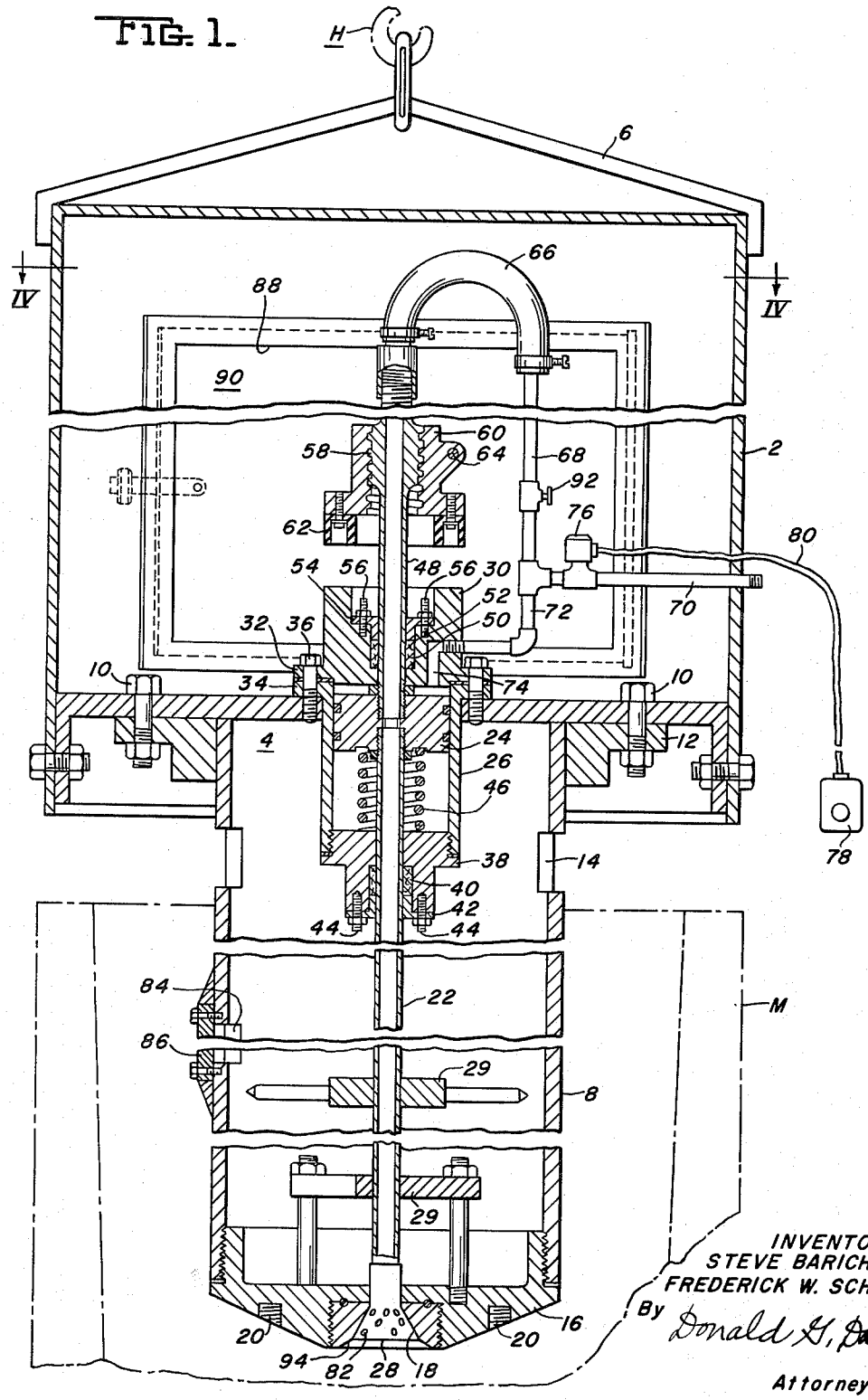
Sept. 7, 1965 S. BARICH ET AL 3,204,604

SPRAYING APPARATUS

Filed July 18, 1962 2 Sheets-Sheet 1

FIG. 1.



INVENTORS.
STEVE BARICH and
FREDERICK W. SCHURG
By Donald G. Dalton
Attorney

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2 Sheets-Sheet 2

FIG. 2.

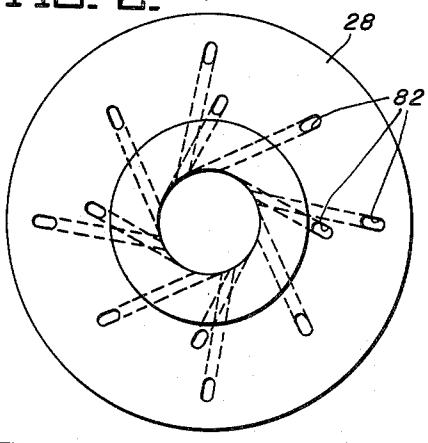


FIG. 5.

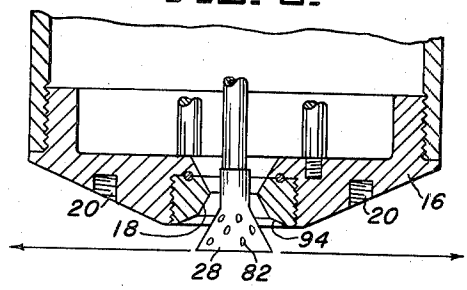


FIG. 3.

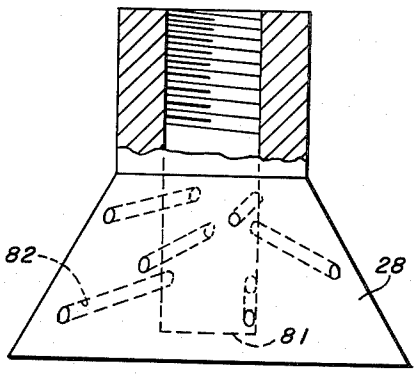


FIG. 6.

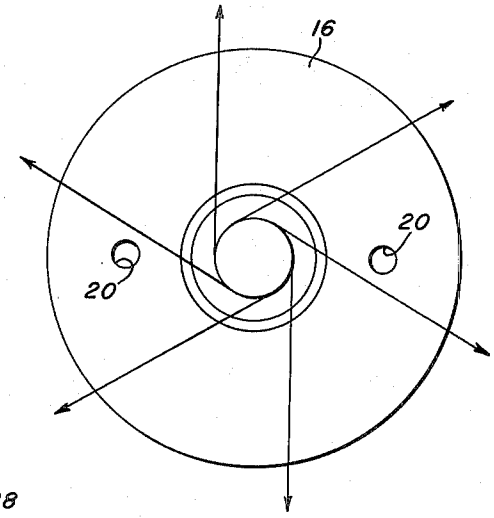
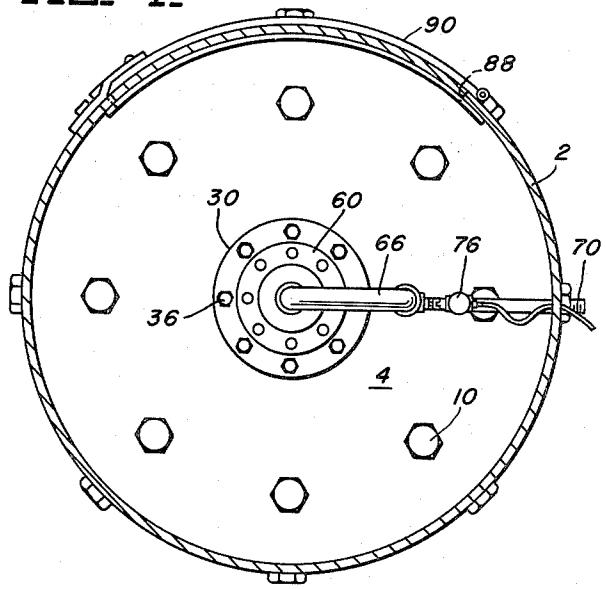


FIG. 4.



INVENTORS.
STEVE BARICH and
FREDERICK W. SCHURG
By Donald G. Dalton
Attorney

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SPRAYING APPARATUS

Steve Barich, Gary, and Frederick W. Schurg, Hobart, Ind.

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6 Claims. (Cl. 118—317)

The present invention relates generally to spraying machines and more particularly to an improved spraying apparatus especially suitable for applying a coating of tar or other material to the interior sides of an ingot mold.

In the manufacture of steel, molten steel is poured into molds and allowed to solidify to form ingots. After solidification the ingots are stripped from the molds and subsequently rolled into blooms, plates and other forms of primary steel products which in turn are further processed to produce finished steel products. The primary purpose of coating the interior sides of the ingot mold with tar or other mold washes is to obtain a clean, smooth surface on the ingot so that the products ultimately formed from the ingot will be free from surface and subsurface physical defects.

Another purpose for the tar coating is to supply a lubricating film on the interior sides of the mold so that the solidified ingot can be stripped from the mold with a minimum of resistance.

The tar coating also serves to prolong the life of the ingot mold by providing a thermal cushion and insulator for tempering the abrupt temperature changes that take place when the molten steel which has a temperature of approximately 2800° F. is poured into the mold which has a temperature of about 140° F.

When tar coating is being applied to the interior of the ingot mold, care must be taken so that only a minimum amount of tar will be deposited in the bottom of the mold. If a relatively thick layer of tar was permitted to accumulate in the bottom of the mold, the danger of an explosion occurring when the molten metal was poured into the mold would result.

Prior to our invention various types of machines were developed and used to spray coating material on the interior surfaces of ingot molds but none proved completely effective. All of these machines with which we are familiar involved the use of a rotating centrifugal distributor or disc for ejecting the material to be sprayed. In use, this type of machine was lowered into the ingot mold and tar was delivered to the centrifugal distributor which was rotated at very high speed to throw the tar against the walls of the mold. The machine was gradually lifted out of the mold as the distributor continued to rotate so that the entire interior was coated.

This type of machine did not actually spray the tar but rather slung it unevenly about the mold by centrifugal force which was difficult to control. As a result the tar coating thus applied was non-uniform in thickness. In some areas on the mold interior too much tar was applied and on others too little was applied. In the locations where too much tar was applied, the surplus tar was entrapped between the mold wall and the ingot during solidification of the poured molten metal. This caused blow holes to be formed in the ingot surface. The areas which were not covered with sufficient coating were exposed to thermal shock and damage when molten steel was poured into the mold.

Another difficulty encountered in the use of spraying machines of the type having rotating distributors was the excessive service necessary to keep the numerous moving parts of the machines operating. These machines required the use of rotating shafts and plates or other centrifugal distributor means attached to the shafts and

motors to rotate the shafts and centrifugal distributors at high speeds to create the centrifugal force needed to throw the tar. The problem of maintaining these moving parts was further aggravated by the high heat they were subjected to in operation since the tar to be applied to the mold interior was pre-heated to approximately 170 to 180° F. to give it a consistency suitable for application.

It is accordingly, the primary object of our invention to provide an improved apparatus for spraying material which is simple in construction, rugged in structure and easy to maintain.

It is another object of our invention to provide a spraying apparatus which includes control means for regulating the thickness of a coating being applied by the apparatus.

As a corollary to the above object it is another object of our invention to provide a spraying apparatus as set forth by the objects above whereby material is sprayed generally normal to the longitudinal centerline of the material-discharge port of the apparatus.

It is a further object of our invention to provide apparatus of the character set forth in the above objects which is devoid of any rotating parts and is constructed with a minimum of other moving parts.

It is another object of our invention to provide a spraying apparatus as set forth in the above objects which is portable and which can be operated from a remote location.

These and other objects will become more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a vertical sectional view of the apparatus of the invention;

FIGURE 2 is an enlarged plan view of the spray valve of the invention;

FIGURE 3 is an elevational view of FIGURE 2;

FIGURE 4 is a cross sectional view taken along the line IV—IV of FIGURE 1;

FIGURE 5 is a partial vertical sectional view of the bottom portion of FIGURE 1 showing the valve in open position; and

FIGURE 6 is a bottom plan view of FIGURE 5.

Referring more particularly to the drawings reference numeral 2 designates a cylindrical carriage having a base 4 and a bail 6 whereby the carriage can be suspended from the hook H of an overhead lift crane. An elongated cylindrical tank 8 is secured by one end to base 4 by means of spaced bolts 10 which pass through the base 4 and a circumferential flange 12 on the tank. The tank 8 serves as a reservoir for the tar to be sprayed and is provided with openings 14 in its upper portion for filling purposes. A cap 16 having a central discharge port 18 therethrough is threaded into and closes the bottom of the tank 8. Tapped holes 20 may be provided in the outer surface of cap 16 for receiving studs (not shown) to facilitate threading the cap into or removing it from the tank so as to provide access to the interior thereof.

A hollow tube 22 is disposed in the tank 8 and extends axially therethrough from a threaded connection with the piston 24 of a pneumatic cylinder 26 at its upper end to a threaded connection with a valve 28 at its lower end. Spider bearings 29 support the tube concentrically within the tank 8. Valve 28 is substantially conical in shape and is displaceably seated in the discharge port 18 which is shaped to match the shape of the valve. Valve 28 is adapted to be moved out of port 18 outwardly of the tank 8 by the rod 22 as will be explained more fully hereinafter.

Cylinder 26 is closed at its upper end by a head 30 having a circumferential flange 32 which matches with

a flange 34 extending around the upper end of the body of cylinder 26. Spaced screws 36, which pass through the flanges 32 and 34, connect the head 30 to the body of cylinder 26 and mount the cylinder on the base member 4. A cap 38 is threaded into the bottom of cylinder 26 surrounding the hollow tube 22. The tube 22 is axially slidable in the cap 38. Conventional packing 40, held in place by a packing gland 42 and studs 44, prevents air leakage through the cap 38. A helical return compression spring 46 is disposed concentrically around the tube 22 in the cylinder 26 and constantly urges the piston 24 and tube 22 upwardly.

An air pipe 48 is threaded into the upper portion of the piston 24 and communicates with the upper end of tube 22 to supply air thereto. Pipe 48 extends through the cylinder head 30 and is free to move longitudinally therein as the piston 24 moves up or down. Packing 50 is provided around the pipe 48 in a counterbore 52 of head 30 and is adjustably held in compression by packing gland 54 and studs 56. Sufficient compression is maintained on packing 50 so that there is no loss of air through the head 30.

Air pipe 48 is externally threaded as at 58 adjacent its upper end. An elongated split locking nut 60 having an annular shaped rubber cushion 62 depending therefrom is threaded on the portion 58 and locked thereon by means of a bolt 64. Loosening of bolt 64 permits adjustment of the nut 60 along the threaded portion 58 of the air pipe for a purpose which will become apparent.

A flexible hose 66 connects air pipe 48 with one branch 68 of an air supply pipe 70 which is connected with a compressed air source (not shown). Another branch 72 of air supply pipe 70 is connected with a port 74 through the head 30 for supplying air under pressure to the head side of piston 24. A solenoid controlled valve 76 is provided in the pipe 70 for regulating the flow of compressed air therethrough. A remotely disposed switch 78 for operating solenoid valve 76 is connected thereto by means of a cable 80.

Valve 28 is provided with a center bore 81 and is formed with a plurality of orifices 82 which extend from the center bore of the valve to its exterior surface at a downwardly sloping angle of approximately 70 degrees from the longitudinal axis of the center bore 81. The inner ends of the orifices 82 are tangent to the center bore 81.

An access opening 84 covered with a removable plate 86 is formed in the wall of the tank 8 and an access opening 88 covered by a hinged door 90 is provided in the wall of the carriage 2 to facilitate assembly, adjustment and maintenance of the interior elements of the apparatus.

In operation, the apparatus is suspended from the crane hook H by the bail 6 and the tank 8 is filled with hot tar through the openings 14 up to the level of the openings. The apparatus is then lowered into an ingot mold M until the bottom of the tank is a few inches above the bottom of the mold. Switch 78, which may be located in the crane cab (not shown) for operation by the crane operator, is actuated to energize and open the solenoid valve 76. Opening of valve 76 permits air under pressure to flow through branch 72 of air supply pipe 70 and port 74 into the cylinder 26. The flow of air under pressure into cylinder 26 creates sufficient pressure in the cylinder to move piston 24 downwardly against the resistance of compression spring 46. As piston 24 moves downwardly it causes simultaneous axial movement of air pipe 48 in the same direction. The piston continues to be moved downwardly until rubber cushion 62 engages the head 30 of the cylinder. The downward movement of piston 24 also causes the tube 22 and valve 28 to move the same distance axially of the tank 8 in the same direction as the piston. With the valve 28 in open position as shown in FIGURE 5 and the solenoid valve 76 energized and open, air under pressure flows from the branch 68 of air supply pipe 70, through the flexible hose 66 and air pipe 48 into the hollow tube 22 where it travels downwardly to the valve 28 from whence it emerges through the orifices 82. The arrangement of the orifices causes the air to emerge therefrom at high velocity and to strike the hot tar flowing by gravity through the discharge port 18 and over the valve 28. The air thus striking the hot tar atomizes it and forces it to leave the discharge port in a fine misty horizontal spray directed against the walls of the mold, as shown by the arrows in FIGURES 5 and 6. Discharge port 18 is flared at its exit end, as at 94, to promote the flow of the air streams discharging from orifices 82 of valve 28 in a plane normal to a continuation of the longitudinal centerline of port 18.

As the hot tar is thus being atomized and sprayed, the apparatus is gradually raised inside the mold until the bottom of tank 8 emerges from the top of the mold so that a uniform coating is applied to the interior wall surfaces of the mold.

The volume of tar issuing from the discharge port 18 may be varied by adjusting the nut 60 along the pipe 48 to increase or decrease the distance piston 24 is moved before the rubber cushion 62 engages head 30 to stop movement of the piston. The extent of movement of valve 28 from discharge port 18 will depend directly on the distance that piston 24 moves. If the distance piston 24 moves is reduced by adjustment of nut 60, the distance that valve 28 moves out of discharge port 18 will also be reduced so that less tar will flow from the port. If the movement of piston 24 is increased, the distance valve 28 moves out of port 18 will also be increased so that more tar will flow out of the discharge port.

As the bottom of tank 8 emerges from the ingot mold, switch 78 is opened to break the circuit to solenoid valve 76 to de-energize it and cause it to close. This stops the flow of air to the cylinder 26 and to tube 22. With the air pressure removed from the head side of piston 24, spring 46, which has been compressed, now returns piston 24 to its retracted position and also causes valve 28 to re-seat in the discharge port 18 to close the port and stop the flow of tar from the tank.

If desired, a manually operated valve 92 may be installed in the branch 68 of air supply pipe 70 for directing air solely to the cylinder 26 so that the valve 28 may be displaced from port 18 for draining purposes without air being emitted from the orifices 82. Closing of branch 68 by valve 92 will prevent air from flowing to hollow tube 22 during the time valve 28 is displaced from port 18 for draining purposes.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. Apparatus for spraying viscous liquid material comprising a tank for containing said material, a rigid hollow rod mounted for longitudinal reciprocal movement in said tank, said tank having an outlet port through one end thereof, said outlet port having an exit end whereby material is discharged from said tank, a valve having an outside surface and a closed-bottom center bore displaceably seated in said port and closing said exit end, said valve being adapted to be displaced from said port only outwardly of said tank to open said exit end, said rod being rigidly connected with said valve and communicating with said center bore, said valve having a plurality of orifices extending angularly from said center bore to the outside surface thereof, means connected with said hollow rod for supplying pressurized fluid to said valve through said hollow rod, and power means connected with said hollow rod for reciprocating the same to displace said valve from said outlet port outwardly of said tank, said outlet port being formed with a first inner surface terminating short of its exit end and a second inner surface continuous with and extending from said first surface to

said exit end, said first surface tapering outwardly toward said exit end at an acute angle to the longitudinal axis of said tank, the outside surface of said valve being substantially frusto-conical in shape and mating with said first inner surface when said valve is seated in said outlet port and closing said exit end, said second inner surface tapering outwardly toward said exit end at an angle to the longitudinal axis of said tank greater than the taper angle of said first surface whereby material discharged from said tank is directed in a plane substantially normal to a continuation of the longitudinal axis of said tank.

2. Apparatus as defined by claim **1** in which said power means includes a fluid pressure cylinder and means for supplying fluid under pressure to said cylinder.

3. Apparatus as defined by claim **2** including means connected with said means for supplying pressurized fluid to said valve and with said means for supplying fluid under pressure to said cylinder for controlling the flow of fluid to said valve and to said cylinder.

4. Apparatus as defined by claim **1** including adjustable means connected with said rod for limiting the reciprocal movement thereof to thereby regulate the amount of displacement of said valve from said port.

5. Apparatus as defined by claim **1** including a carriage attached to said tank for engagement with a lift hook.

6. Apparatus as defined by claim **1** in which said orifices are disposed tangential to said center bore and extend angularly therefrom toward said one end of said tank at an angle of approximately 70 degrees to the longitudinal axis of said center bore.

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CHARLES A. WILLMUTH, *Primary Examiner.*

RICHARD D. NEVIUS, *Examiner.*