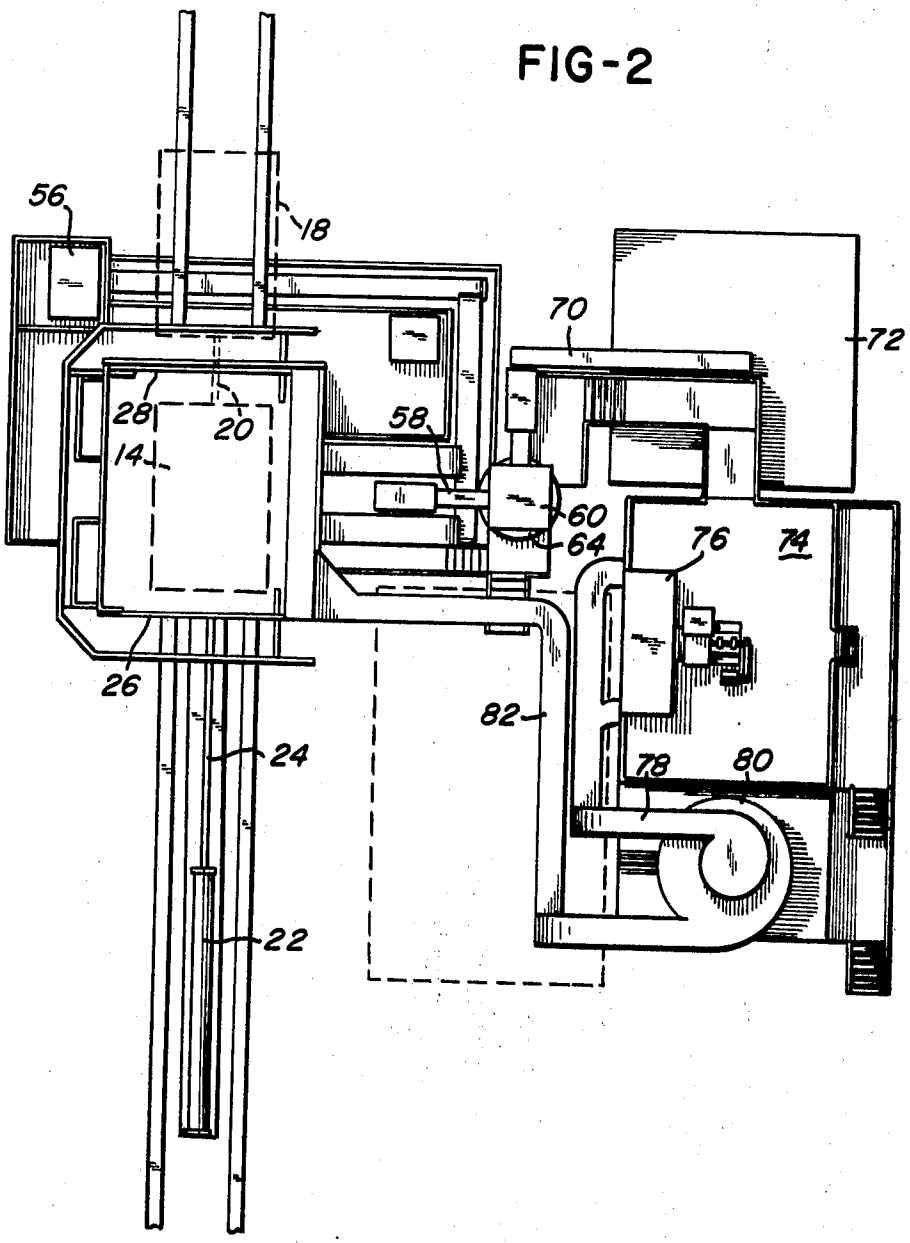


FIG-1



INVENTOR
Alexander McDonald
By
Walter Berkey

FIG-2



INVENTOR
Alexander McDonald
By

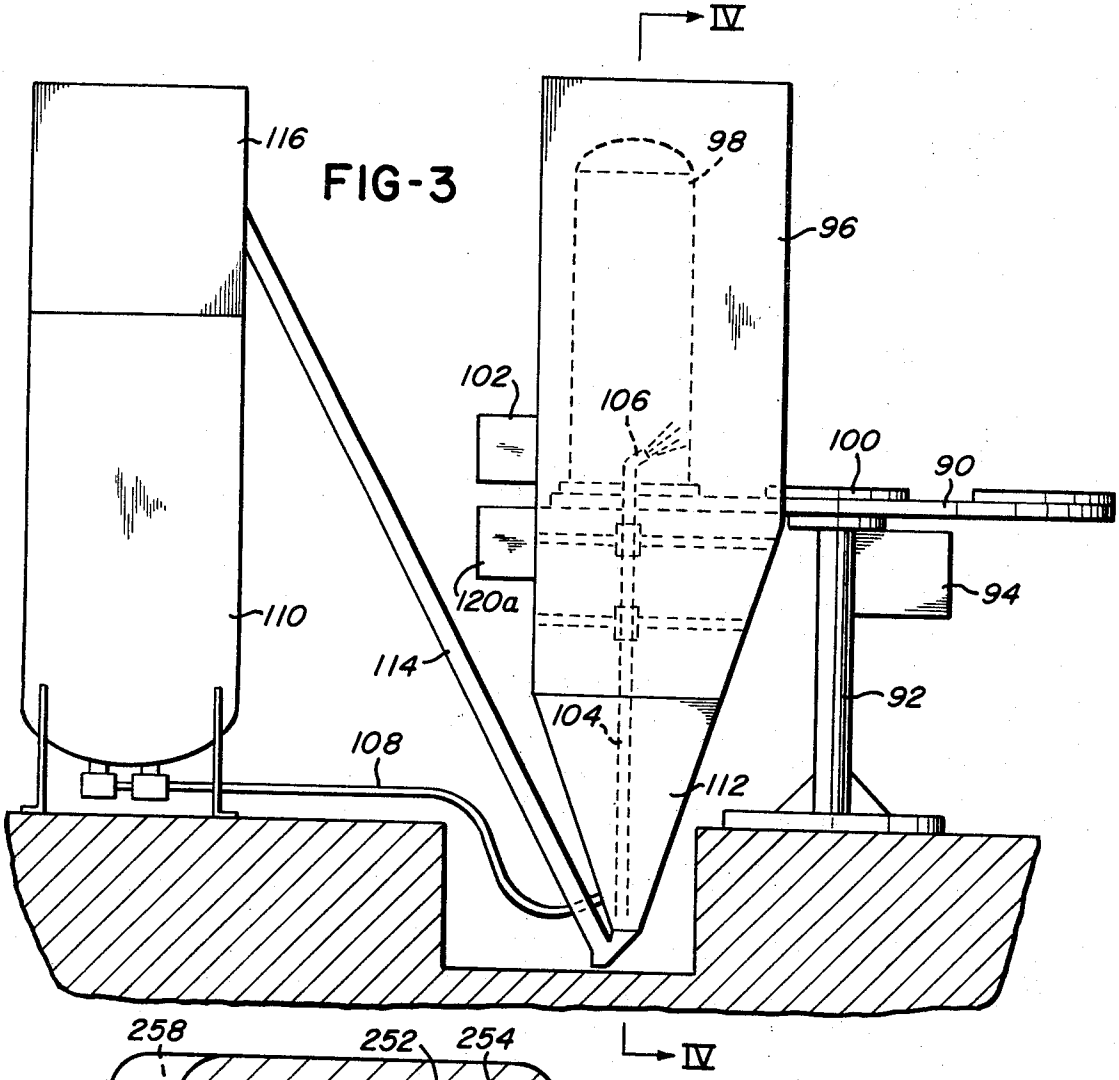


FIG-3

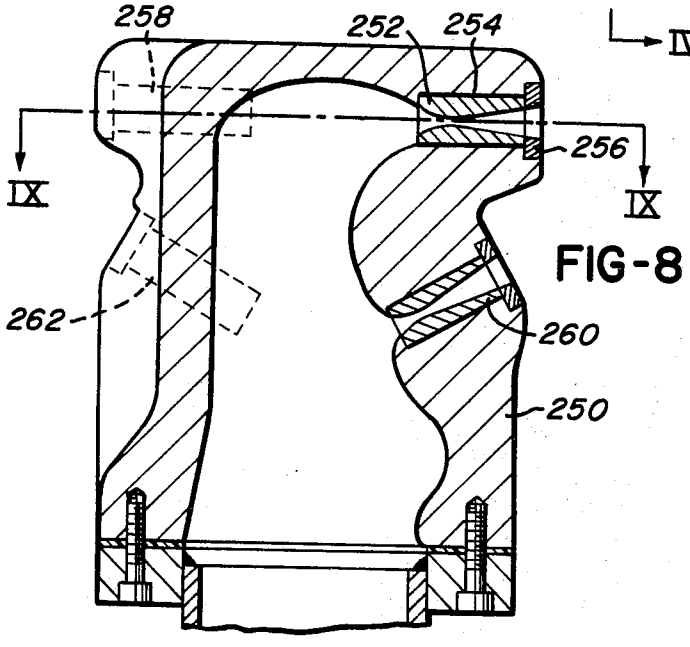


FIG-8

INVENTOR
Alexander McDonald
By
Walter Becker

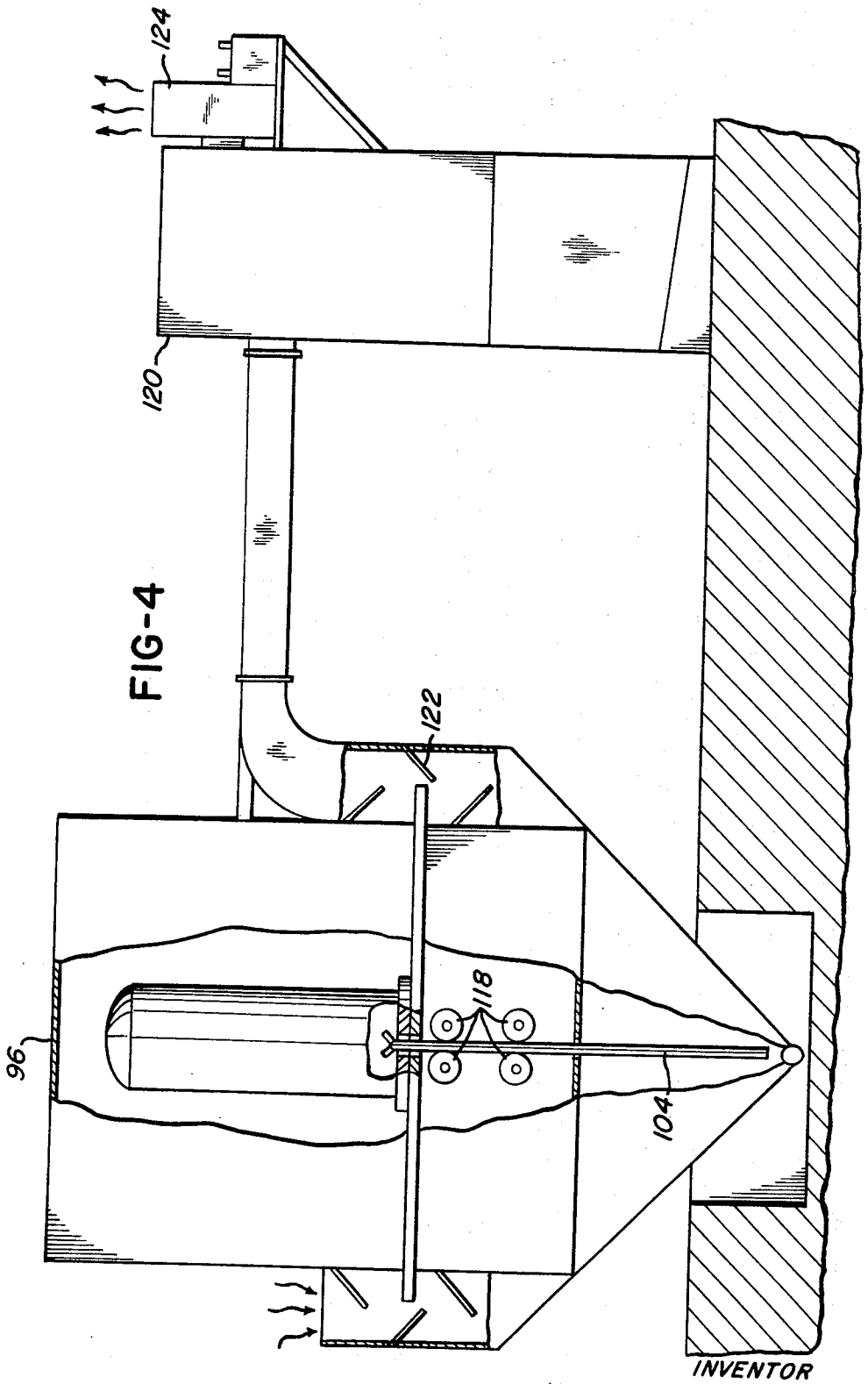
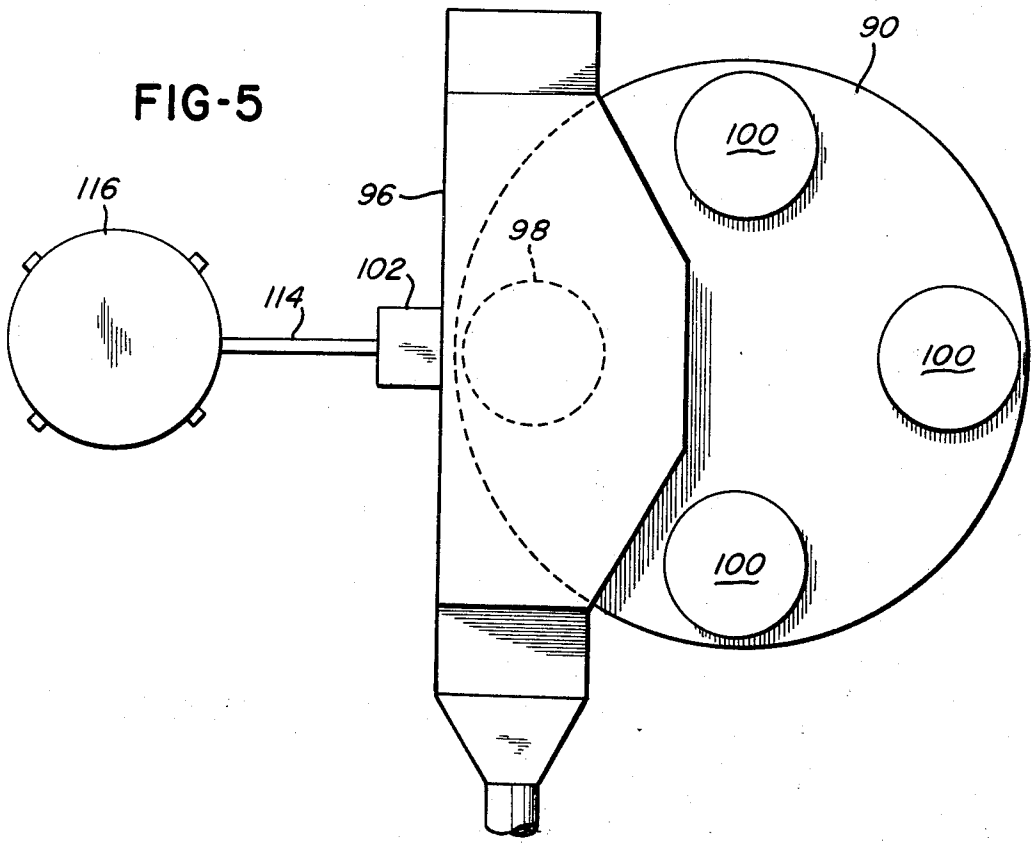


FIG-4

INVENTOR
Alexander McDonald
By
Walter Burke

FIG-5



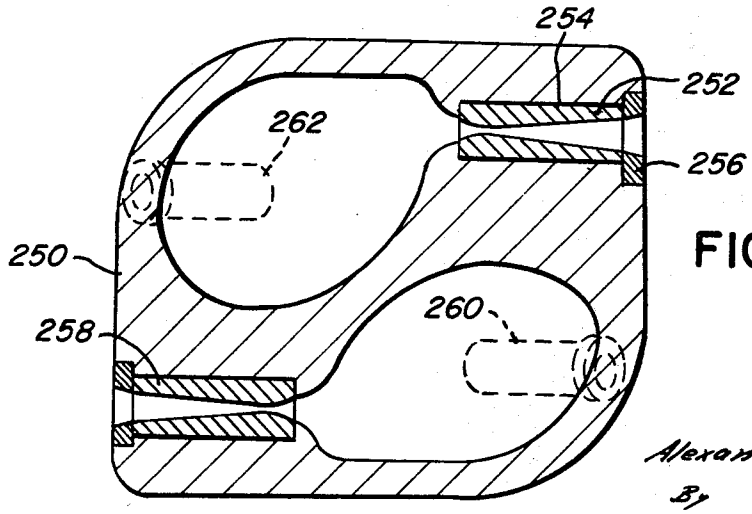


FIG-9

INVENTOR
Alexander McDonald
By Walter Burke

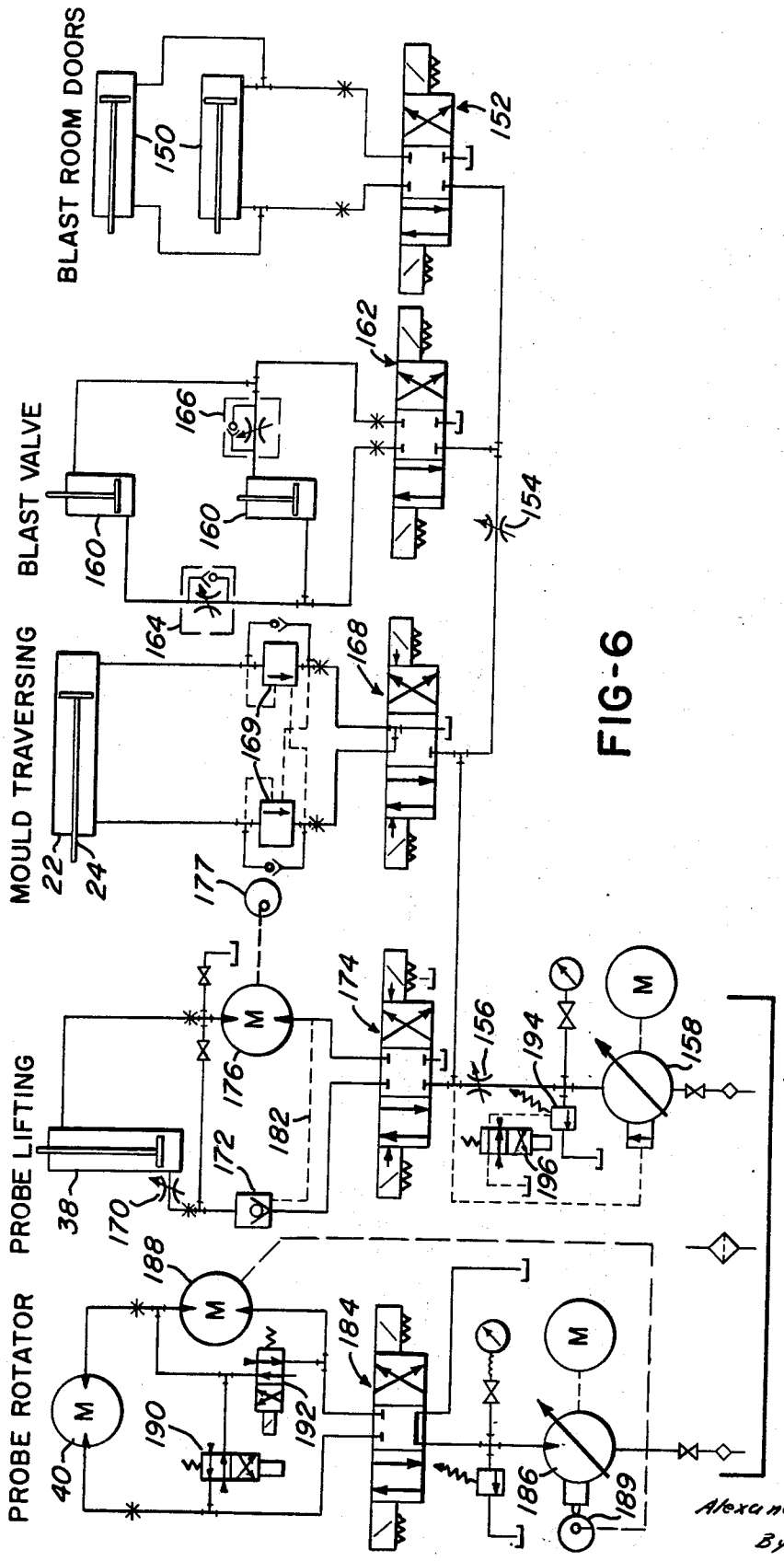
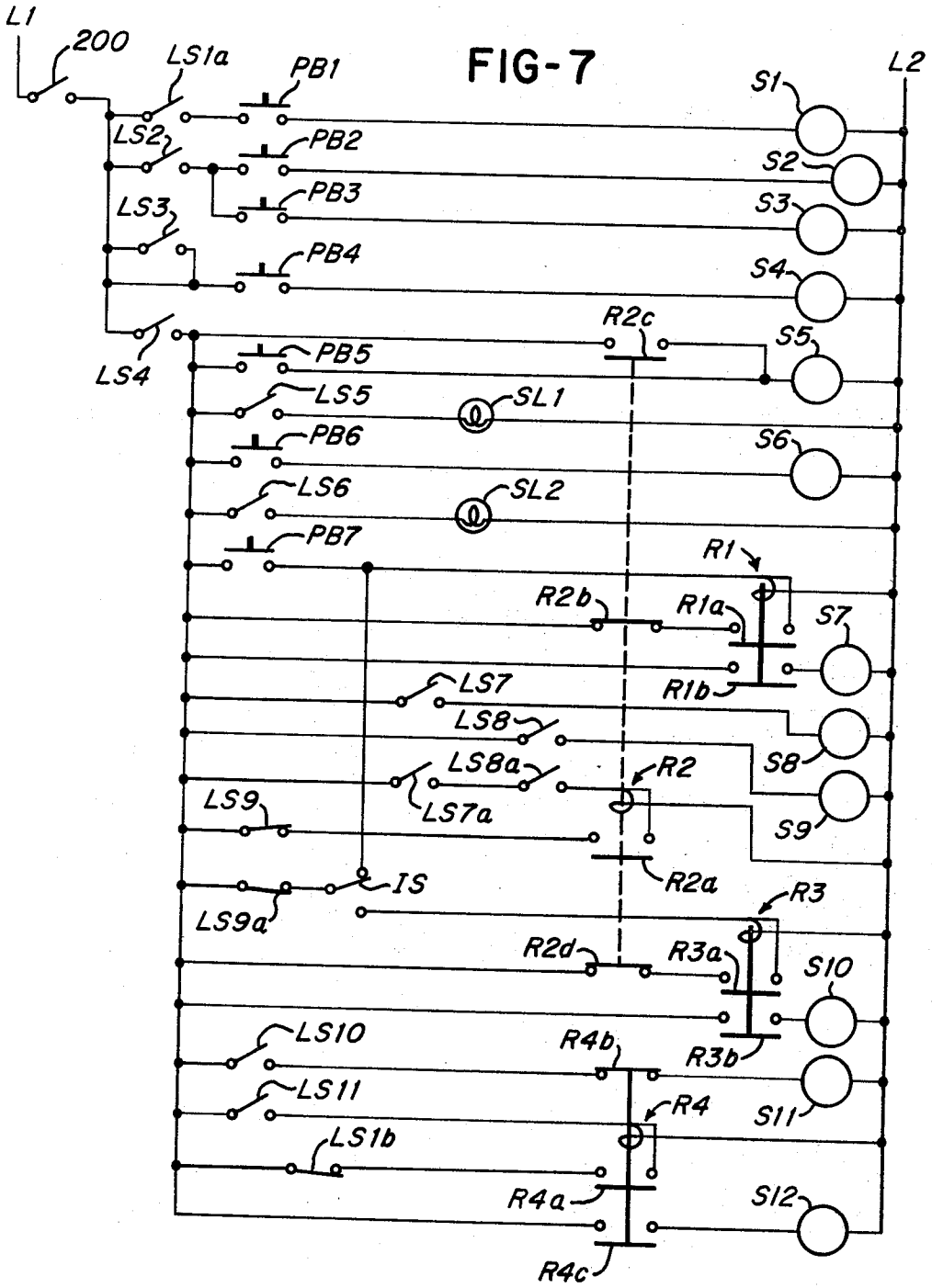


FIG-6

INVENTOR
Alexander McDonald
By Walter Burkey

FIG-7



INVENTOR
Alexander Mc Donald
By Walter Becker

APPARATUS FOR SHOT BLASTING WORK MEMBERS

The present invention relates to an apparatus for shot blasting work pieces, particularly cylindrical work pieces, together with an arrangement for recirculating the shot employed in the blasting operation.

Hollow members, such as ingot molds and the like, present particular cleaning problems after casting thereof because considerable sand remains on the inside of such work members. This sand can be removed manually by means of chipping hammers or it can be removed mechanically by means of shot slinger units and the like which propell shot or like particles into the interior of the work member from a position relatively remote from the actual work face and thereby dislodge the sand therefrom.

The sand deposits may, at times, be relatively thick, and both of the aforementioned leave much to be desired. In neither is the interior surface of the work member treated with the degree of efficiency desired, and in respect of the shot slinging arrangement, it is difficult to confine the shot to the area being treated and difficult to apply the work effort in a uniform manner to the entire area of the work member from which sand must be removed.

Furthermore, high dust concentrations is a problem in all such cases and is particularly disadvantageous when hand operations are being carried out.

With the foregoing in mind, the primary objective of the present invention is the provision of an improved apparatus for shot cleaning work members, particularly hollow work members such as ingot molds.

Another object of the invention is the provision of an apparatus for shot cleaning work members in which operators are not exposed to high levels of dust concentration and which is efficient and rapid in operation.

Still another object is the provision of a shot blasting installation of the nature referred to in which the shot is efficiently cleaned and reprocessed so that it can be used over again.

Still another object of the invention is the provision of an arrangement to recover the foundry sand in a substantially dust free condition suited to reuse in a foundry.

The foregoing objects of the present invention as well as still other objects and advantages thereof will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a somewhat schematic side elevational view of an installation according to the present invention with portions thereof in section to show construction details;

FIG. 2 is a plan view of the installation of FIG. 1;;

FIG. 3 is a side view of a modified arrangement according to the present invention;

FIG. 4 is a sectional view, indicated by line IV—IV on FIG. 3;

FIG. 5 is a plan view of the installation of FIG. 3;

FIG. 6 is a schematic representation of the hydraulic control system for the modification of FIGS. 1 and 2;

FIG. 7 is a schematic representation of an electrical control circuit for controlling the valves illustrated in FIG. 6;

FIG. 8 is a section through a typical probe head showing the nozzles therein; and

FIG. 9 is a section taken on line IX—IX of FIG. 8.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, the shot to be employed for shot blasting the interior of the hollow work member is conveyed to nozzles carried by a vertically moveable rod-like probe. With the probe in downward retracted position, a work member is moved into position above the probe and in axial alignment therewith, and the probe moves axially upwardly inside the work member while blasting medium, such as shot, and air is delivered from the probe nozzles in the generally radial direction toward the internal surface of the work member.

The probe may advantageously be advanced, step by step, in the upward direction until the entire axial length of the work member has been treated. It is also advantageous to rotate at least one of the probe and work member during the blasting operation to provide for substantially uniform treatment of the entire internal periphery of the work member.

The probe and work is located within an enclosure having closure doors, and which enclosure communicates with suction systems that draw off the dusty air therefrom. At a lower level in the enclosure, a conveyor is provided for receiving spent shot and sand which forms from the work member during treatment thereof, and the shot and sand are conveyed laterally from the enclosure with simultaneous breaking up of lumps of sand and, further, with separation of large particles of trash, such as pieces of scale, metal impregnated sand, and the like, from the shot.

Each of the separated fractions is delivered separately to either a disposal region or a storage region. In particular, the shot is delivered to a shot storage station which is cooperatively arranged with a blast hopper and from which the shot is withdrawn for delivery to the aforementioned probe.

The sand may be conveyed to a sand storage bin for reuse, if desired, and the separated out trash is conveyed to a trash disposal region.

The operation of the entire device is integrated by means of a control system that provides for automatic operation of the probe and with interlocks being provided to require at least certain operations to be completed before the next operation can be carried out.

In one form of the invention, the work members are mounted on a rotary table, open end down, and by indexing the table, the work members can be conveyed one at a time into a treatment enclosure in which the probe above referred to is located.

In another form of the invention, the work members are mounted, open end downwardly, on a carriage moveably mounted on rails so that the carriage can be moved into and out of the treatment enclosure through doors provided on respectively opposite sides thereof.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings somewhat more in detail, in FIGS. 1 and 2, an installation is illustrated which comprises an enclosure 10 adapted for receiving work piece 12 which is thereby cleaned internally by blasting with a blasting medium. Work piece 12 is open at at least one end, and this end is at the lower end and rests on a trolley 14 supported by wheels on tracks 16 which, as will be seen in FIG. 2, extend out both sides of the enclosure 10 a predetermined distance.

The trolley 14 in FIG. 1 will be seen in FIG. 2 to have a companion trolley 18 spaced therefrom and connected thereto by a rigid connector 20 so that the trolleys will move in unison, and when either is centrally positioned in the enclosure, the other is disposed outside the enclosure. For actuating the trolleys to move one trolley or the other into working position in the enclosure is provided a stationary hydraulic cylinder 22 having an elongated double acting ram 24 therein connected to the interconnected trolleys.

Enclosure 10 has doors 26 and 28 on the opposite sides thereof moveable, as by sliding, between open and closed positions. Advantageously, the doors 26 and 28 may be hydraulically operated.

The trolleys 14 are advantageously formed in such a manner that substantially the entire lower end of the work members 12 mounted thereon are exposed. The open lower ends of the workpieces are adapted for receiving a probe 30 having nozzle means 32 on the upper end thereof.

Probe 30 is mounted on a carriage member 34 guided for vertical movement on rails 36 extending into a pit beneath the floor level and which is at the level of the bottom of enclosure 10. Hydraulic motor 38 is connected to carriage 34 and moving it in the vertical direction. A further hydraulic motor 40 is provided on carriage 34 and is operable for rotating probe 30.

Probe 30 has connected thereto near the lower end a supply hose 42 by means of which blasting medium and compressed air are supplied to the probe for the discharge of the air and blasting medium at high velocity from the nozzle means 32.

Means are provided for drawing air off the upper portion of enclosure 10, as by means of the stack 44, while at the bottom of enclosure 10 there is an oscillating sieve tray 46 actuated by a drive mechanism 48. The sieve tray 46 receives spent blasting medium and sand and trash from inside work member 12 and conveys it rightwardly.

The sand and blasting medium drop through the sieve tray and are delivered by a chute 50 to the lower end of an upwardly extending conveyor 52. Any trash, such as unbroken pieces of sand and pieces of scale and the like, continue on across the sieve tray to the right end and are discharged into a trash conveyor 54 which leads, as will be seen in FIG. 2, to a trash box 56.

The admixed sand, dust, and blasting medium is elevated in conveyor 52 to the upper end thereof and drops down a chute 58 into a separator stage 60, wherein the sand and dust are separated from the heavier blasting medium, with the blasting medium passing downwardly through a rotary screen and air washer 62 to remove further dust and sand therefrom to a shot storage chamber 64 which, at its lower end, communicates with a hopper 66, from which the blasting medium is supplied for being conveyed, together with compressed air, to hose 42.

The separated out sand is delivered to a second elevator 68, and from the upper end thereof passes by way of chute 70 to a sand hopper or bin 72 for further use.

Adjacent sand bin 72 is a bag house 74 forming a part of a dust collecting stand that includes a primary separator for coarse particles in the form of a cyclone cleaner 80 which is interposed between the air wash 62 and the bag house 74 which is exhausted by a fan 76 and duct 78 leading to the discharge side of a cyclone cleaner 80, the inlet side of which is connected by duct work 82 to the aforementioned stack 44 at the top of treatment enclosure 10. The purpose of the cyclone is to reduce the heavy "work loading" on the bag house by removing the bulk of the coarse dust particles before the material reaches the bag.

In the above described modification, the work pieces are conveyed on rail supported carriages into and out of the treatment enclosure in straight lines, while in the modification of FIGS. 3 to 5, the workpieces are mounted on an indexing table and are moved thereon into and out of the treatment station, while the work pieces rotate on the table, rather than the probe rotating inside the work pieces.

In the modification of FIGS. 3 to 5, a rotary table 90 is rotatably supported on a central support 92 and is adapted for being indexed by a drive motor arrangement 94. One side of the table is moveable through a treatment station 96 having suitable doors, which may be work piece operated at the entrance and exit points.

Each work piece 98 is mounted, open end downward, on a respective support ring 100 rotatable on table 90. When each work piece is properly positioned in the treatment enclosure 96, a variable speed drive arrangement 102 engages operatively with the respective ring 100 for driving the ring and the work piece supported thereon in rotation.

Positioned on the axis of a work piece in working position of the treatment enclosure is a vertically moveable probe 104, having nozzle means 106 at the upper end, and supplied with compressed air and blasting medium via hose means 108 leading from blasting medium storage arrangement 110.

Spent blasting medium and material dislodged from the work member collect in a hopper 112 beneath the treatment enclosure and may be conveyed pneumatically up a chute 114 to a cleaning station 116, from which the blasting medium is returned to storage bin 110.

The probe 104 is vertically moveable as by the roller means 118, which are adapted for being driven in rotation by a variable speed drive arrangement 120*a*.

The interior of the treatment enclosure 96 is adapted for having dusty air withdrawn therefrom and cleaned by way of the dust collector means 120, connected through trap 122 with the treatment enclosure and having connected on the discharge side blower 124.

A hydraulic control circuit for the first described modification of FIGS. 1 and 2 is shown in FIG. 6. In FIG. 6, the fluid motors for operating the doors 26 and 28 are indicated at 150 and connected thereto is a normally centered closed center reversing valve 152 having a pressure supply line connected via a first adjustable valve 154 and a second adjustable valve 156 with the discharge side of a pump 158.

The control of blasting medium to the hose, or hoses, connected to the probe, is under the control of fluid motors 160, to which pertains another normally centered closed center reversing valve 162, which receives pressure from the downstream side of valve 154.

The upper one of fluid motors 160 has its one side connected directly to an outlet port of valve 162 and its other side connected through a choker-check arrangement 164, with the other outlet port of valve 162. The lower one of fluid motors 160 is similarly connected with its one side leading through a choker-check arrangement 166 to one outlet port of valve 162

and the other side connected directly to the other outlet port thereof.

The fluid motor **22, 24** pertaining to the carriages **14** and **18** is connected through a normally centered closed center reversing valve **168** with the downstream side of valve **156.**

Counterbalance valves **169** in the lines leading from valve **168** relieve excessive pressure in the system should such a condition develop on account of an extremely heavy load being moved, or stopped, by the fluid motor **22, 24.**

The fluid motor **38** for moving the probe vertically has the side thereof which causes elevation of the probe connected through an adjustable valve **170** with the discharge side of pilot operated check valve **172,** the opposite side of which is connected with one outlet port of a normally centered closed center reversing valve **174,** the inlet port of which is connected to the downstream side of valve **156.**

The other side of fluid motor **38** is connected to one side of a rotary motor **176,** the other side of which is connected with the other outlet port of valve **174.** A branch conduit **178** extends from the outlet side of check valve **172** to the side of fluid motor **176** opposite the side connected to valve **174** and has therein a shut off valve **180.** A pilot line **182,** extending from the side of fluid motor **176** connected to valve **174** to check valve **172,** is operable for piloting the check valve to open position, whenever pressure is supplied to motor **176** from valve **174.**

The rotary motor **40** connected with the probe has one side connected to one outlet port of a normally centered close center reversing valve **184** which, in its center position, has its inlet port connected to an exhaust. The inlet port of valve **184** is connected to the discharge side of a pump **186.** The other side of motor **40** is connected to one side of a rotary motor **188,** the other side of which is connected to the other outlet port of reversing valve **184.**

A normally closed solenoid operated valve **190** is connected in bypassing relation to motor **40** and another normally closed solenoid operated valve **192** is connected in bypassing relation to motor **188.**

Each of the reversing valves **152, 162, 168, 174** and **184** are solenoid operated into their respective shifted positions and automatically center when the solenoids pertaining thereto are deenergized.

Pump **158** may have an unloading arrangement connected to the discharge side thereof in the form of a relief valve **194,** the opening pressure of which is under the control of a normally open solenoid operated valve **196.**

The control of the several solenoid operated valves of FIG. **6** is somewhat schematically illustrated in FIG. **7,** at least with respect to the basic operative instrumentalities of the hydraulic circuit.

In FIG. **7,** power lines are indicated at **L1** and **L2** and a main control switch **200** is provided which controls the entire circuit.

A first limit switch **LS1,** which is closed when the probe is in its lowermost position, has one blade **LS1***a* in circuit with a pushbutton **PB1,** which controls a solenoid **S1** pertaining to valve **152,** and which controls the opening of the doors for the treatment enclosure.

Second limit switch means **LS2,** which close when the doors are completely open, and which may be in the form of a pair of serially arranged limit switches, with one pertaining to each door arrangement. This limit switch means, is in series with another pushbutton **PB2,** which controls a solenoid **S2,** which is one of the solenoids for valve **168** that controls the movement of carriages **14** and **18** in one direction.

Another pushbutton **PB3** is provided, which controls solenoid **S3,** which is the other solenoid pertaining to valve **168.**

When either carriage is in working position, limit switch means **LS3** is closed, and this will permit a supply of energy through a further pushbutton **PB4** to a solenoid **S4,** which is the other solenoid pertaining to valve **153,** so that the treatment enclosure doors can be closed.

When the doors are closed, a further limit switch means **LS4** is actuated, which permits a supply of energy to a pushbutton **PB5,** in circuit with a solenoid **S5,** which is the solenoid pertaining to valve **174** that brings about elevating of the probe.

According to the present invention, the movement of the probe is programmed in conformity with the size and shape of the work piece being treated, so as to rise to a certain axial point of the work piece, whereupon the probe and work piece rotate relatively, and then the probe rises to another level, and the probe and work piece again rotate relatively, and this operation continues until the entire length of the work piece has been treated, whereupon the probe will retract downwardly.

This operation is taken care of in the present arrangement by a limit switch **LS5,** which may be under the control of a cam driven by the probe. When this limit switch is closed, a signal light **SL1** is illuminated, showing that the probe is at proper elevation. At that time, pushbutton **PB5** is released, and the probe comes to a halt.

The supply of blasting medium and compressed air to the probe can now be initiated, and this is accomplished by way of a pushbutton **PB6** controlling a solenoid **S6,** which is one of the solenoids associated with valve **162.** When the blast valves are completely open, a limit switch **LS6** is actuated, illuminating a signal lamp **SL2,** which will indicate to the machine operator that the probe is in starting position and is now being supplied with blasting medium.

A pushbutton **PB7** is now depressed and which will initiate an automatic cycle. CLosing of **PB7** energizes a relay **R1,** which has a holding circuit through its blade **R1***a* and a normally closed blade **R2***b* of a relay **R2.** Relay **R1** has a further blade **R1***b* in circuit with a solenoid **S7** which is one of the solenoids associated with reversing valve **184.**

Energization of solenoid **S7** will shift valve **184** in such a direction as to cause probe rotation **40** and rotary motor **188** to run in one direction. The probe rotator motor will, of course, rotate the probe, whereas motor **187** rotates a cam that regulates the rate of delivery from pump **186,** thereby controlling the speed of rotation of the probe, so that each circumferential portion of the work member receives the proper amount of treatment.

When motor **40** has rotated 180°, it causes a limit switch **LS7** to close which is in circuit with a solenoid **S8,** which pertains to valve **190,** so that probe motor **40** is bypassed and, therefore, comes to a halt. When motor **188** rotates 180°, it causes a limit switch **LS8** to close, which is in circuit with a solenoid **L9,** pertaining

to valve 192, which will bypass fluid motor 188 and thereby bring the cam to a halt.

Limit switch LS7 has a second blade LS7*a*, and limit switch LS8 has a second blade LS8*a*, and when both of the said limit switches are closed, the last mentioned switch blades also close and energizes the coil of a relay R2, which has a holding circuit through its blade R2*a*. When relay R2 closes, it opens its blade R2*b* and causes deenergization of relay R1 and closes a blade R2*c* in circuit with solenoid S3 for the probe lift motor 38, so that the probe now moves upwardly to its next position.

When the probe reaches its next position, it actuates a limit switch LS9, which interrupts the holding circuit for relay R2, and simultaneously closes a second blade RS9*a* thereof. Blade RS9*a* is in series with an indexing switch blade IS, which alternately moves between an upper and lower contact each time switch LS9 is actuated.

If switch IS is resting on its lower contact, when switch blade LS9*a* closes, a relay R3 will be energized, which will establish a holding circuit through its blade R3*a* and a normally closed blade R2*d* of relay R2, and which will also close a blade R3*b* in circuit with a solenoid S10, which is the other solenoid pertaining to valve 184, so that the probe rotator motor 40 and motor 188 will not rotate in the reverse direction.

As before, when each of the motors has completed 180° of revolution, limit switches LS7 and LS8 will close, and the previously described cycle will be repeated, except this time relay R1 will be energized instead of relay R3 and cause the probe and cam to rotate in the opposite direction.

The operation continues with the probe elevating step by step and alternately rotating clockwise and counter clockwise, together with the speed control cam, until the probe reaches an upper position, at which time it will close the limit switch LS10 in circuit with a valve solenoid S11 through a normally closed blade R4*b* of a relay R4. Solenoid S11 is associated with valve 162 and causes the blast valve motors 160 to close.

When these motors are closed, the limit switch LS11 is closed, and this energizes relay R4, which establishes a holding circuit through its blade R4a and a further blade LS1*b* of the limit switch actuated by the probe in its lowermost position. Relay R4 has a further blade R4*c* in circuit with a solenoid S12, which is the solenoid pertaining to valve 174, which shifts the valve in a direction to cause the probe to move downwardly.

When the probe reaches its lowermost position, it will open blade LS1*b* to deenergize relay R4 and will close the first mentioned blade LS1*a* in circuit with pushbutton PB1.

The doors to the treatment enclosure can now be opened, and the treated work piece withdrawn therefrom, and a new work piece put in position and the cycle described above repeated.

Substantially the same control system can be employed in respect of the second described modification, wherein the work pieces are moved into and out of the treatment enclosure on an indexing table.

FIGS. 8 and 9 show a typical probe arrangement in section. In these figures, the probe head is indicated at 250 and may comprise, for example, a hollow cast steel member of wear resistant qualities.

Near the upper end of the head and arranged on opposite sides thereof are horizontally directed nozzles 252 which have venturi shaped passages therein and which are formed of an extremely hard material, such as boron carbide or the like. The nozzles are preferably held in place in holes provided therefor in head 250 as by epoxy cement 254 and a retaining hard steel keeper plate 256 secured in place by screws can also be provided.

In the probe head arrangement illustrated in FIGS. 8 and 9 in an upper level, two nozzles 252 and 258 directed substantially horizontally and in opposite directions and offset on opposite sides of the diameter of the probe head which is parallel to the nozzle axes.

The probe head, at a level lower than nozzles 252 and 258, comprises inclined nozzles 260 and 262, arranged on opposed sides of the probe head and also offset laterally from the aforementioned diameter. Nozzles 260 and 262 are advantageously inclined upwardly at an angle of about 25° from the horizontal.

A probe head of the nature described, if caused to rotate through about 180°, or slightly more, will provide for complete coverage of the inside of a whole work member being treated.

In this manner, the upwardly directed nozzles are operable for dislodging most of the sand inside a work piece, so that the horizontally directed nozzles, and which can be arranged to have extremely high velocity jets, will treat the sand which is closest to the work member and, therefore, the most difficult to remove because of having been subjected to high heat during the casing operation.

With this in mind, it will be understood that the single hose shown in FIG. 1 leading to the probe could, in fact, constitute two or more hoses, manifolded into the probe tube giving a common mixed stream of blasting medium and compressed air to each nozzle. The horizontal nozzles may advantageously be of a longer, high velocity venturi type which provides greater acceleration forces to the blasting medium.

The control of the speed of motor 40 can be accomplished by using motor 188 to rotate a cam 189 which adjusts the stroke of pump 186 which is variable in delivery.

Similarly, the programming of the upward movement of the probe can be accomplished by having motor 176 drive a cam 177 which is arranged to operate the remove switches which control the energization of the solenoids which shift valve 174.

It is, of course, to be understood that the present invention is, by no means, limited to the particular showing in the drawings, but also comprises any modifications within the scope of the appended claims.

What is claimed is:

1. In an apparatus for cleaning the insides of hollow work members by a blasting medium, especially to remove residual core sand from cast work members; an enclosure, means for supporting a work member open end down in said enclosure substantially coaxial with a predetermined work axis, a probe on said work axis moveable upwardly from beneath a work member into the inside of a work member in the enclosure and having nozzle means on the upper end directed toward the internal surface of the work member, means for supplying solid blasting medium and compressed air to said nozzle means, work member conveying means moveable into and out of said enclosure, means for actuating said work member conveying means, and means for

permitting movement of said work member conveying means only when said probe is in a lowered position.

2. An apparatus according to claim 1 which includes means for rotating said probe and work member relatively on said work axis.

3. An apparatus according to claim 1 which includes means for advancing said probe along said work axis step by step and for rotating said probe and work member relatively at each said step.

4. An apparatus according to claim 1 which includes conveyor means leading laterally from said enclosure and adapted to receive spent solid blasting medium in said enclosure and to convey it from said enclosure.

5. An apparatus according to claim 4 which includes means to separate the sand from the solid blasting medium after leaving said enclosure, and separate receiving stations for said sand and solid blasting medium.

6. An apparatus according to claim 1 which includes door means for said enclosure for the entrance and exit of work members, means connected to the top of said enclosure for withdrawing air and dust therefrom, and conveyor means leading laterally from the enclosure at the bottom for conveying spent solid blasting medium and sand therefrom.

7. In an apparatus for cleaning the insides of hollow work members by a blasting medium, especially to remove residual core sand from cast work members; an enclosure, means for supporting a work member open end down in said enclosure substantially coaxial with a predetermined work axis, a probe on said work axis moveable upwardly from beneath a work member into the inside of a work member in the enclosure and having nozzle means on the upper end directed toward the internal surface of the work member, means for supplying solid blasting medium and compressed air to said nozzle means, door means for said enclosure for the entrance and exit of work members, means connected to the top of said enclosure for withdrawing air and dust therefrom, conveyor means leading laterally from the enclosure at the bottom for conveying spent solid blasting medium and sand therefrom, means permitting operation of said door means only when said probe is in a lowered position, work member conveying means moveable into and out of said enclosure via the openings pertaining to said door means, and means permitting movement of said conveying means only when said door means are open.

8. An apparatus according to claim 7 which includes work member conveying means moveable into and out of said enclosure, and means for actuating said work member conveying means.

9. An apparatus according to claim 1 in which said work member conveying means comprises an indexable table having one side extending into said enclosure.

10. An apparatus according to claim 9 in which said table has circumferentially spaced ring members rotatable thereon and each adapted to support a work member open end down.

11. An apparatus according to claim 1 in which said work member conveying means comprises wheeled carriage means, and track means leading into said enclosure and supporting said carriage means.

12. An apparatus according to claim 11 in which said carriage means comprises a pair of rigidly interconnected carriages spaced so that when either is in working position in said enclosure the other is outside said enclsoure.

13. An apparatus according to claim 1 in which said nozzle means includes first nozzles inclined upwardly from the horizontal and second nozzles which are horizontal.

14. An apparatus according to claim 13 in which said second nozzles supply jets at higher velocity than said first nozzles.

15. An apparatus according to claim 1 which includes openings in said enclosure for the introduction and removal of work members, door means for closing said openings, work member conveying means to convey work members to and from said enclosure via said openings, a supply of compressed air and solid blasting mediums and valve means controlling the connection of said supply to said nozzle means, first fluid motor means for actuating said door means, second fluid motor means for actuating said valve means, third fluid motor means for actuating said conveying means, fourth fluid motor means for actuating said probe, fifth fluid motor means for rotating a work member in said enclosure and said probe relatively, and means for reversible supplying pressure fluid selectively to said aforementioned fluid motor means comprising pump means and control valves interposed between said pump means and said respectively fluid motor means.

16. An apparatus according to claim 15 which includes means to control the speed of said fifth fluid motor means.

17. An apparatus according to claim 15 which includes means to vary the speed of said fifth fluid motor means during rotation thereof.

18. An apparatus according to claim 5 which includes means for air washing said solid blasting medium at the time of separation thereof from said sand to remove dust and sand therefrom.

* * * * *