United States Patent [19]

Baker

[11] **3,869,830**

[45] **Mar. 11, 1975**

[54] **APPARATUS FOR CLEANING THE CAVITIES OF CASTING AND THE LIKE**

[75] Inventor: **Jesse L. Baker,** Radford, Va.

[73] Assignee: **The Mead Corporation,** Dayton, Ohio

[22] Filed: **Sept. 28, 1973**

[21] Appl. No.: **401,890**

[52] **U.S. Cl.** ..... **51/8 R**

[51] **Int. Cl.** **B24c 3/04,** B24c 3/32

[58] **Field of Search** ..... 51/8 R, 8 SP, 14, 5 R

[56] **References Cited**

UNITED STATES PATENTS

1,890,164	12/1932	Rosenberger	51/8
2,253,225	8/1941	Bowes	51/8
3,193,975	7/1965	Millhiser	51/8
3,309,818	3/1967	Brown	51/8
3,769,752	11/1973	McDonald	51/14 UX

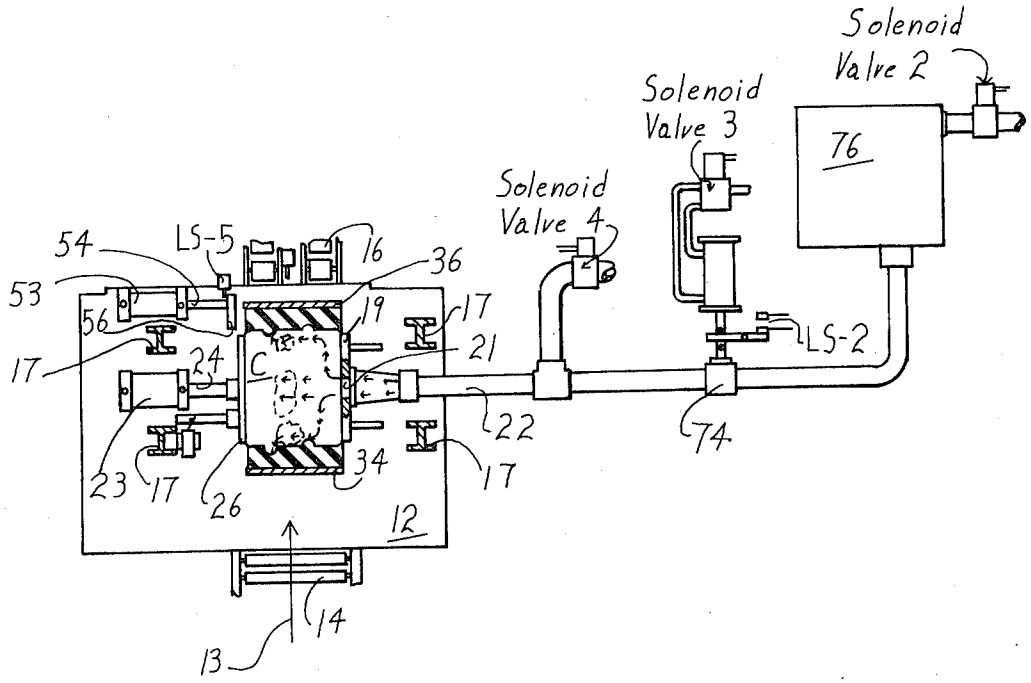
Primary Examiner—Donald G. Kelly

Attorney, Agent, or Firm—Jennings, Carter & Thompson

[57] **ABSTRACT**

Automated apparatus for cleaning out manually inaccessible cavities of castings. The casting is placed on a work station or table and is held by side and top clamping members. An airborne stream of abrasive particles is now passed through the cavities, exiting through an opening in communication therewith. After a predetermined time clean air is blown through the casting along the same path as the abrasive material, thus to purge the casting of all foreign matter.

5 Claims, 5 Drawing Figures



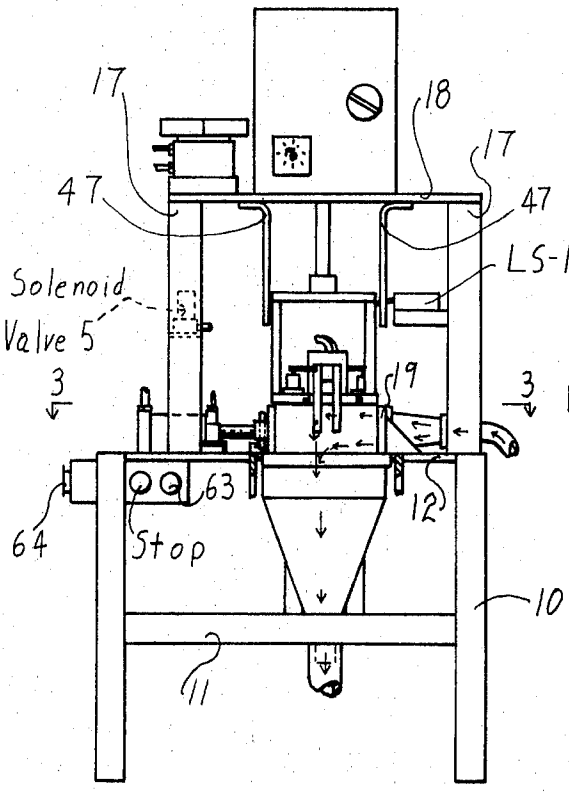


Fig. 1

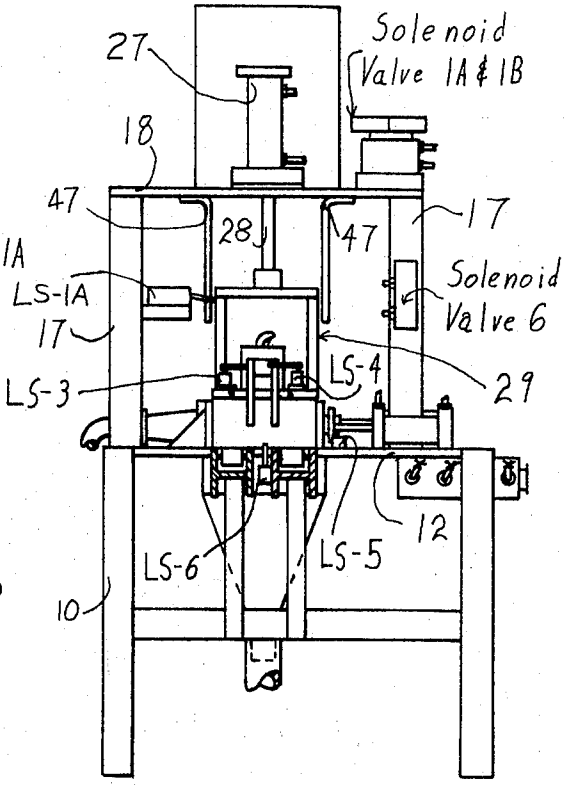


Fig. 2

Fig. 3

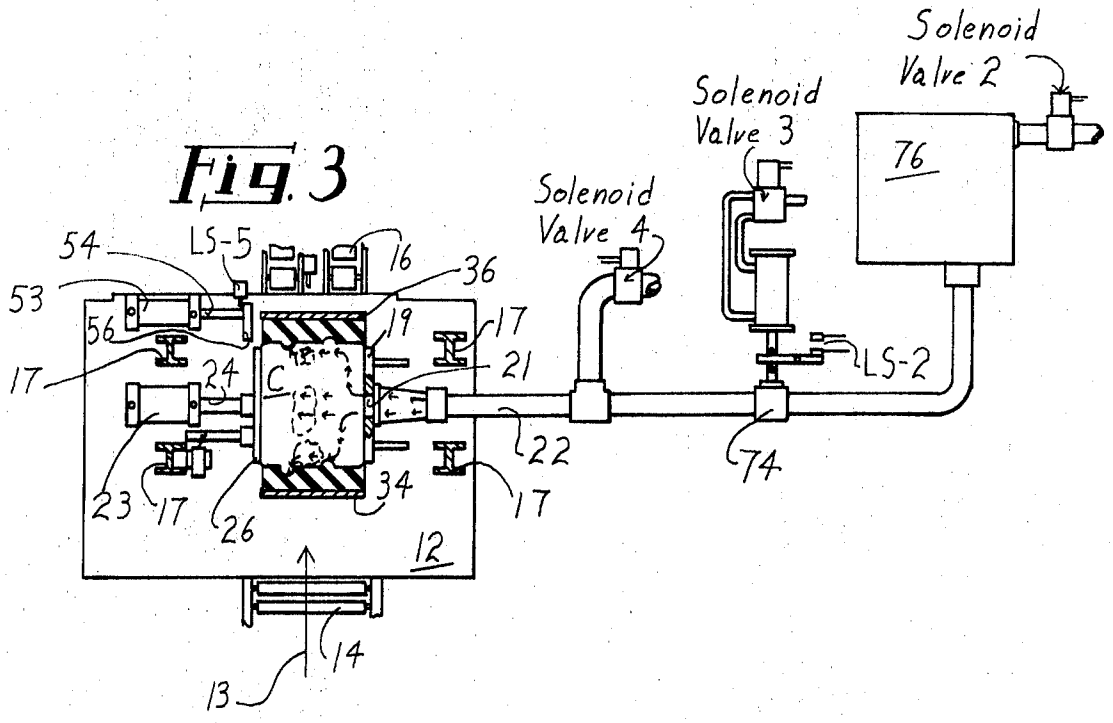
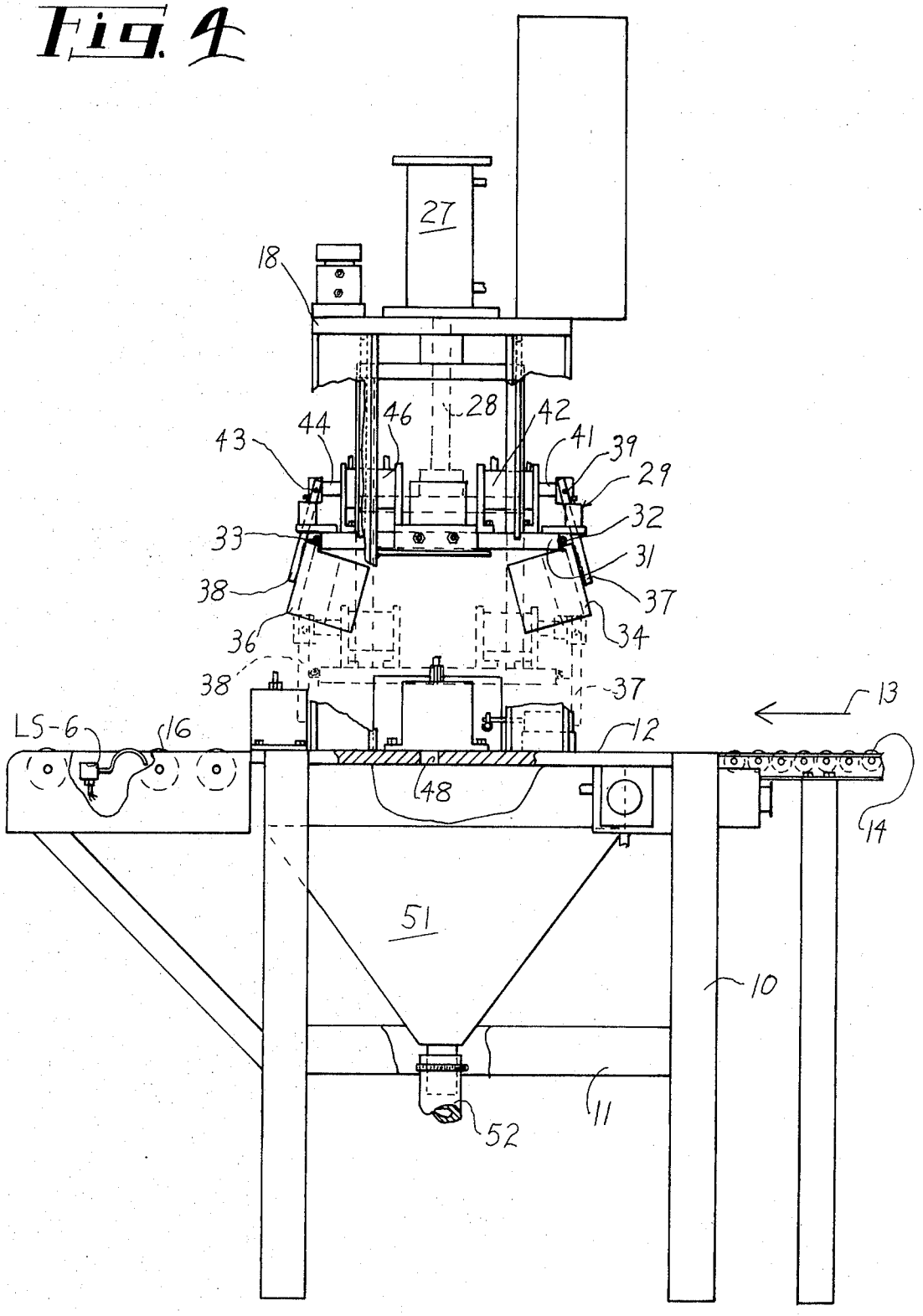


Fig. 4


27
18
44
46
28
42
43
41
39
29
32
33
31
38
37
36
34
38
37
13
LS-6
16
12
48
14
51
10
11
52

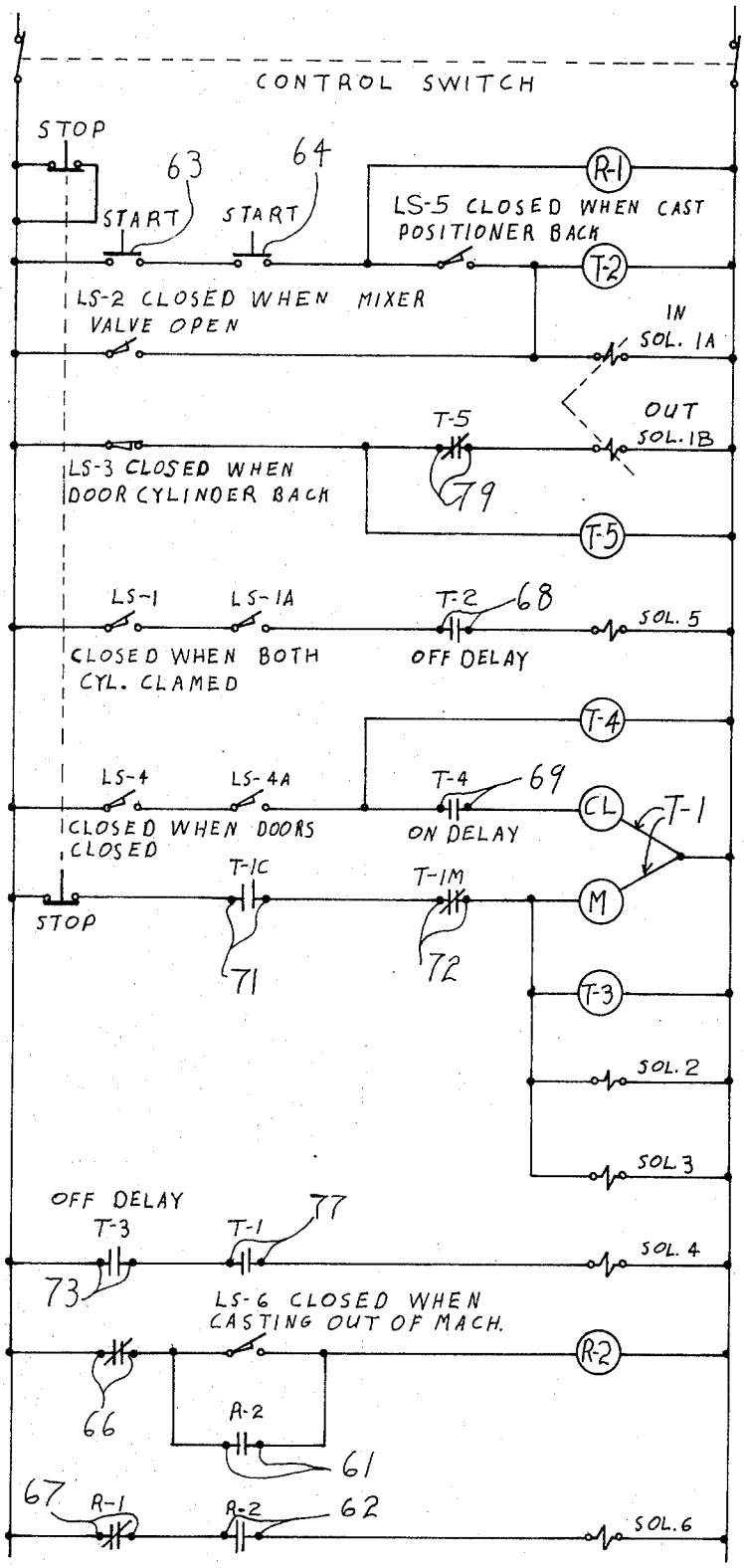

CONTROL SWITCH
STOP
63
64
START
START
R-1
LS-5 CLOSED WHEN CAST POSITIONER BACK
T-2
LS-2 CLOSED WHEN MIXER VALVE OPEN
IN SOL. 1A
OUT SOL. 1B
T-5
79
LS-3 CLOSED WHEN DOOR CYLINDER BACK
T-5
LS-1
LS-1A
T-2
68
SOL. 5
CLOSED WHEN BOTH CYL. CLAMED
OFF DELAY
T-4
LS-4
LS-4A
T-4
69
CL
T-1
CLOSED WHEN DOORS CLOSED
ON DELAY
T-1C
T-1M
M
STOP
71
72
T-3
SOL. 2
SOL 3
OFF DELAY
T-3
T-1
77
SOL. 4
73
LS-6 CLOSED WHEN CASTING OUT OF MACH.
R-2
66
A-2
61
67
R-1
R-2
62
SOL. 6

Fig. 5

APPARATUS FOR CLEANING THE CAVITIES OF CASTING AND THE LIKE

My invention relates to apparatus for cleaning the interior, generally inaccessible cavities of castings and the like.

In the foundry arts castings such as cylinder heads for engines which contain coolant passages are generally cast by the use of removable cores of sand or the like. Thus, at the completion of the casting operation it is required that all of the sand, fins and the like left in the cavities be removed so that there will be no impediment to the flow of coolant when the part is assembled into an engine. As can be appreciated, these passages are extremely tortious in the sense that they must surround the parts of the head to be cooled, making it practically impossible to ram out or otherwise mechanically to remove the remaining sand and fins. Therefore, my invention is directed particularly to apparatus which is adapted to clean such cavities by passing therethrough an airborne stream of an abrasive material such as abrasive steel shot.

My invention has as an object the provision of apparatus of the character designated into which a casting, having cavities as aforesaid, may be placed, secured in place, a stream of the abrasive shot passed through the cavities in such fashion as to clean them out completely and then, after the cleaning operation, to purge or completely clean the cavities of all remaining shot, dust, and other foreign bodies.

More in detail my improved apparatus comprises generally a table onto which the casting is placed. Many castings have openings in the sides and bottom, communicating with the cavities and in some instances such castings also have openings in the top which also communicate with the cavities. In view of this my improved apparatus also comtemplates the provision of means to hold the side openings in communication with means to force the abrasive material into the casting and to hold the bottom openings in communication with openings through the table for the discharge of such material. Furthermore, when cleaning castings which have openings through their tops as well as their sides and bottoms, it is necessary to close off the top openings in such fashion that the abrasive material will follow the continuous circuit to be followed by the coolant in the casting. My improved apparatus also embodies means to be lowered down onto the top of the casting, while in place on the table, thus to close any top openings and hold it more securely in place, together with side clamps carried by such hold down means which straddle the casting and hold it still more further rigidly and firmly in position during the cleaning operation.

My invention also contemplates the substantially complete automation of the cleaning operation in the sense that the abrasive material is blown through the casting for a certain, predetermined length of time automatically followed by the introduction of a purging, cleaning stream of air.

My invention further contemplates the provision of means to deliver and remove castings from the apparatus in the form of conveyors, together with a stop member which is in place when a casting is first delivered, thus to assure that it is aligned properly in the apparatus relative to the direction of movement of the casting thereonto, together with means to remove said stop

member to permit a cleaned casting to be removed from the machine by means of a discharge conveyor.

Apparatus illustrating features of my invention is shown in the accompanying drawings in which:

FIG. 1 is a front elevational view with certain parts broken away and in section;

FIG. 2 is a rear elevational view with certain parts broken away and in section;

FIG. 3 is a detail sectional view taken generally along line 3—3 of FIG. 1 and showing further the addition of means to supply abrasive material and clean air to the casting;

FIG. 4 is a side elevational view, drawn to a larger scale than the remaining figures with certain parts broken away for the sake of clarity; and,

FIG. 5 is a wiring diagram.

Referring now to the drawings for a better understanding of my invention the same embodies a supporting framework **10** which may be in the form of shapes embodying vertical legs and cross members **11.** Across the top of the supporting framework is a heavy plate or table **12** which forms a support for a casting C to be cleaned.

As best shown in FIG. **4** the castings are delivered to my improved apparatus generally in the direction of the arrow **13,** that is, pushed or otherwise moved onto the plate or support **12** from the delivery conveyor **14.** The castings are removed at the opposite side after being cleaned by pushing them onto a discharge conveyor **16** which takes them away for shipment, or other operations.

Mounted as a sort of superstructure over the support **12** is a framework comprising vertical members **17** and another plate **18.** The purpose of this superstructure is to support mechanism presently to be described which is adapted to move down on top of a casting C in place on the support, thus to hold it down while it is being cleaned as will presently appear.

Mounted along one side of the table is an abutment in the form of a plate **19,** the abutment having an opening **21** therethrough. See FIG. **3.** In communication with the opening **21** is a conduit **22** through which there may be passed an airborne stream of abrasive material such as shot or, alternatively, a supply of clean air. The details of this supply mechanism will be later described.

Mounted on the table, opposite the abutment **19** is a two-way pneumatic cylinder **23** having a piston rod **24.** The piston rod **24** carries a clamping plate member **26** which is adapted as presently will appear, to push the casting C to the right as viewed in FIG. **3** whereby the side openings in the casting come into sealed communication with the opening **21** in the abutment **19,** thus in effect connecting the cavity of the casting substantially airtight to the conduit **22.**

Mounted on top of plate **18** is a double acting fluid pressure cylinder **27** having a piston rod **28.** Carried by the lower end of the piston rod is a hold down and clamping assembly indicated generally by the numeral **29.**

The unit **29** may comprise a plate **31** which is connected to the lower end of the piston rod **28.** Pivotally mounted on the plate as at **32** and **33** are side clamp members **34** and **36** and secured to the clamp members **34** and **36** are upstanding arms **37** and **38.** The upper ends of the arms **37** are pivoted at **39** to the piston rod **41** of a double acting fluid pressure cylinder **42.** In simi-

lar manner, the arms 38 of the member 36 are pivoted at 43 to the piston rod 44 of another double acting cylinder 46. Both of the cylinders 42 and 46 are mounted on the plate 31. As is shown in the drawings when the piston rods 41 and 44 are retracted into their cylinders the respective side clamps are moved away from each other as shown in FIG. 4, whereby with the arms or clamps in this position the lowering of piston rod 28 lowers the clamps about a casting C in place on the support 12. When the cylinders 42 and 46 are energized in an opposite direction the clamps 37 and 38 pivot inwardly toward each other, clamping and holding the casting between them. At the same time, the casting is engaged at its top by the plate 31 which is lowered into place to press the casting downwardly onto the table, prior to moving the clamps 37 and 38 inwardly.

From what has just been described it will be seen that when the parts move from the full line position to the dotted line position of FIG. 4 the clamping members 37 and 38 are moved first downwardly to straddle the casting and thence inwardly to clamp it, while at the same time the casting is pushed downwardly onto the top of the table 12 by the bottom of the plate 31. In order to stabilize the movement of the entire unit 29 and to prevent it from rotating I provide guide members 47 secured to the underside of the upper plate 18 between which the assembly 29 slides, vertically.

The table 12 is provided with one or more openings 48 which are adapted to communicate with bottom openings in the casting C. Thus, whenever the casting C is in position on the table and clamped by the mechanisms described opening 21 in the abutment 19 is in sealed communication with a side opening in the casting which communicates with its cavity or cavities and opening 48 is in communication with the bottom or discharge openings of the casting.

Secured beneath the plate or support 12 is a hopper 51 having a discharge pipe 52. As will later be explained, the abrasive material in the form of shot passes through conduit 22 into the cavity through opening 21 in the abutment 19 and thence through the cavities of the casting and then through the opening 48 in the plate 12 and into the hopper 51. The material from hopper 51 may be conveyed through the conduit 52 to a storage place for reuse if desired.

Also mounted on the table is a double acting fluid pressure cylinder 53 having a piston rod 54. The piston rod 54 carries on its outer end a locator member 56 which is adapted to move from the position shown in FIG. 3 to the right, whereby when a casting is moved into the machine in the direction of arrow 13 the rear end of the casting engages the forward edge of the member 56, thus to accurately locate the position of the casting, in the direction of its movement into the machine. As will be explained, while the casting is being cleaned the locator member 56 is withdrawn from the path of the casting as shown in FIG. 3 and the passage of the finished casting onto the discharge conveyor 16 actuates a limit switch, to be described, to move the member 56 back into locating position for the next casting.

While the apparatus shown herein may be operated by providing fluid under pressure to the several cylinders and so forth, and using individual, manually controlled valves for the same, I prefer to automate the operation so that it will operate more efficiently and more accurately. While various types and forms of control mechanisms may be devised to do so, in FIG. 5 I show schemmatically a wiring diagram for controlling the various solenoid actuated valves, timers and relays and in which also is included various limit switches, all of which will now be described.

With the various switches, relays and parts in the position shown in FIG. 5 a casting has just been cleaned and purged and is now ready to be pushed from the plate 12 onto the discharge conveyor 16. Upon pushing the casting, either manually or with mechanism not shown, onto conveyor 16, in its passage along the conveyor the casting momentarily closes a switch LS6. The closing of LS6 energizes a relay R2. The energization of relay R2 closes normally opened contacts 61 and 62. contacts 62, being holding contacts and contacts 62 being used to energize a solenoid valve 6. The solenoid valve 6 controls cylinder 53 and moves the piston rod 54 and locator member 56 from the position shown in FIG. 3 to a position substantially midway of the path of movement of a casting being pushed into the machine in the direction of line 13.

With the locator member 56 now in place another casting to be cleaned is pushed from the conveyor 14 onto the table or support 12 until its end contacts the edge of the locator member 56. With the casting to be cleaned in place the operator, now depresses the two start buttons 63 and 64. The two start buttons are located so that the operator is forced to use both hands to make the machine operate, thereby assuring that his hands are out of the way of the moving parts. Simultaneously depressing the two start buttons 63 and 64 energizes control relay R1, opening its normally closed contact 66 and 67. The opening of contacts 66 of course deenergizes relay R2. Furthermore, the opening of contacts 67 deenergizes the solenoid valve 6, energizing cylinder 53 in the opposite direction and thus withdrawing the positive locating member 56 to the position shown in FIG. 3. The withdrawing of the locating member 56 closes limit switch LS5, thus to energize pneumatic timer T2 and solenoid 1A. This energizes cylinder 27 in a direction to lower the entire vertically movable clamp assembly about the casting and also energizes cylinder 23 in a direction to move the clamping member 26 to the position shown in FIG. 3, namely, to a position where it is pressing the casting against the abutment member 19. It will be noted that the closing of LS5 energizes a timer T2. The energization of timer T2 also closes a set of off delay contacts 68, thus to ready the energization of a circuit consisting of limit switches LS1. LS1A and solenoid valve 5, the latter of which will be energized to power cylinders 42 and 46 in directions to close the clamps 37 and 38. When the two clamp cylinders 42 and 46 move to close the clamps, they actuate limit switches LS4 and LS4A. The closing of these switches energizes a timer T4 and this timer is set to allow the doors to clamp tightly before the actual cleaning operation commences. The energization of timer T4 also closes a set of contact 69, thus to energize blow timer T1. As shown diagrammatically, timer T1 comprises a motor indicated by the letter M and a clutch indicated by CL. The energization of T1 establishes a curcuit through a set of contacts 71 and 72 to the motor M of the timer T1. Timer T1 energizes timer T3 and when T3 is energized a set of off delay contacts 73 is closed. T1 also energizes solenoid valve 2 and solenoid 3 controlling the mixer valve 74. This causes an airborne stream of shot from the shot tank 76

to flow through the conduit **22**, into the casting, cleaning it, and to discharge downwardly into the hopper **51**, through the opening **48**. It will be noted, during all the times previously set forth the operator has had to hold both of the start buttons **63** and **64** manually closed. However, upon energization of the mixer, valve LS2 closes, by passing the start buttons and holding the circuit energized. The operator can now release the two start buttons **63** and **64**. The time of the blast is determined by the time set on T1. When T1 times out to stop the blasting, contacts **72** open and deenergize timer T3. Thus, off delay contacts **73** are now timing the opening of contacts **72** to deenergize solenoid valves **2** and **3** to stop the air blast and the flow of shot. It will be noted that this time the mixing valve **74** is now closed. Now that no more shot is being applied it is now necessary to remove the shot remaining in the casting. Upon the timing out of T1 a set of contacts **77** closes, (it being remembered that contacts **73** at this time are closed) thereby energizing solenoid valve **4**. This introduces a flow of clean air into the cavity of the casting, which takes the same path as did the abrasive material, thus to blow out any remaining shot, dust, and other fine particles left in the casting. When the mixer valve **74** closes, limit switch LS2 opens, thereby to deenergize solenoids **1A** and timer T2. A normally closed set of contacts **68** controlled by T2 now opens to deenergize solenoid **5**, thus to power the cylinders **42** and **46** in directions to open the clamps **37** and **38**. When the clamps open, limit switches **4** and **4A** open thus to reset T1 and T4. Also, the opening of the clamps opens limits swtich **3** and energizes solenoid valve **1B**, to energize cylinder **27** for upward movement of the clamping unit **29** and also to energize cylinder **23** in the direction to move clamp **26** to the left as viewed in FIG. **3**. The closing of limit switch **3** also energizes timer T5. When T5 times out, contacts **79** open, opening the circuit to solenoid **1B**, to allow power to be applied to solenoid **1A** when ready. It will here be noted that solenoids **1A** and **1B** are double solenoid valves, namely, of the type that when power is applied to the coil to shift the valve, even though the power is subsequently removed, the valve would remain shifted until power is applied to the other coil. The casting is now ready to be discharged from the machine, and in moving over LS6 readies the machine to receive another casting.

From the foregoing it will be apparent that I have devised an improved apparatus fully effective to clean the inner passageways of castings of sand, fins, and other undesirable foreign material. In practice my invention has proven to be extremely practical and satisfactory and furthermore has proven to be capable of cleaning castings of such intricate design that the same could hardly ever be cleaned by hand or otherwise.

While various velocities and sizes and types of abrasive materials may be used by way of example I have found that for cleaning the passages or cavities of cast iron cylinder heads, I use abrasive steel shot and grit of a size to pass through a **12** to **18** size shiv or screen. The air pressure employed typically is 90 pounds per square inch, applied through a one and one-half inch line **22**.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What I claim is:

1. In apparatus for cleaning internal cavities in castings and the like wherein there is at least one opening into a side of the casting communicating with at least one opening in the bottom of the casting,

a. a table on which the casting is placed, said table having an opening therethrough in communication with the bottom opening in the casting when in place on the table,

b. a stationary abutment against which the side of the casting having said opening therein is adapted to engage, there being an opening through the abutment in communication with the side opening in the casting when in place on the table,

c. a power driven clamp member opposite the abutment adapted to press the side of the casting having the opening therein against the abutment,

d. a movable casting positioning member disposed to be engaged by an end of the casting when it is moved onto the table, thus accurately to position the casting on the table relative to the direction of its movement thereonto,

e. a power driven hold down member adapted to lower onto and engage the top of the casting while in place on the table, and

f. means to force an airborne stream of abrasive material through the openings in the abutment thence into said side opening in the casting, into the casting cavities and out through the bottom casting and table opening, thus to clean said cavities.

2. Apparatus as defined in claim **1** in which there is means to stop the flow of said abrasive material and to purge the casting with a stream of clean air which passes into and out of the casting along the flow path of said abrasive material.

3. Apparatus as defined in claim **1** in which the power driven hold down member includes arms disposed when the hold down member is moved downwardly into contact with the top of the casting to straddle the casting, and power means to move the arms toward each other, thus to clamp the casting between them, further securing the casting in place while it is being cleaned.

4. Apparatus as defined in claim **3** in which the power driven hold down member includes material disposed to make a substantially airtight seal with the top of the casting when lowered thereonto, whereby castings having openings through the upper surfaces may have such openings closed off during the cleaning operation.

5. In apparatus for cleaning internal cavities in castings and the like, wherein there is at least one opening into a side of the casting with at least one opening in the bottom of the casting,

a. a horizontally disposed table on which the casting is adapted to rest and having an opening therethrough in communication with an opening in the bottom of the casting,

b. delivery and discharge conveyors at opposite ends of the table by means of which the casting is delivered to and carried away from the table,

c. a stationary abutment along one side of the table against which the side of the casting having said opening therein is adapted to engage, said abutment having an opening therethrough in communication with the side opening in the casting when the casting is in place on the table,

d. a power actuated clamp member opposite the abutment adapted to press the side of the casting

having said opening therein against the abutment,

e. a casting positioning member located adjacent the discharge end of the table,

f. power means selectively to move the positioning member into the path of the casting moving onto the table, thereby to stop it in predetermined position thereon, and to withdraw the same, permitting the casting to move onto the discharge conveyor,

g. a power driven hold down member mounted for vertical movement over the table and adapted to be lowered onto the top of the casting while on the table,

h. a pair of power actuated arms carried by the hold down member disposed to engage the casting between them after the hold down member is lowered onto the casting,

i. means to force an airborne stream of abrasive material through the opening in the abutment thence through the opening in the side of the casting into the casting cavities and out through the bottom casting and table opening, thus to clean said cavities, and

j. means to force clean air through the casting cavities along the path set forth in (i) above, thus to purge the cavities of abrasive material.

* * * * *