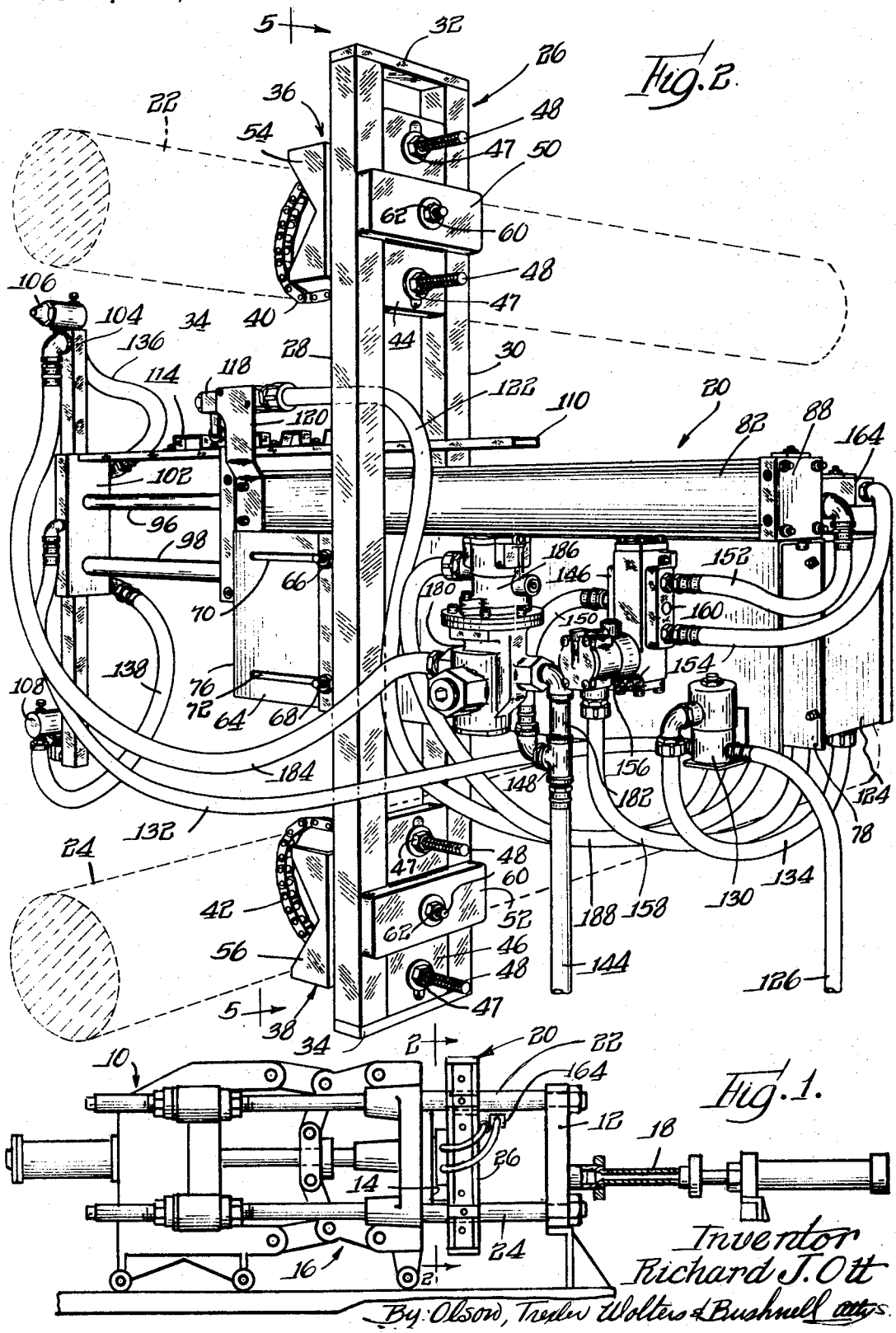
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SPRAY SYSTEM

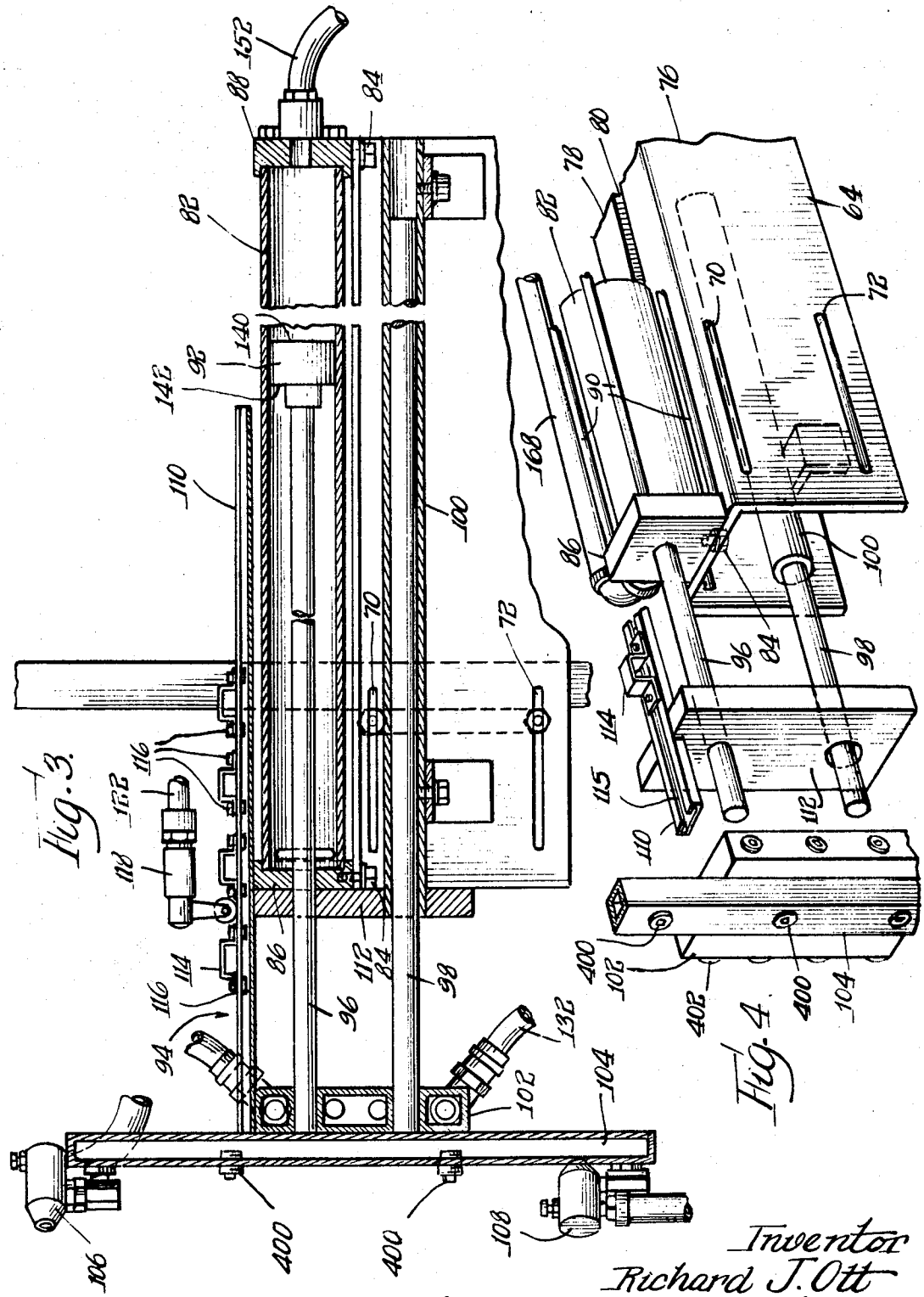
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SPRAY SYSTEM

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Fig. 5.

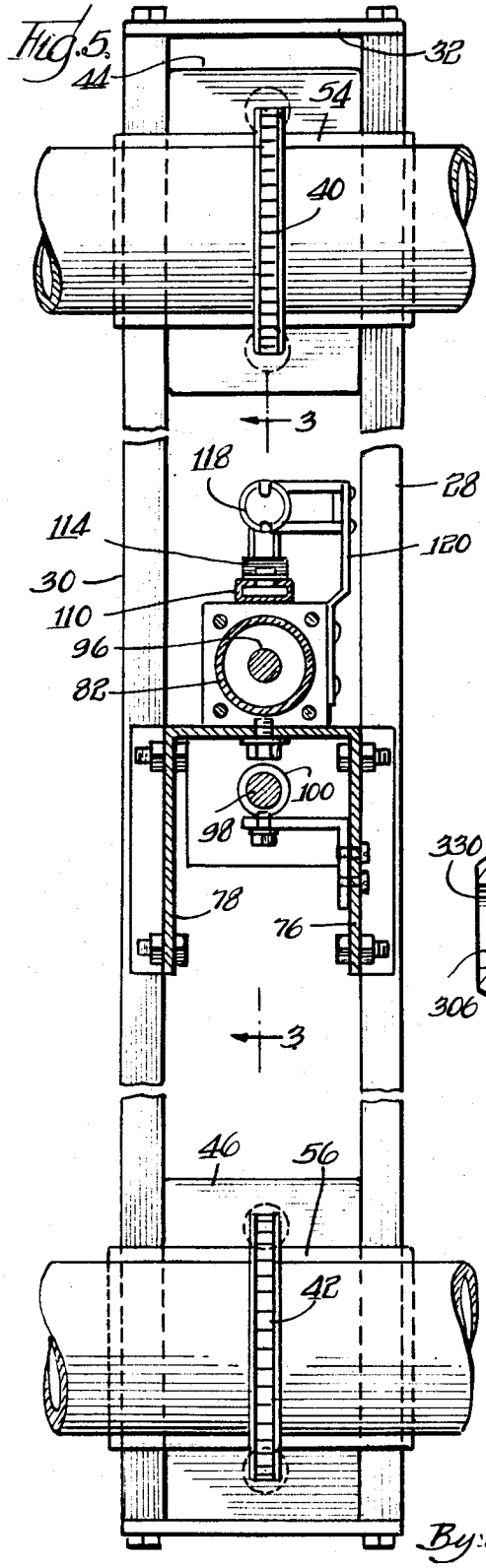


Fig. 6.

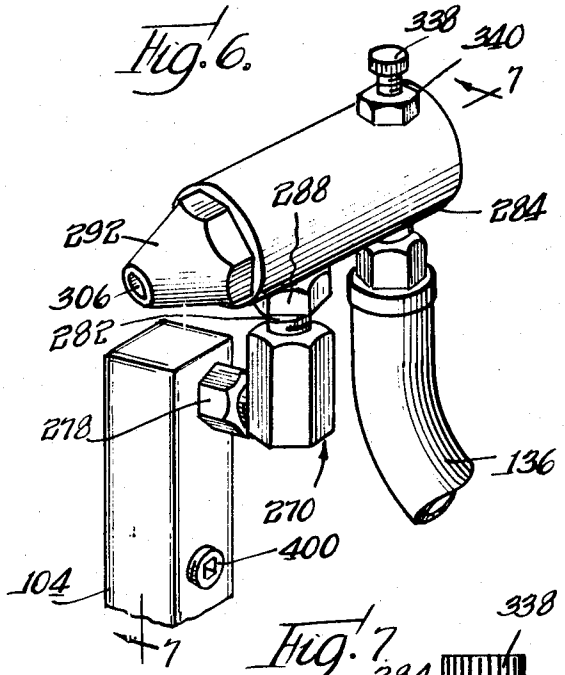
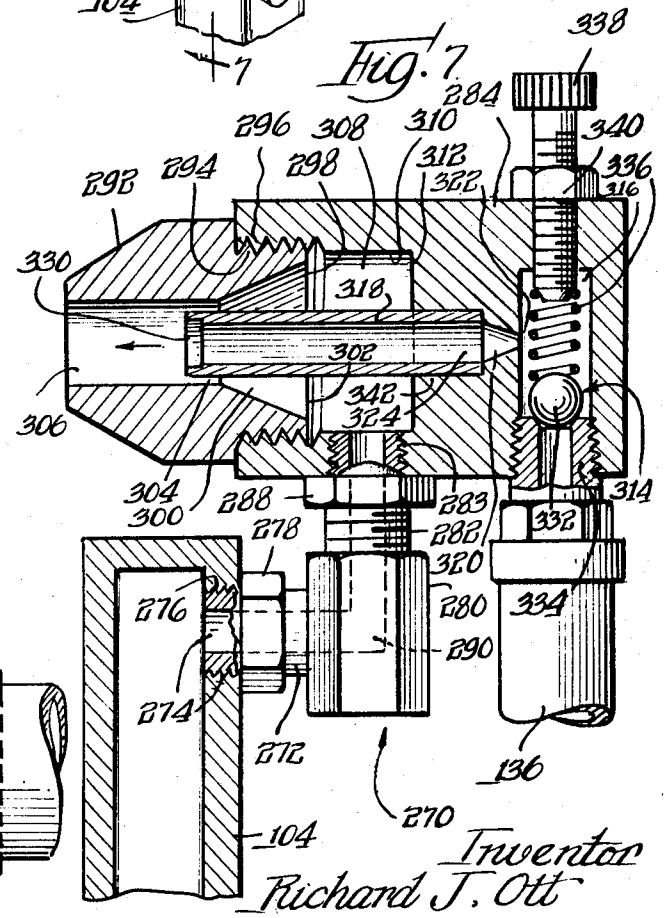


Fig. 7



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SPRAY SYSTEM

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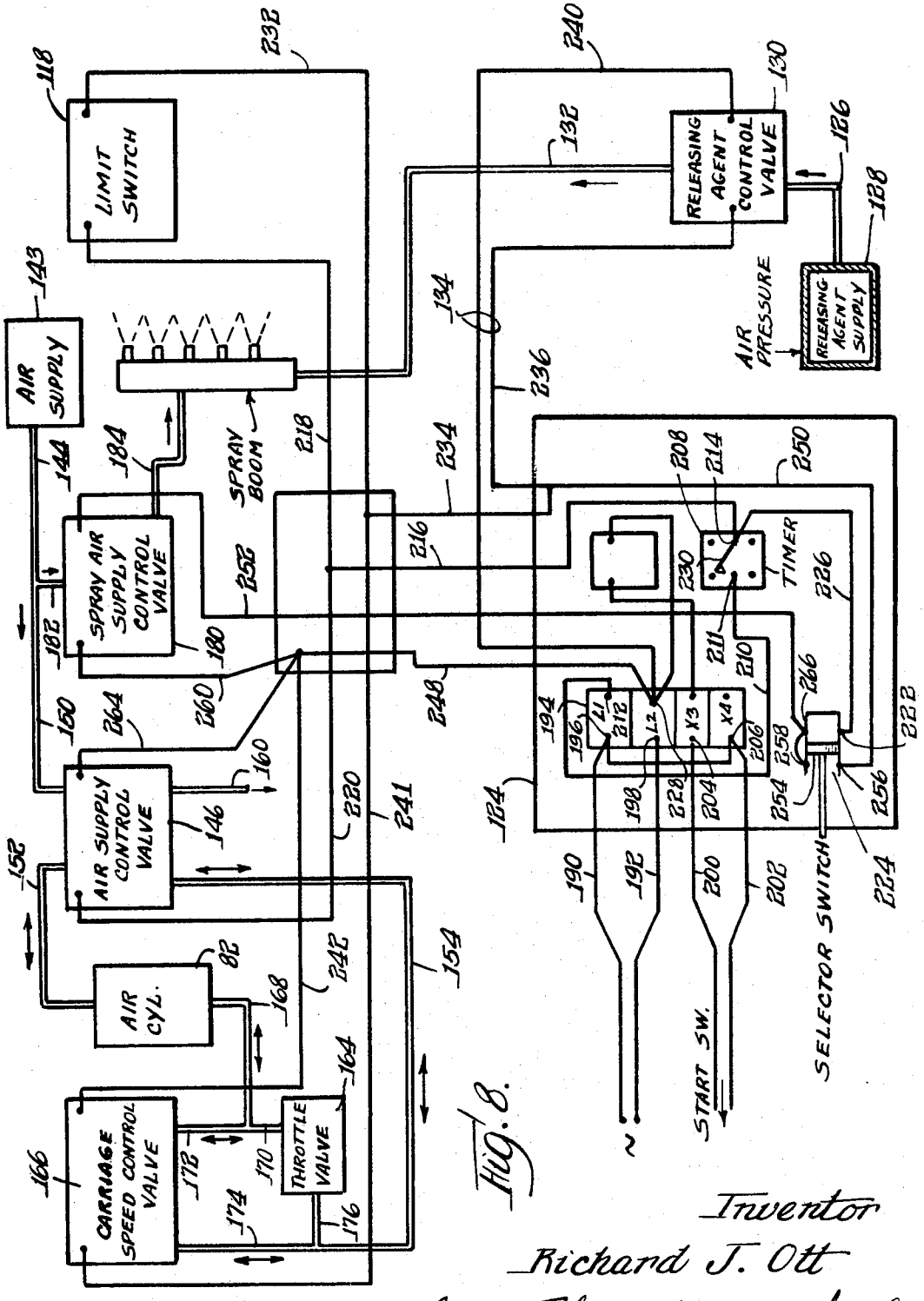


Fig. 8.

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United States Patent Office 3,393,658 Patented July 23, 1968

3,393,658

SPRAY SYSTEM

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Filed Apr. 7, 1966, Ser. No. 540,874
11 Claims. (Cl. 118—7)

ABSTRACT OF THE DISCLOSURE

There is disclosed an apparatus for spraying a release agent onto dies in a die-casting machine. The apparatus includes a manifold structure carrying a plurality of spray guns and having internal passageways for release agent and air under pressure. The manifold structure is carried on the ends of the piston rod and a guide rod for movement between retracted and advanced positions. Control means responsive to movement of the manifold are provided for controlling the flow of air and release agent.

This invention relates generally to a spray system and more particularly to a spray system for use with a die casting machine for selectively applying a releasing agent to molds or dies used with the machine.

When die castings are made, the casting tends to adhere to the hot mold after it has been formed. The removal of a hot casting which is adhering to a hot mold is difficult and results in considerable lost time during the casting process. Machines and highly trained men are forced to be idle while the sticking casting is removed from the mold. In addition to increasing the lost time during a production operation a stuck casting is frequently damaged while being removed from the die and must be scrapped. To increase production efficiency and to reduce the scrap rate it is a common practice to apply a releasing agent to the dies or molds. The releasing agent lubricates adjoining surfaces of the mold and the casting to prevent the casting from sticking to the mold.

A die or mold has a cavity in which the casting is formed. This die cavity commonly has a number of protuberances and indentations which give shape to a casting. The application of a releasing agent to all the irregular surfaces of the die cavity is usually accomplished by means of a manually actuated spray gun. To obtain complete coverage of the irregular die or mold surface the gun is moved back and forth several times while being tilted at various angles to the surface of the die cavity. After the mold has been covered with releasing agent in this manner, the casting machine is actuated to continue the casting operation.

Due to variations in the movements of the spray gun operator, the manual application of releasing agent to a mold or die generally results in an uneven coating. Excess releasing agent is applied to parts of the die where the operator has moved the gun slowly. Conversely the coating of releasing agent will be skimpy and discontinuous at places where the spray gun is moved too rapidly. This uneven manual application of releasing agent to the mold results in increased production costs due to the sticking of castings where the coating is too skimpy or interrupted. Production costs are further increased by the wasting of time and releasing agent by the spray gun operator as he applies the agent. This loss of time and releasing agent results from needless application of excess releasing agent to surfaces of the mold. Thus, the production efficiency of a highly developed die casting machine is greatly reduced by the manual application of releasing agent to the molds by means of a single spray gun.

The spray gun itself commonly has a nozzle for directing a stream of releasing agent onto the surface of the die. The nozzle is usually positioned adjacent to the hot

dies, immediately after forming a casting, to spray the die for the next casting operation. Elastomeric seals in the nozzle soon deteriorate, due to the heat from the dies when the spray gun is used. Thus the efficiency of the prior art method of applying releasing agent to dies or molds is further reduced by the lost time required to periodically change the seals in the nozzle of the spray gun.

Therefore, one of the objectives of this invention is to provide a novel means for automatically spraying a releasing agent evenly and quickly onto a die or mold cavity.

Another object of this invention is to reduce the quantity of releasing agent applied to a die when spraying the die.

Another object of this invention is to provide a spray gun nozzle suitable for continuous use adjacent to a hot die.

Another object of this invention is to increase the production rate of die casting machines.

Another object of this invention is to provide a novel spray system to selectively apply a releasing agent to the irregular surfaces of a die cavity.

These and other objects and features of the invention will become more apparent from a reading of the following detailed description taken in combination with the accompanying drawings wherein:

FIG. 1 is an elevational view of a die casting machine embodying the invention;

FIG. 2 is a perspective view of the spray system utilized with the die casting machine of FIG. 1;

FIG. 3 is a fragmentary detailed sectional view of the carriage or boom for the spray system of FIG. 2;

FIG. 4 is a fragmentary exploded view of the mounting means for the carriage in FIG. 3;

FIG. 5 is a fragmentary sectional view taken along the line 5—5 of FIG. 2;

FIG. 6 is a perspective view of a spray gun;

FIG. 7 is a fragmentary sectional view taken along the line 7—7 of FIG. 6; and

FIG. 8 is a schematic drawing of the control system for the spray assembly.

Referrng now to the drawings in greater detail, there is shown in FIG. 1 a die casting machine **10** of a conventional construction. The die casting machine **10** includes a stationary die or mold **12** and a movable die **14** which cooperates with the stationary die **12**. During the die casting operation, the two dies **12** and **14** are forced together by a hydraulic toggle mechanism **16**. The toggle mechanism **16** will retain the dies **12** and **14** in an abutting relationship. Molten metal is forced between the two abutting dies **12** and **14** by means of a shot mechanism **18** which fills the mating die cavities with a suitable metal for forming a casting. The construction of the die casting machine **10**, and the operation of the shot mechanism **18**, is well known and does not per se constitute a part of this invention.

After an object has been cast between the two dies **12** and **14**, the toggle mechanism separates the dies and the casting is removed. As previously explained, the hot casting tends to adhere to the surface of the dies **12** and **14**. To facilitate the removal of the casting from the dies, a suitable releasing agent is applied to the surfaces of the die cavities. A spray assembly **20** is utilized to apply the releasing agent to the surfaces of the dies **12** and **14**, so that the cast object can be readily removed from the dies.

Referring now to FIG. 2, the spray assembly **20** is fastened to the tie bars **22** and **24** of the die casting machine **10** by means of a support frame **26**. The support frame **26** includes two vertically extending support bars **28** and **30** which are interconnected by end plates **32** and

34. The support frame 26 is connected to the tie bars by means of movable connection assemblies 36 and 38. The connection assemblies are attached to the tie bars 22 and 24 by roller chains 40 and 42. The roller chains 40 and 42 are secured to the connection assemblies 36 and 38 by the nuts 47 and bolts 48. When the nuts 47 and roller chains are loosened the support frame 26 can be moved horizontally to adjust the position of the spray assembly 20 relative to the dies 12 and 14. It will also be apparent that the adjustable roller chains 40 and 42 permit the spray assembly to be easily connected to die casting machines having tie rods of different diameters.

The connection assemblies 36 and 38 include sliding plates 44 and 46 which are positioned intermediate the support bars 28 and 30. Backing plates 50 and 52 are fastened, by welding or other means, to the sliding plates 44 and 46. V-blocks 54 and 56 are connected to the backing plates 50 and 52 by the bolts 60 and nuts 62. When the nuts 62 are tightened, the V-blocks 54 and 56 will clampingly engage the support bars 28 and 30. By loosening the nuts 62 the support frame 26 can be moved up and down to vary the vertical position of the spray assembly 20 relative to the dies 12 and 14. This vertical adjustment also permits the spray assembly to be used with die casting machines having tie bars spaced apart by various distances.

From the foregoing remarks it is apparent that the support frame 26 can be utilized to connect the spray assembly 20 to any desired die casting machine. The roller chains 40 and 42 enable the connection assemblies 36 and 38 to engage tie bars of various diameters on different die casting machines. Since the support bars 28 and 30 may be adjusted vertically, relative to the connector blocks 36 and 38, the support frame 26 may also be attached to die casting machines having tie bars spaced apart by various vertical distances. If the spray assembly is to be used with a die casting machine which does not have tie bars, simulated tie bars may be utilized for mounting the support frame 26 on the die casting machine. This is done by the use of suitable cylinders which are securely connected to the die casting machine and act as substitute tie bars for mounting the spray assembly. Thus, the support frame 26 may also be connected to a die casting machine of a type which does not utilize tie bars.

The spray assembly 20 is mounted on a main frame 64 which is adjustably fastened to the support bars 28 and 30 by means of the bolts 66 and 68 which engage the slots 70 and 72 in the side of the main frame 64. The slots 70 and 72 permit the main frame to be adjusted horizontally relative to the support bars 28 and 30. From an examination of FIG. 4, it will be apparent that the main frame 64 is advantageously made up of two identical support beams 76 and 78. The support beams are separated by a central slot 80 which provides, as will be explained in greater detail subsequently, a means for mounting the drive mechanism for the spray system on the main frame 64.

Referring now to FIG. 3, the drive mechanism includes an air cylinder 82 which is connected to the main frame 64 by means of bolts 84 which extend through the central slot 80 between the two support beams 76 and 78. The air cylinder 82 has an outer end plate 86 and an opposite inner end plate 88 for closing the ends of the air cylinder 82. The two end plates 86 and 88 are clamped in a firm sealing engagement with the air cylinder 82 by means of tie rods 90. A piston 92 is slidable within the air cylinder 82 from a position adjacent the rear end plate 88 to a position adjacent the forward end plate 86. A carriage assembly 94 is connected to the piston 92 by means of a connecting rod 96. It will be apparent that forward and rearward movement of the piston 92 will also move a carriage assembly 94 relative to the air cylinder 82 and main frame 64. The carriage assembly 94 is guided for forward and rearward movement by means of a supporting guide bar 98 which slides in a casing or cylinder 100 positioned immediately below the air cylinder 82.

The carriage assembly 94 includes a releasing agent or coating fluid manifold 102 and an air or carrier fluid manifold 104. Spray guns 106 and 108 are connected to the manifolds 102 and 104 by connections which will be explained in greater detail subsequently. When the carriage assembly 94 is moved forwardly, by the connecting rod 96 and piston 92, the spray guns 106 and 108 will be positioned adjacent to the two dies 12 and 14 of the die casting machine 10. A cam rod 110 is connected to the manifolds 102 and 104 and is moved forwardly with the spray guns 106 and 108. The cam rod 110 is guided by means of a guide block 112 which is supported by the guide cylinder 100. The cam rod 110 has a plurality of cam members 114 mounted in a slot 115 in the cam rod 110. The cam members 114 may, by loosening the connecting bolts 116, be adjusted relative to the cam rod 110. The cams 114 actuate a limit or sensing switch 118 which is fastened by a bracket 120 to the end plate 86 of the air cylinder 82. The limit switch 118 is connected by suitable electrical leads 122 to a main control box 124 which is mounted on an outer end of the main frame 64 (see FIG. 1).

The main control box 124 coordinates and controls the movements of the carriage assembly 94 and the actuation of the spray guns 106 and 108 by means of control valves and switch mechanisms. When the spray guns 106 and 108 are actuated a coating fluid or releasing agent is applied to the dies. The releasing agent is supplied, under pressure, to the spray assembly 20 by means of a suitable fluid passage or conduit 126 which is connected to a pressurized source of releasing agent 128 (see FIG. 8). A normally closed releasing agent solenoid valve 130 (see FIG. 1) is connected to the conduit 126 and a conduit 132 which extends from the solenoid valve 130 to the releasing agent manifold 102. The solenoid valve 130 controls the flow of releasing agent between the conduit 126 and the releasing agent manifold 102.

The solenoid valve 130 is connected to the main control box 124 by means of a suitable electrical connection 134. When the limit or sensing switch 118 is actuated by one of the cams 114, the normally closed solenoid value 130 will be opened to enable the releasing agent or coating fluid to flow through the conduit 132 to the releasing agent or coating fluid manifold 102. The releasing agent or coating fluid is conducted from the manifold 102 to the spray guns 106 and 108 by the connecting conduits or hoses 136 and 138. As will be explained in greater detail subsequently, when the sensing switch 118 is actuated by one of the cams 114 the spray guns 106 and 108 will be in a spray position, relative to the dies 12 and 14. The opening of the solenoid value 130 will then allow the pressurized releasing agent or coating fluid to be conducted to the spray guns 106 and 108 onto the dies at the predetermined spray location.

When the spray guns 106 and 108 are not in a spray position, they will not spray releasing agent or coating fluid onto the dies since the supply of releasing agent is cut off by the closing of solenoid valve 130. Thus, the cams 114, which actuate the limit or sensing switch 118 when the spray guns are in a spray position, permit the spray assembly to only spray the dies with releasing agent at predetermined locations. It will be apparent that this feature will reduce production costs by reducing the wastage of releasing agent or coating fluid.

The carriage assembly 94 is moved into the spray position, relative to the dies 12 and 14, by the piston 92 which is forced forwardly by air pressure on a rear surface 140 of the piston. The piston 92 and spray carriage assembly 94 are moved rearwardly by air pressure on a forward surface 142 of the piston. High pressure air, to move the piston 92, is conducted to the air cylinder 82 from a suitable source 143 by means of the pipe or con-

duit **144**. The pipe or conduit **144** is connected to the air supply control valve **146** by means of a T-connection **148** and conduit **150**. In a manner to be explained in greater detail subsequently, the control valve **146** selectively directs the air pressure into either the conduit or air hose **152** which is connected to the rear of the air cylinder **82** or the conduit **154** which is connected to the forward end of the air cylinder **82**. It will be apparent that when the control valve **146** directs the high pressure air through the conduit **152** to the rear of the air cylinder **82**, the piston **92** will be forced forwardly by air pressure on the rear surface **140** of the piston. When the air is conducted through the conduit **154** it will be directed against the forward surface **142** of the piston **92** to move the carriage assembly and piston rearwardly relative to the main frame **64**.

The air control valve **146** is a two-way valve which is actuated by means of a solenoid **156** which is connected to the main control box **124** by a suitable electrical connection **158**. When the air control valve **146** is actuated to direct the high pressure air through the conduit **152** to the rear of the piston **92**, the conduit **154** will be connected to an exhaust port **160**. Thus, the air between the forward surface **142** of the piston and the end plate **86** of the air cylinder **82** will be returned to the air control valve **146** by the conduit **154** and exhausted to the atmosphere through the exhaust port **160**. When the forward portion of the cylinder is at the relatively low exhaust or atmospheric pressure, the piston **92** will move forward under the force of the high pressure air against the rear surface **140** of the piston. When the air control valve **146** is returned to its normal or unactuated position, the conduit **152** will be connected to the exhaust port **160**. The high pressure air, from the conduit **150**, will then be directed through the conduit **154** to the forward end of the air cylinder **82** to apply air pressure against the forward surface **142** of the piston. The high pressure air on the forward surface **142** of the piston will force the piston and carriage assembly **94** rearwardly to the return or starting position. The air between the rear surface **140** of the piston **92** and the end plate **88** will be conducted, through the conduit **152**, to the exhaust port **160** to permit the piston **92** to move rearwardly.

The rate of movement of the carriage assembly, relative to the main frame **64**, is controlled by means of a throttle valve **164** and a normally open speed control valve **166** (see FIG. 8). The forward end of the air cylinder **82** is connected to the throttle valve **164** by air conduits **168** and **170**. The air cylinder is also connected to the speed control valve **166** by means of a conduit **172**. It will be apparent from an examination of FIG. 8 that the speed control valve **166** and throttle valve **164** are connected in a parallel relationship by means of the conduits **174** and **176**.

The adjustable throttle valve may be set to permit a predetermined quantity of return air to flow through the conduits **170** and **176** to the return conduit **154**. When the normally open speed control valve **166** is actuated to the closed position, it will be apparent that the setting of the throttle **164** will regulate the rate of flow of return air, and therefore the speed with which the piston **92** can be driven forward by the high pressure air on the rear surface **140** of the piston. The throttle valve **164** is set to restrict the flow of return air from between the forward surface **142** of the piston **92** and the end plate **86** of the air cylinder **82**. The resulting low piston speed, as will be explained in greater detail subsequently, corresponds to a relatively slow spray speed. Thus, the carriage assembly **94** will, when the speed control valve **166** is closed, move forwardly at a relatively slow speed to permit the spray guns **106** and **108** to thoroughly coat the dies with the releasing agent or coating fluid.

When the carriage assembly **94** is being returned to its original position after spraying the dies, and during the non-spray forward movement of the carriage assembly, that is when the cams **114** are not in actuating contact with the sensing switch **118**, the carriage assembly is moved at a relatively high traverse speed. When the carriage is moving at this relatively high traverse speed, the speed control valve **166** is open to enable the return air to flow through the conduits **172** and **174** to the return conduit **154**. It will be apparent that when the speed control valve **166** is open the return air can be conducted from the forward part of the air cylinder **82** at a much greater rate. Therefore, the piston **92** will move forward at a higher speed under the force of the high pressure air on the rear surface **140** of the piston **92**.

From the foregoing remarks, it will be apparent that the rate of movement of the carriage assembly **94** is controlled by regulating the flow of return air from the cylinder **82**. When the flow of return air from the cylinder **82** is restricted by the adjustable throttle valve **164** and the speed control valve **166** is closed, the carriage assembly will move at a relatively slow spray speed. When the speed control valve **166** is open, the flow of return air will, to some extent, bypass the throttle valve **164** so that the carriage assembly **94** will move at a relatively high traverse speed. Thus, the time required for a spray cycle is held to a minimum by enabling the carriage to move at a first relatively high speed to the spray position, then reducing its rate of forward movement during the spray operation. After the dies have been sprayed the carriage is returned to its initial position at the relatively high traverse speed.

To coordinate the rate of movement of the carriage **94** with the position of the spray guns **106** and **108** relative to the dies, the speed control valve **166** is actuated by the closing of the limit or sensing switch **118** by the cams **114**. The cams **114** are positioned on the cam rod **110** at predetermined locations so that the carriage and spray guns will be in a spray position relative to the dies when the sensing switch **118** is actuated. As previously explained, the closing of the sensing switch **118** also actuates the normally closed releasing agent solenoid valve **130**. Thus, the closing of the sensing switch slows the rate of movement of the carriage **94** from the traverse speed to the spray speed while simultaneously opening the releasing agent solenoid valve **130** to enable releasing agent to be conducted to the spray guns **106** and **108**.

In addition to supplying air for moving the carriage assembly **94**, the air conduit or hose **144** conducts air to a normally closed spray air supply control valve **180** by a conduit **182**. The spray air supply control valve **180** is connected to the air manifold **104** by a conduit **184**. When the normally closed spray air supply control valve **180** is opened, high pressure air will flow from the conduit **144** through the valve to the manifold **104**. As will be explained in greater detail subsequently, the air will then flow from the manifold **104** to the spray guns **106** and **108** to entrain the releasing agent or coating fluid for application to the dies. The actuation of the spray air supply control valve **180** is controlled by the solenoid **186** which is connected to the main control box **124** by the electrical connector **188**. When the air supply valve **186** is in its normal or closed position, the air manifold **104** will not be pressurized and the spray guns **106** and **108** will not apply coating fluid or releasing agent to the dies.

The actuation of the releasing agent flow control solenoid valve **130**, the air supply control valve **146** and the spray air supply control valve **180** are all coordinated by the main control box **124**. The main control box **124** senses the position of the carriage assembly **94** relative to the main frame by means of the sensing switch **118** which is connected to the main control box by the electrical leads **122**. Referring now to FIG. 8, the main control box **124** is supplied with power by lines **190** and **192** which are connected to terminals **196** and **198** of a terminal block **194**. To begin the spray cycle a start switch, not shown, is actuated by the operator of the die casting

machine. The start switch is connected by means of leads **200** and **202** to the terminals **204** and **206** of the terminal block **194**. A timer **208** is connected to the power line **190** by means of a lead **210** which is connected to a terminal **211** of the timer and terminal **212** and terminal block **194**. Terminal **214** of the timer **208** is in turn connected to the limit switch **118** and air supply control valve **146** by means of the leads **216**, **218** and **220**. The terminal **214** of the timer is also connected to a terminal **222** of a selector switch **224** by a lead **226**. It will be apparent that actuation of the timer **208**, to interconnect terminals **211** and **214**, is necessary to complete the circuit from the power line **190**, through the solenoids for the control valves to the power line **192**.

The timer **208**, of a known construction, may be set for any predetermined time, during which the terminal **211** will be connected to the terminal **214** by the timer switch **230**. At the end of the predetermined time, the timer **208** will open a switch **230** so that the terminal **214** is no longer connected to the terminal **211**. When the switch **230** is opened, the various control solenoids will be released and the control valves will be returned to their normal position.

The limit or sensing switch **118** is connected by the leads **232**, **234** and **236** to the releasing agent supply control valve **130**. The releasing agent supply control valve **130** is in turn connected by the lead **240** to the power line **192** through terminals **228** and **198** of the terminal block **194**. Actuation of the normally open limit switch **118**, will close the circuit between the two power leads **190** and **192** to actuate the releasing agent control valve **130**.

The limit switch **118** is connected by means of leads **232** and **241** to the carriage speed control valve **166**. The carriage speed control valve **166** is connected to the terminal **238** of the terminal block **194** by means of the leads **242** and **248**. The limit switch or sensing switch **118** is also connected to the spray air supply control valve **180** through the selector switch **224** by means of the leads **232**, **234**, **250** and **252**. The leads **250** and **252** are interconnected, at the selector switch **224**, by means of the switch bar **254** and the contacts **256** and **258**. When the selector switch is moved to the left the limit switch **118** will be connected to the spray air supply control valve **180**. The spray air supply control valve **180** is also connected to the power line **192** by means of the leads **260** and **248**.

The above circuitry interconnects the components of the spray assembly so that closing of the limit switch **118** by the cams **114** will simultaneously cause the actuation of the liquid solenoid valve **130**, the spray air supply control valve **180**, and the cylinder speed control valve **166**. Since the cams **114** have a length corresponding to the duration of a spray period and are located to actuate the switch when the spray guns are in a spray position, it will be apparent that the closing of the limit switch will occur only at spray positions for a predetermined spray period. During the spray period releasing agent will be supplied to the spray guns **106** and **108** through the actuated releasing agent control valve **130**. High pressure air will simultaneously be supplied to the guns by the actuation of the spray air supply control valve **180**. The speed control valve **166** is closed so that the carriage travels at a relatively slow rate during the spray period. The limit or sensing switch **118**, by sensing the positioning of the carriage assembly in a predetermined spray position, coordinates the conducting of releasing agent and the air to the spray guns **106** and **108** while simultaneously reducing the rate of travel of the carriage assembly **94**.

The air supply control valve **146** is connected to the timer **208** by the leads **216** and **220**. The air supply control valve **146** is also connected to the power line **192** by means of the leads **264** and **248**. Thus, the air supply control valve **146** will be actuated to supply high pressure air against the rear surface **140** of the piston **92**, through the conduit **152** whenever the timer switch **230** is closed. When the timer switch **230** opens, at the end of a predetermined time the air supply control valve **146** will be released and the carriage **94** will be returned to its normal position by high pressure air which will be connected to the forward end of the air cylinder **82** by means of the return air conduit **154**.

When the selector switch **224** is placed with the selector bar **254** between contacts **266** and **222**, that is with the selector switch moved to the right of the position shown in FIG. 8, the spray air supply control valve **180** will be connected to the power line **190** through the leads **252**, **226** and **210**. Since the other side of the spray air supply control valve **180** is connected directly to the power line **192** by the leads **260** and **248**, the spray air supply control valve **180** will be continuously actuated when the timer **208** is closed. Thus, a continuous stream of air will flow out of the spray guns **106** and **108**. The releasing agent or coating fluid will be controlled by the solenoid **130** which is actuated in response to the limit switch **118** sensing a spray position. The continuous flow of air, when the selector switch is across contacts **266** and **222**, will cool the hot dies while the carriage assembly is moving at the relatively high traverse speed to a spray position. When an intermittent air supply is desired, the selector switch **224** may be moved across contacts **256** and **258**, so that the sensing or limit switch **118** must be actuated in order to complete the circuit through the spray air supply control valve.

Referring now to FIGS. 3, 6 and 7, high pressure air is supplied to the spray guns **106** and **108** through the air manifold **104**. The spray guns **106** and **108** are connected to the air manifold **104** by means of a universal mounting **270**. The universal mounting **270** is connected to the manifold **104** by a threaded connector tube **272** which is screwed into an aperture **274** in the manifold. The threads **276** on the connector tube **272** mate with threads on the interior of the aperture **274**. When the connector tube **272** has been threaded into the aperture **274**, a jam or lock nut **278** is tightened to secure the connector tube **272** in position. A fitting or elbow **280** is fastened to the opposite end of the connector tube **272**. A second, upwardly directed, connector tube **282** is connected to the fitting **280** and is threaded into an aperture **283** in the body member **284** of the spray gun. The connector tube **282** is locked into position by means of the jam or lock nut **288**. A channel or passage **290** is provided in the center of the connector tubes **272** and **282** and the fitting **280**. The channel **290** will conduct high pressure air from the manifold **104** into the body **284** of the spray gun.

The spray gun may be pointed in any desired direction by adjusting the universal connection **270**. It will be apparent that the spray gun, as shown in FIG. 6, may be pointed downwardly by pivoting the universal connection **270**. The universal connection **270** is pivoted, relative to the manifold **104**, by loosening the jam or lock nut **278** and turning the connector tube **272** in the threaded aperture **274**. When the spray gun is pointed in the desired direction, the lock nut **278** is tightened to retain the connector tube **272** and the spray gun in the desired position. In a similar manner, the spray gun may be adjusted to point in any horizontal direction, as viewed in FIG. 6, by loosening the lock nut **288** and moving the body member **284** on the threaded end portion of the connector tube **282**. When the spray gun has been pointed in the desired horizontal direction, it will be apparent that it can be locked in that position by merely tightening the lock or jam nut **288**.

As is best shown in FIG. 7, the spray gun includes a forward nozzle member **292** which is connected to the body **284** by means of threads **294** in the end portion of the nozzle. The threads **294** mate with threads **296** on the interior of an aperture **298** in the body member

284. The nozzle 292 includes a frustoconically shaped mouth or orifice 300 which has a base portion 302 and a head portion 304. A channel or passage 306 is connected to the head portion 304 of the mouth 300. A cylindrical chamber 308 is defined by a side wall 310 connected to a base wall 312 and the base 302 of the frustoconical orifice 300 of the nozzle 292. From an inspection of FIG. 7, it will be apparent that air from the manifold 104 will flow through a passage 290 to the chamber 308. The air will then flow through the base 302 of the nozzle 292 to the channel 306. When the air flows from the frustoconically shaped mouth or orifice 300 into the channel 306, a releasing agent will be entrained in the air in a manner to be explained in greater detail subsequently.

The spray gun is supplied with releasing agent, as previously explained, by the conduit 136 which is connected to the releasing agent manifold 102. The releasing agent will flow from the conduit 136 through a valve 314 into a chamber 316 in the body member 284 of the spray gun. The releasing agent chamber 316 is connected to an expansion tube 318 by means of the nozzle or orifice 320. The nozzle or orifice 320 is frustoconical in shape and has a head portion 322 connected to the chamber 316 and a base portion 324 abutting the expansion tube 318. It will be apparent that the releasing agent will flow through the tube 136 and the valve 314 into the chamber 316. The pressurized releasing agent will then flow from the chamber 316 through the head 322 of the nozzle or orifice 320 into the expansion tube 318. Since the nozzle 320 is frustoconical in shape, the releasing agent will tend to atomize when it flows from the chamber 316 to the expansion tube 318 through the nozzle 320. The atomized releasing agent will flow through the tube 318 into the channel 306 in the nozzle 292. The atomized releasing agent will be entrained, in the channel 306, in the air flowing from the chamber 308 through the nozzle 292. The entraining of the releasing agent, in the air which acts as a carrier fluid, is facilitated by an expansion area 330 in the end portion of the tube member 318.

The valve 314 includes a ball check 332 which is seated against the conduit fitting 334 by the spring 336. The pressure exerted on the ball check 332 by the spring 336 can be varied by turning the adjustment screw 338. When the adjustment screw 338 is turned downwardly the spring will exert a greater pressure seating the ball check on the fitting 334. Similarly, if the adjustment screw 338 is unscrewed or turned upwardly, the spring 336 will exert less pressure on the ball check 332. When the adjustment screw 338 has been positioned to give the desired seating force on the ball check 332, the jam or lock nut 340 is tightened to retain the adjustment screw in the desired position.

If the pressure on the releasing agent or fluid coating in the conduit 136 is insufficient to overcome the spring pressure on the ball check 332, it will be apparent that the valve 314 will prevent the releasing agent or coating fluid from flowing into the chamber 316. Thus, the flow of the releasing agent, through the spray gun, will be controlled by both the valve 314 and the releasing agent control solenoid valve 130. The spray gun may also be utilized with a system which does not supply releasing agent or coating fluid under pressure. When used with such a system the adjustment screw is positioned to apply a very light pressure on the ball check 332. When this is done air flowing through the nozzle 292 will draw or siphon the releasing agent from the chamber 316 and the conduit 136 through the expansion tube 318. The siphoned releasing agent or coating fluid will be entrained in the high pressure air, flowing around the expansion tube 318, in the manner previously explained for a system utilizing a pressurized source of releasing agent or coating fluid.

The spray gun, as will be seen in FIG. 7, does not require the use of any elastomeric seals in order to obtain a fluid tight connection between the various components of the spray gun. The expansion tube 318 is forced into a circular aperture 342 in the body member 284. The various other threaded connections are all tightened to form a seal so that they do not leak. Since there are no elastomeric seals in the spray gun, it will be apparent that the gun may be utilized in a relatively hot environment for a long period of time. Thus, the heat from the dies 12 and 14 of the die casting machine 10 will not, after a relatively short period of use, cause leaks at the joints between the components of the spray guns 106 and 108.

For purposes of affording a more complete understanding of the invention, it is advantageous now to provide a functional description of the mode in which the component parts thus far identified cooperate. The spray assembly support frame 26 is clamped to the tie bars 22 and 24 of the die casting machine 10. The main frame 64, which is connected to the support frame 26, positions a carriage assembly 94 adjacent to the dies 12 and 14 of the die casting machine 10. The support frame 26 can be adjusted vertically, by means of the connection assemblies 36 and 38 to position the spray guns 106 and 108 adjacent to the center of the die. The two slots 70 and 82 enable the main frame 64 and spray guns to be adjusted horizontally relative to the dies 12 and 14.

When a suitable starting switch, not shown, is actuated, the air supply control valve 146 will be actuated to connect air from the high pressure air supply conduit 144 to the conduit 152. The conduit 152 is connected to the rear end the air cylinder 92 so that the high pressure air will force the piston 92 to move forwardly in the cylinder 82. The return air, from the forward end of the cylinder 82 will then flow through the conduits 168, 170 and 172 to the speed control valve 166 and throttle valve 164 (see FIG. 8) and into the return air conduit 154. When the two-way air supply control valve 146 was actuated to connect the high pressure air to the conduit 152, the return air conduit 154 was connected to the exhaust port 160 of the control valve. Thus the return air will flow from the return air conduit through the exhaust port into the atmosphere as the piston moves forward.

The carriage assembly 94 and the piston 92 will move forwardly until the spray guns 106 and 608 are adjacent a portion of the dies which is to be sprayed. When this predetermined spray position is reached, the sensing switch 118 will be actuated or closed by contacting a cam 114. When the switch 118 is closed, the speed control valve 166 will be closed to block the flow of air from the conduit 172 to the conduit 174. The return air from the air cylinder 82 will then be able to flow only through the throttle valve 164. Thus, the rate of forward movement of the piston 92 and the carriage assembly 94 will be reduced and the carriage will slow down to a predetermined spray speed which can be adjusted by means of the throttle valve 164.

In addition to reducing the rate of forward movement of the carriage assembly, the closing of the limit switch 118 actuates the releasing agent or coating fluid control valve 130 to enable the pressurized releasing agent or coating fluid to flow through the conduits 126 and 132 to the releasing agent manifold 102. The pressurized releasing agent or coating fluid will flow from the manifold 102 through the conduits 136 and 138 to the spray guns 106 and 108. Simultaneously with the actuation of the releasing agent control valve 130 a spray air supply control valve 180 will be actuated by the closing of the sensing switch 118. When the spray air supply control valve 180 is actuated, high pressure air will then flow through the conduits 144 and 184 to the air or carrier fluid manifold 104.

The air or carrier fluid manifold 104 is connected to the spray guns 106 and 108 through the passages 290 in the universal mounting 270. The releasing agent or coating fluid will be entrained in the high pressure air or carrier fluid in the nozzle 292 of the spray guns 106 and 108. The entrained releasing agent will be sprayed onto the dies 12, 14 by the spray guns 106 and 108. It should be realized

that while only two spray guns **106** and **108** have been shown, it is contemplated that any desired number of spray guns can be connected to the air manifold **104** by removing plugs **400** and mounting air guns in the apertures in the air manifold **104**. Similarly, plugs **402** are provided for apertures in the releasing agent manifold **102**. Thus, additional releasing agent conduits, similar to **132** and **136**, could be connected to the added spray guns to conduct releasing agent from the manifold **102** to the spray guns.

When the cams **114** are moved out of contact with the sensing switch **118**, the carriage assembly will have moved past the spray position and the sensing switch will open, When the sensing switch **118** has opened, the releasing agent control valve **130** and spray air supply control **180** will be closed. Thus, the spray guns **106** and **108** will, when the carriage assembly **94** moves past the spray position, stop spraying releasing agent on the dies **12** and **14**. Simultaneously with the release of the control valves **130** and **180**, the speed control valve **166** will be opened. The return air, from the air cylinder **82**, will then flow through the conduits **172** and **174** to enable the piston **92** to travel at a higher forward speed in the air cylinder **82**. The carriage assembly **94** will continue to move at this relatively high traverse speed until the limit switch **118** again contacts a projecting cam **114**.

It will be apparent that the duration of the spray period of any given spray position will be determined by the length of the cam **114**. Since the cams **114** may be of any desired length, the spray period at each of the spray positions may be of any desired duration. The cams **114** are also independently adjustable longitudinally on the cam rod **110** to vary the location of a spray position relative to the dies **12** and **14**. Thus, the spray positions may be adjusted so that the spray guns **106** and **108** will apply the releasing agent to die cavities having any shape in accordance with the object to be cast.

A timer **208** is connected to the air supply control valve **146**. When the timer indicates that a predetermined time period has elapsed, the timer will open to break the circuit retaining the air spray control valve **146** in open or forward position. The air supply valve **146** will, when the timer **208** breaks the circuit, be actuated to connect the forward air supply conduit **152** to the exhaust port **160** and the rearward air supply conduit **154** to the source **143** of high pressure air. The high pressure air will then travel through the conduits **154**, **174** and **176** and the throttle valve **164** and speed control valve **166** to the forward end of the air cylinder **82**. The high pressure air will contact the forward surface **142** of the piston **92** to move the piston rearwardly in the air cylinder **82**. The piston **92** will return to the original or starting position adjacent to the end plate **88** of the air cylinder **82** until the next spray cycle. The carriage assembly, in the original or starting position, will be spaced apart from the dies **12** and **14** so that the die casting machine can bring the two dies together for a die casting operation.

A continuous flow of spray air, through the control valve **160** may be applied to the air or carrier fluid manifold **104** by placing the selector switch **224** across contacts **222** and **266**. When the selector switch is in this position a continuous stream of cooling air will be applied to the surface of the hot dies on both the outwardly and inwardly movements of the carriage assembly **94**. When the selector switch **224** is placed across contacts **256** and **258**, the spray air supply control valve **180** will be actuated, as previously explained, when the sensing switch **118** is closed by the cams **114**. Thus, with the selector switch in this position, there will be an intermittent flow of carrier fluid or air from the spray guns **106** and **108** at only the spray position when the coating fluid or releasing agent will be entrained in the air by the spray guns.

The spray guns, which may be of any desired number by merely mounting additional guns in place of the plugs **400** in the air manifold **404**, are connected to the air manifold **104** by means of a universal mounting **270**. The universal mounting permits the guns to be pointed in any desired direction to provide an optimum angle of contact for the stream of air-entrained releasing agent to contact the dies **12** and **14**. It will be apparent that this feature is particularly useful with a deep die having angled surfaces.

The spray guns are made of metal parts which are heat resistant. The heat from the hot dies will not therefore deteriorate the joints between the components of the spray gun. Thus, the spray guns can be utilized for a relatively long period of time without replacing any of the component parts.

Although the preferred embodiment of the invention has been shown with a carriage mounted in a horizontal position, it will be apparent to those skilled in the art that the spray assembly could be mounted with the carriage assembly in the vertical position. Also, while a fluid releasing agent has been found to be most satisfactory for most applications to dies, it is contemplated that a powdered releasing agent could be used with the spray assembly. In addition to these modifications, it will be apparent to those skilled in the art that the spray will have applications in environments other than die casting. Thus, a coating fluid, other than a releasing agent, could be applied by the spray guns **106** and **108** to a given object. The spray guns are capable of entraining any desired coating fluid in a given carrier fluid.

In view of the foregoing remarks, it should be understood, that the invention is not limited to the particular embodiment shown. These and many other modifications may be made; and it is, therefore, contemplated to cover by the appended claims any such modifications as fall within the spirit and scope of the invention.

What is claimed is:

1. An apparatus for applying a release agent to dies in a die-casting machine comprising a frame mountable adjacent a die-casting machine, manifold means including a first portion connectable to a source of release agent and a second portion connectable to a source of air under pressure, spray gun means mounted on said manifold means and connected to said release agent portion and said air portion, a pair of parallel spaced apart elongated rod-like members reciprocably mounted on said frame and connected to and supporting said manifold means for movement between a retracted position and advanced spraying positions laterally outwardly from said frame and adjacent said dies, drive means connected with one of said members for selectively advancing and retracting said members and said manifold means, an elongated cam support member parallel to said rod-like members and connected for movement in unison with said manifold means, cam means on said cam support member, and control means for controlling said drive means and flow of release agent and air to said manifold means and including a sensor mounted on said frame and engageable with said cam means.

2. An apparatus, as defined in claim **1**, wherein said cam means includes a plurality of independently adjustable cams, each of said cams representing a predetermined spraying position, and said sensor comprises a single sensing switch actuated by said cams upon movement of the manifold means to said predetermined spraying positions.

3. An apparatus, as defined in claim **2**, wherein said switch is a double acting switch responsive to both advancing and retracting movements of the manifold means.

4. An apparatus, as defined in claim **1**, wherein said control means includes an air control valve connected between the source of air under pressure and said air portion of the manifold means, a valve control connected to said valve to actuate the valve from a first closed position to a second open position, and selector means connected to said valve control and actuatable from a first

selector position to a second selector position, said valve control being connected to said sensor when said selector means is in said first position so that said valve will be actuated from the closed position to the open position when said sensor indicates the spray gun means to be in a spraying position, said valve means being held continuously in said open position by the valve control when said selector means is in said second position.

5. An apparatus, as defined in claim 1, wherein said control means includes timer means for actuating said drive means to move said spray gun means from an advanced spraying position to said retracted position at the end of a predetermined time.

6. An apparatus, as defined in claim 1, wherein said release agent portion of the manifold means comprises a block-like member having a passageway therein with a plurality of outlet ports, said air portion of the manifold means comprises a rigid tube structure secured to said block member and having an internal passageway with a plurality of outlet ports, said spray gun means comprises a plurality of separate spray guns, said apparatus including fitting means rigidly and adjustably mounting said spray guns of said air manifold tube structure and respectively connecting spray guns to the outlet ports of the air passageways, and a plurality of conduits respectively connecting spray guns to the outlet ports of said release agent passageway.

7. An apparatus, as defined in claim 6, wherein said block member traverses and is secured to ends of said elongated rod-like members and said cam support member.

8. An apparatus, as defined in claim 1, wherein said frame comprises a frame member disposed transversely with respect to said elongated rod-like members and extending outwardly in opposite directions therefrom, and attachment means on opposite end portions of said frame member for securing said frame to tie-rods of a die-casting machine.

9. An apparatus for spraying material such as a release agent onto workpieces such as dies in a die-casting machine comprising a frame mountable adjacent a die-casting machine, an elongated air cylinder mounted on said frame, an elongated piston rod telescopically associated with and operable by said cylinder and having an outer end projecting laterally of said frame, a guide rod reciprocably mounted on said frame in parallel spaced relationship with respect to said piston rod, a manifold block connected to and carried by outer ends of said rods and having internal passageway means including an inlet port connectable with a source of release agent and a plurality of outlet ports, a rigid tube manifold structure secured to and carried by said block and having an internal passageway with an inlet port connectable with a source of air under pressure and a plurality of outlet ports, a plurality of spray guns each having a release agent inlet port and an air inlet port, a plurality of pipe fitting means rigidly and adjustably mounting said spray guns on said tube manifold structure and connecting the outlet air ports of said manifold structure with the inlet air ports of the spray guns, and a plurality of flexible conduits respectively connecting the outlet ports of said block manifold member with the release agent inlet ports of the spray guns.

10. An apparatus, as defined in claim 9, which includes an elongated cam support member parallel to said rods and connected with said block member, said support member having a longitudinally extending slot therein, cam means adjustably mounted in said slot on said support member, and control means mounted on said frame for controlling the flow of the release agent and air to said spray guns, said control means including a sensor engageable with said cam means.

11. An apparatus, as defined in claim 10, wherein said cam support member and said cam means are disposed over said rods and substantially over said frame in an exposed position for facilitating adjustment of the cam means.

References Cited

UNITED STATES PATENTS

2,672,844	3/1954	Flint	118—315
2,878,058	3/1959	Gauthier et al.	118—323 X
3,027,095	3/1962	Paasche	118—323 X
3,050,416	8/1962	Yahnke et al.	118—315 X
3,266,729	8/1966	Baskett	239—186

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