Oct. 4, 1966 M. D. GIARDINO ETAL 3,276,695

COATING APPARATUS

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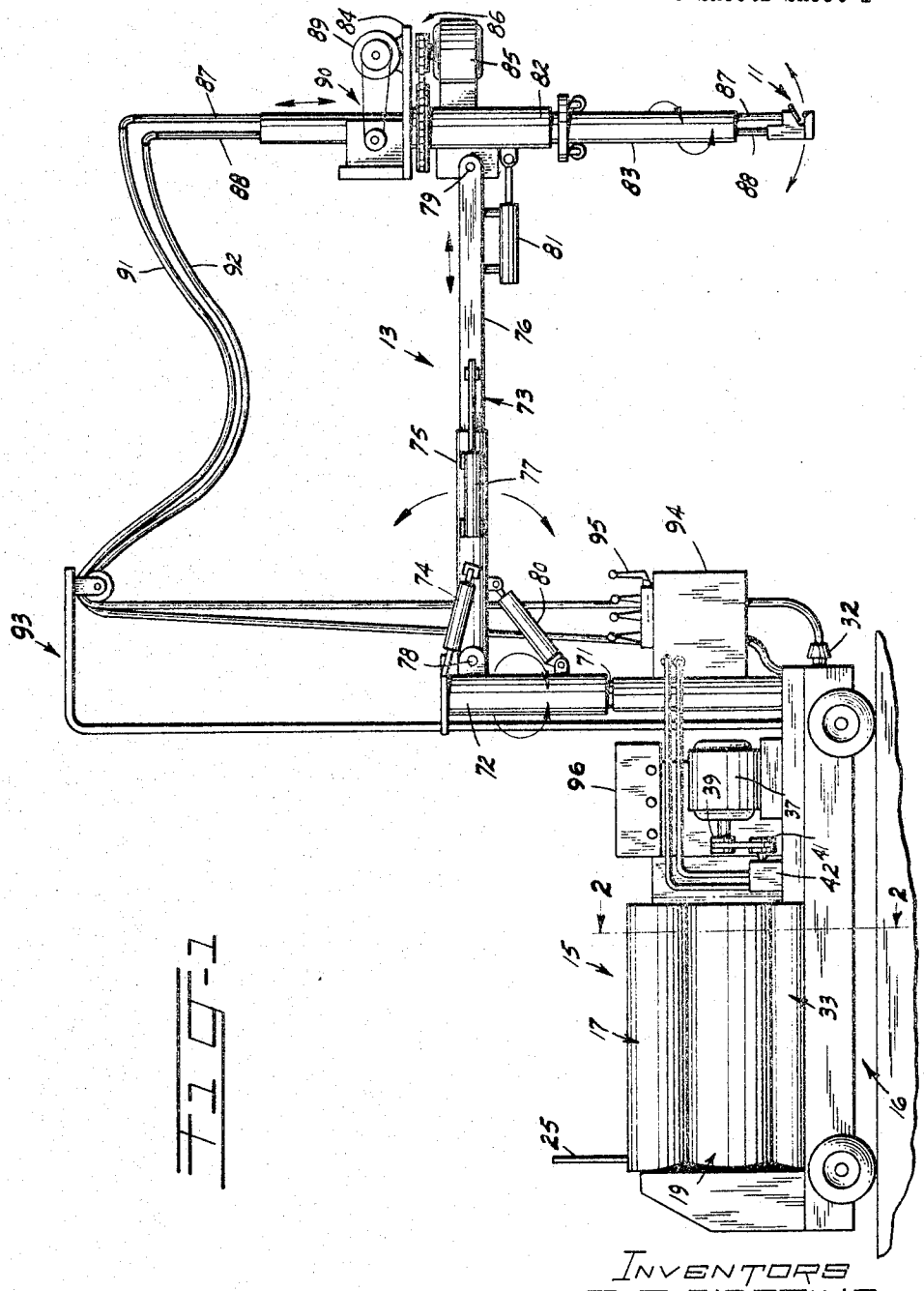


FIG-1

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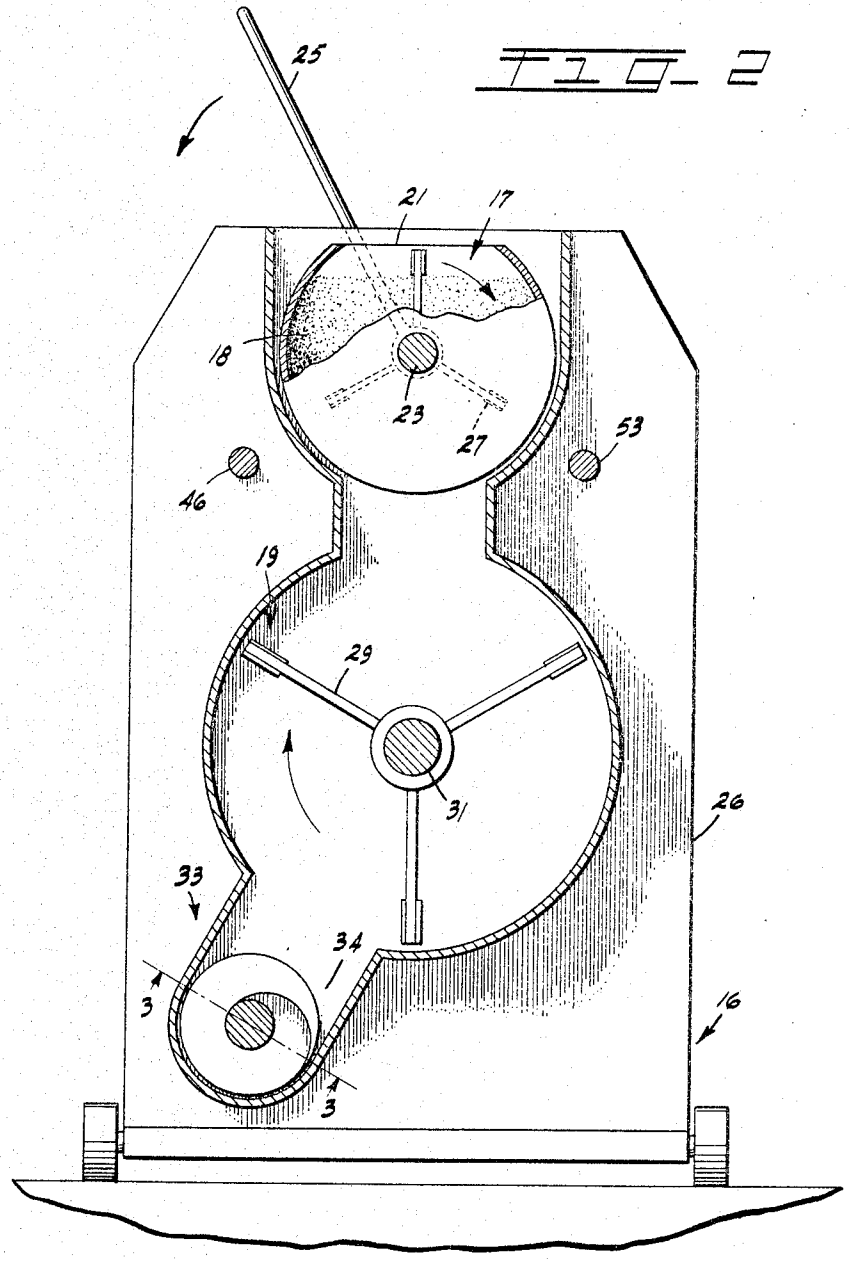
By John Maier, III
ATTORNEY

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COATING APPARATUS

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FIG. 2

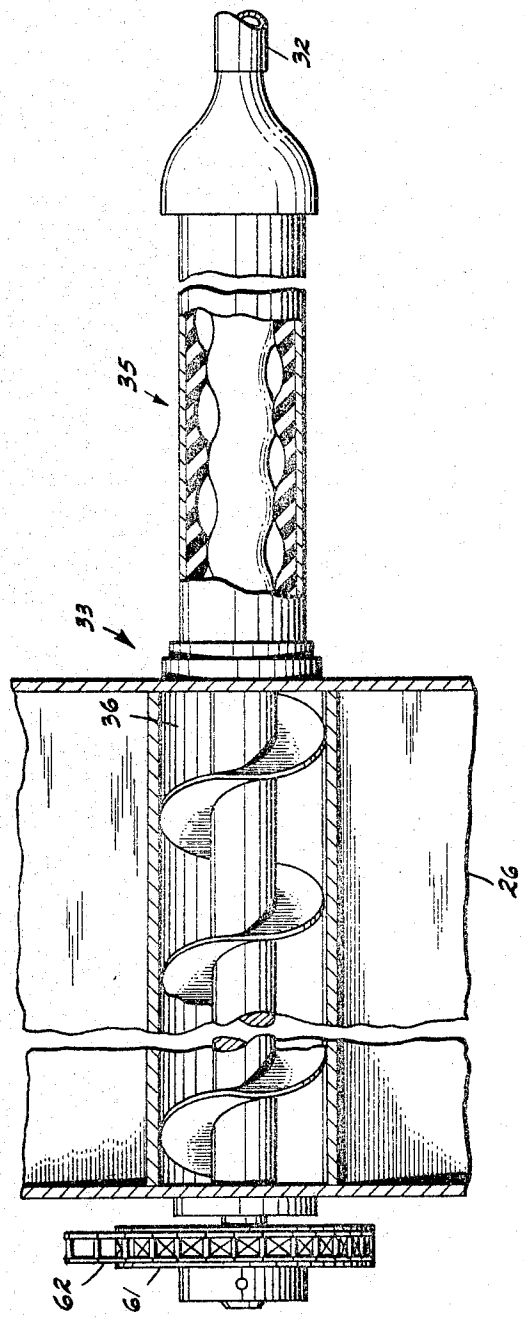


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COATING APPARATUS

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FIG. 3

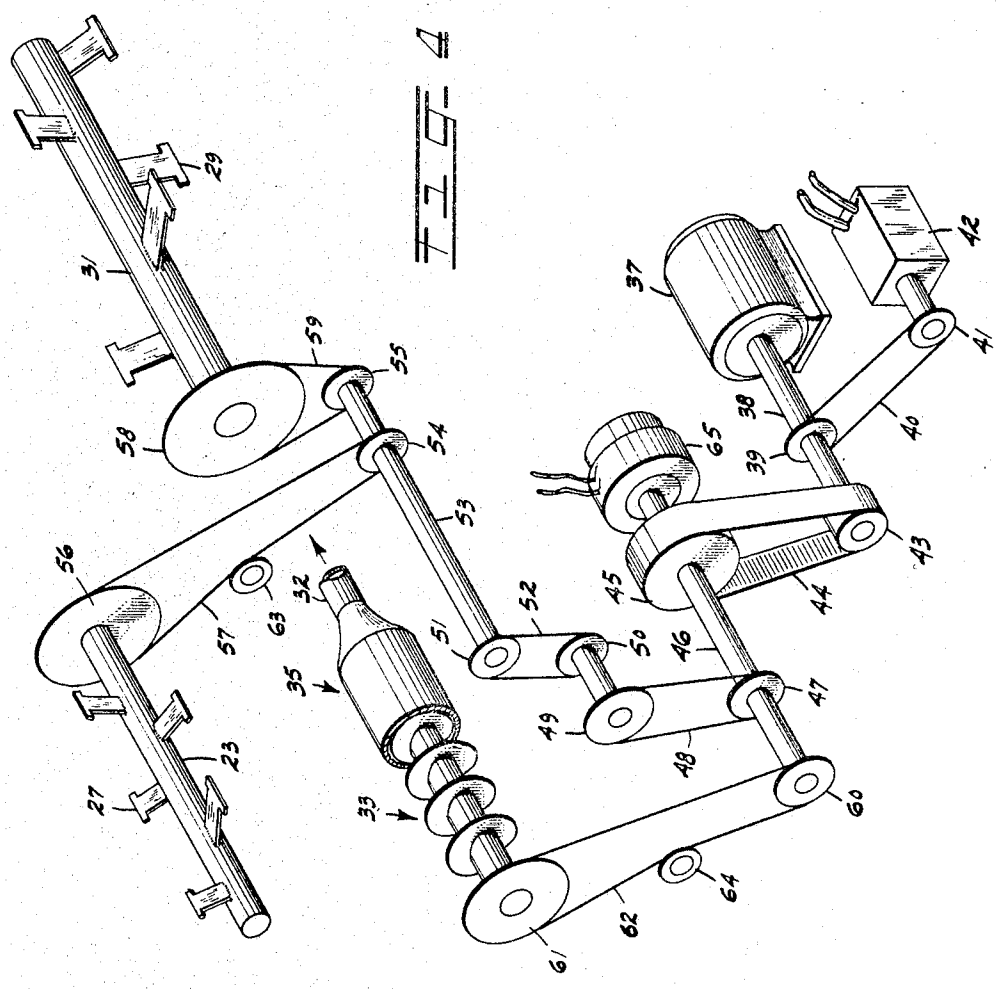


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COATING APPARATUS

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FIG. 4



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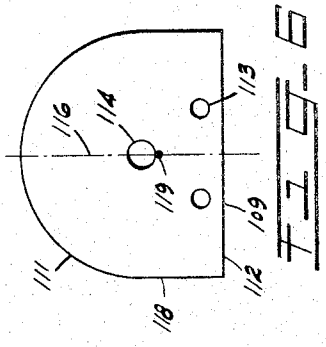


FIG. 6

FIG. 7

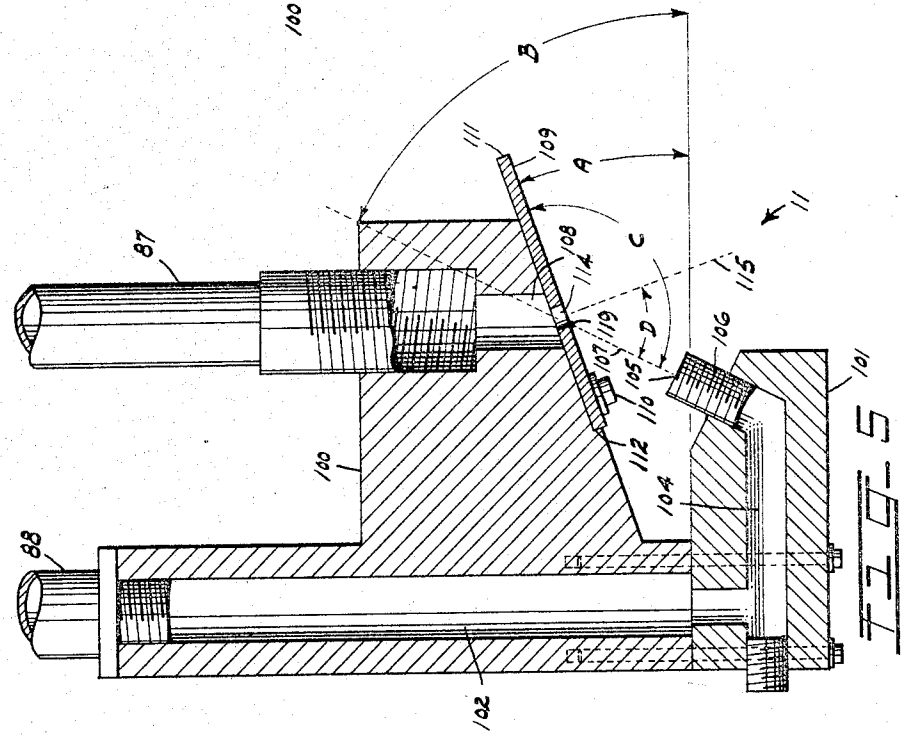


FIG. 5

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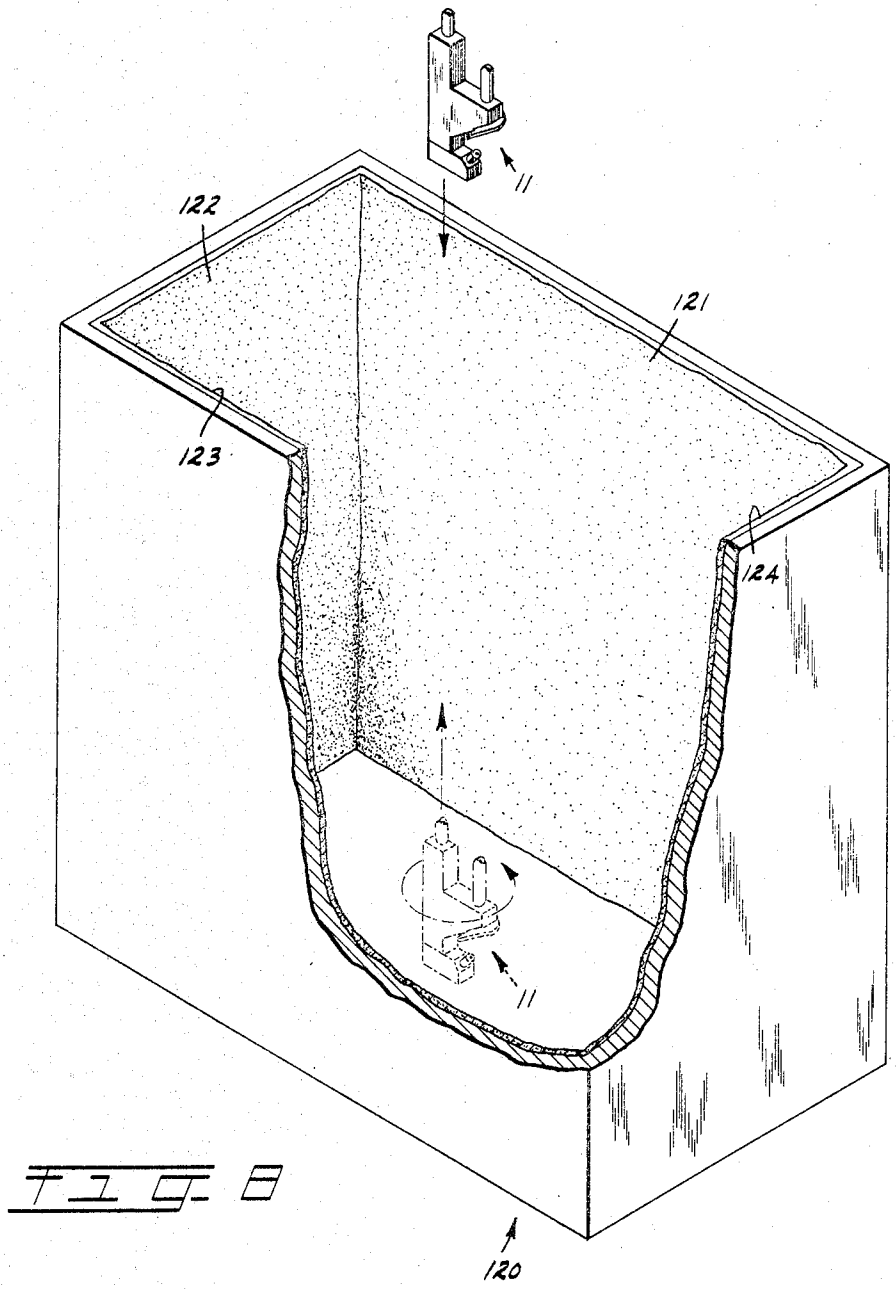


FIG 8

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3,276,695
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3,276,695

COATING APPARATUS

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Filed Sept. 29, 1965, Ser. No. 491,195
12 Claims. (Cl. 239—142)

This application is a continuation-in-part of co-pending application Serial No. 411,329, filed November 16, 1964.

This invention relates to apparatus for applying a coating, and more particularly, to apparatus for rapidly applying a coating of heavy, thick material.

It has been found that a coating of finely-pulverized slag mixed with a limited quantity of water and a small amount of asbestos produce a valuable coating for molds in which steel ingots are to be cast. By way of illustration, such coating can contain 100 pounds of finely-divided slag, approximately 30 to 40 pounds of water, and 4 to 10 pounds of asbestos. The use of such a mixture as a mold coating makes possible a superior steel ingot that is more readily removed from the mold and that has an improved skin texture thereby reducing the need for surface conditioning and substantially lowering the rejection factor of completed rolled products.

A mixture of pulverized slag which contains just sufficient water to be a thick, heavy, putty-like material, can readily be seen to be a very difficult material to apply rapidly to the surface of a mold. Such a slag containing material has virtually no lubricating properties and cannot be applied with existing cement applying equipment. Although the benefits of such a coating have been known, no apparatus was available to apply the coating with sufficient speed to make use of the coating economically feasible. Therefore, a vastly beneficial process to the steel industry could at best be only used on a limited scale due to lack of suitable equipment. As a result, however, of this invention, a mold which previously took over 20 minutes to coat now be coated in well under one minute.

In applying the coating, it is essential that the apparatus be capable of evenly applying the coating. It is also required that a maximum amount of the material applied remain in contact with the coating and not rebound. When rebounding of the material occurs, the coating which has failed to adhere drops to the bottom of the mold interfering with proper casting.

Therefore, it is an object of this invention to provide an apparatus for preparing and rapidly applying a coating of heavy thick material.

Another object is to provide an apparatus for applying a coating which can be remotely operated.

Another object is to provide an apparatus for evenly applying a coating.

Another object is to provide an apparatus for applying a coating of a preselected thickness.

Another object is to provide an apparatus for applying a heavy, thick material with a minimum of rebounding of the material applied.

Another object is to provide an apparatus which can economically apply a coating to a mold for casting ingots.

Another object is to provide a spray assembly capable of spraying a heavy, thick material.

Another object is to provide a positioning assembly capable of remotely positioning a spray assembly within a mold.

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Another object is to provide a mixing and pumping assembly capable of mixing and pumping a heavy, thick material.

Other objects and a fuller understanding of the advantages of this invention may be had by referring to the specifications and drawings in which:

FIGURE 1 is a side view showing the complete assembly of the apparatus.

FIGURE 2 is a cross-section taken on line 2—2 of FIGURE 1.

FIGURE 3 is a cross-section taken on line 3—3 of FIGURE 2.

FIGURE 4 is a schematic view of the drive mechanism utilized by the invention.

FIGURE 5 is a side cross-sectional view of a spray assembly utilized in accordance with the invention.

FIGURE 6 is a plan view of a baffle plate utilized within the spray assembly.

FIGURE 7 is an isometric view of the spray assembly shown in FIGURE 5.

FIGURE 8 is an isometric view showing the spray assembly and a possible path of travel in applying a coating to the inside of a mold.

Referring now to FIGURE 1, the coating apparatus has a spraying assembly **11**, a placement assembly **13**, and a mixing and pumping assembly **15**. The apparatus is mounted on a cart **16**.

As best seen in FIGURE 2, a premixing compartment **17** is located at the top of the mixing and pumping assembly **15**. Encasing the sides of the premixing compartment **17** and extending below it is a main mixing compartment **19**. The premixing compartment **17** is cylindrical in form and has an opening **21** extending longitudinally across it. The premixing compartment **17** is also rotatable mounted on an axis **23** and has a handle **25** rigidly secured to it to rotate the premixing compartment **17** approximately half of a revolution to invert the opening **21** and dump any material **18** in the premixing compartment **17** into the main mixing compartment **19**. Paddles **27** mounted on the rotating axis **23** mix the material within the premixing compartment **17**. Enclosing the mixing and pumping assembly **15** is a casing **26**.

In operation, a supply of constituents of the material **18** to be sprayed is fed into the premixing compartment **17** through the opening **21**. As has been previously stated, a suitable mixture would include 100 pounds of finely-divided slag, between 30 and 40 pounds of water, and four to ten pounds of asbestos but other variations of quantity and constituents are possible. Following mixing of the material by the paddles **27**, the handle **25** is manually rotated thereby inverting the premixing compartment **17** and causing the material **18** to drop to the main mixing compartment **19** where further mixing of the material is accomplished by rotating paddles **29** mounted on an axis **31**.

Located adjacent the bottom of the main mixing compartment **19** is an auger conveyor **33** which receives the coating material through an opening **34**. It should be noted, as best seen in FIGURE 2, that the opening **34** is so located in relation to the direction of rotation of the paddles **29**, as indicated by the directional arrows, that the material is constantly forced into the auger **33** providing space within the auger **33** is available. As best seen in FIGURE 3, the auger conveyor **33** forces the material into a positive displacement pump **35** connected to the discharge end **36** of the auger **33**. Use of the auger **33**

avoids the formation of air pockets in the positive displacement pump **35**. The material **18** leaves the positive displacement pump **35** through an end opening **32**.

As shown in schematic form in FIGURE 4, an electric motor **37** or other suitable source of rotating power is used to drive both paddles **27**, **29** and the auger **33** along with the positive displacement pump **35**. The motor **37** has a shaft **38** on which a sprocket wheel **39** is mounted. The sprocket wheel **39** is used to drive a hydraulic pump **42** through a chain **40** and sprocket **41**. The hydraulic pump **42** is utilized in operation of the placement assembly **13** as will hereinafter be explained. Also located on the shaft **38** is a timing wheel **43** which through a timing belt **44** drives a timing wheel **45**. The timing wheel **45** is mounted on a shaft **46** which drives a sprocket wheel **47**. The sprocket wheel **47** through a chain **48** drives a sprocket wheel **49** which is secured to a sprocket wheel **50**. The sprocket wheel **50** drives a sprocket wheel **51** through a chain **52**. The sprocket wheel **51** is mounted on a countershaft **53** on which a sprocket wheel **54** and a sprocket wheel **55** are also mounted. The sprocket wheel **54** drives a sprocket wheel **56** through a chain **57** while the sprocket wheel **55** drives a sprocket wheel **58** through a chain **59**. The sprocket wheel **56** is connected to the axis **23** on which the premixing paddles **27** are located while the sprocket wheel **58** is connected to the axis **31** on which the main mixing paddles **29** are located. A sprocket wheel **60** mounted on the shaft **46** drives a sprocket **61** through a chain **62**. The sprocket wheel **61** is mounted on the auger **33** which is connected to the pump **35**. Tension is applied to the chain **57** through an idler **63** and to the chain **62** through an idler **64**.

The shaft **46** is engageable and disengageable with the sprocket **60** through a clutch means **65** attached to it which may be electrically, hydraulically, or pneumatically operated. Operation of the clutch means **65** permits operation of solely the paddles **27**, **29** or operation in combination of the paddles **27**, **29** and the auger conveyor **33** with the pump **35**. However, regardless of the position of the clutch means **65**, the hydraulic pump **42** remains engaged. In this way, the mixing operation can continue without pumping material.

Referring back to FIGURE 1, a post **71** is mounted in a vertical position at one end of the cart **16**. A boom **73** extends outwardly at right angles to the post **71** and is secured to a rotatable collar **72**. Rotation of the boom **73** about the post **71** is achieved by the hydraulic cylinder **74**. The boom **73** has two sections, namely an inner section **75** and an outer section **76**. The two sections, **75**, **76** slideably engage one another to permit extension and retraction of the boom **71**. Movement of the outer section **55** is accomplished by a hydraulic cylinder **77**. The inner section **75** is provided with a pivot **78** connected to the rotatable collar **72** and the outer section **76** also has a pivot **79** at the end remote from the pivot **78**. The pivot **78** is operated by a hydraulic cylinder **80** and the pivot **79** is operated by a hydraulic cylinder **81**.

At the outer end of the boom **71** is a cylindrical support sleeve **82** with an inner sleeve **83** rotatably mounted within it. A platform **84** having an opening therein is secured to the upper end of the outer sleeve **82**. A variable speed motor **85** preferably hydraulic is used to rotate the inner sleeve **83** through a chain drive **86**. A material conduit **87** and an air conduit **88**, each located parallel to one another in spaced relationship pass through the opening in the plate **84** and are secured within the inner sleeve **83**. A hydraulic motor **89** mounted on the platform **84** powers a chain drive **90**. The chain drive **90** operates a drum and cable (not shown) to raise and lower the inner sleeve **83** with the conduits **87**, **88** therein.

A flexible hose **91** connects the pump **35** to the material tube **87**. A similar flexible hose **92** connects the air conduit **88** to a source of compressed air (not shown). A holder **93** supports the hoses **91**, **92**.

The hydraulic pump **42** previously referred to provides hydraulic fluid under pressure within a hydraulic control reservoir **94**. Fluid from the reservoir is fed to the respective hydraulic cylinders **74**, **77**, **80**, **81** and the motors **85**, **89** through valves **95**. An electric control box **96** is used to operate the main drive electric motor **37**.

At the lower end of the conduits **87**, **88**, the spray assembly **11** is located. As best seen in FIGURES 5 and 6, a main block **100** is located with a lower block **101** bolted to it. The air conduit **88** is connected to the main block **100** and a channel **102** vertically through the block **100** continues the conduit **88**. An extension channel **104** in the extension block **101** directs the air flow at approximately right angles to the channel **102** and then slopes upward. An aperture **105** at the end of a tube **106** mounted in the lower block **101** directs a blast of air upward at an acute angle to the horizontal along its longitudinal axis **107**.

The material conduit **87** is connected to the main block **100** and a material channel **108** extends vertically downward along the directional path of the material conduit **87**. At the open end of the material channel **108**, a baffle **109**, preferably in the form of a flat plate, is located. The plate **109** is held in place by means of bolts **110** through holes **113** threaded into the main block **100**. The baffle plate **109** which slopes at an acute angle to the material channel **108** has a rounded or outside end **111** and a square or inside end **112**. An orifice **114** in the plate **95** has a longitudinal axis **115** located on an axis of symmetry or longitudinal axis of the plate **116** which is parallel to two side edges **118** of the plate **109**. The longitudinal axis **115** of the orifice **114** is preferably substantially at right angles to the plate **109**. The material **18** being pumped through the material conduit **87** is forced through the orifice **114**. The longitudinal axis **107** of the aperture **105** is directed toward a point **119** which is in the close general vicinity to the intersection of the axis of symmetry **116** and the periphery of the orifice **114** adjacent the square end **112**. The square end **112** is located closer vertically to the aperture **105** due to the acute angle A of the baffle plate **109** as shown in FIGURE 5. The square end **112** is also located horizontally closer to the aperture **105**. Accordingly, the air blast from the aperture **105** blasts the material being fed through the orifice **114**. It should be noted that the axis of symmetry **116** and the longitudinal axis **115** of the orifice **114** and the longitudinal axis **107** of the aperture **105** lie substantially in a common plane.

As best seen in FIGURE 5, when the material conduit **87** and the air conduit **88** are vertically oriented, the baffle **109** is inclined from the horizontal by an acute angle A. The longitudinal axis **107** of the aperture **105** is inclined from the horizontal by an acute end B. Between the baffle **109** and the longitudinal axis **108** there is an obtuse angle C. The angle D represents the acute angle between the longitudinal axis **107** and the longitudinal axis **115**.

When a diffusion of material over a 90° sector is desired, the angular relationships of the spraying assembly **11** are substantially as follows:

$A = 20°$
$B = 60°$
$C = 140°$
$D = 50°$

When a diffusion of material over a 120° sector is desired, the angular relationships are substantially as follows:

$A = 20°$
$B = 72°$
$C = 128°$
$D = 38°$

In one example of the operation, as illustrated in FIGURE 8, the spray assembly **11** is lowered into a mold **120**, then turned 180 degrees and raised. When the

spray assembly **11** is lowered, the two sides extending from one corner to the opposite corner as, for example, the sides **121, 122** are coated. The spray assembly **11** is then rotated 180 degrees and the remaining two sides **123, 124** are coated with coating material as the spray assembly **11** is raised.

By controlling the rate of flow of the material **18** and the air pressure, the thickness of the coating applied can be regulated.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made by way of example and that numerous changes and modifications in the details of construction and the combination and arrangements of parts may be resorted to without departing from the spirit and the scope of the invention as in the appended claims.

What is claimed is:

1. An apparatus for applying a coating of heavy, thick material comprising:

a plate having an orifice therein, said plate having an outside end and an inside end and a longitudinal axis approximately passing through the center of said orifice;

means having an aperture therein with a longitudinal axis, said aperture and said plate being in a fixed spaced relationship, said longitudinal axis of said aperture and said longitudinal axis of said plate lying substantially in a common plane, said longitudinal axis of said aperture being approximately directed at the point of intersection of the periphery of the orifice and the longitudinal axis of the plate adjacent said inside end, said longitudinal axis of said plate from said outside end to said point of intersection forming an obtuse angle with said longitudinal axis of said aperture, said longitudinal axis of said aperture intersecting said plate at substantially right angles in a plane including said longitudinal axis of said aperture and being at substantially right angles to said common plane;

means for supplying a compressed fluid to said aperture;

a premixing chamber rotatably mounted and having an open top;

premixing paddles rotatably mounted within said premixing chamber;

a main mixing compartment located directly below said premixing chamber and having an opening at the top;

means for rotating said premixing chamber approximately one-half a revolution to invert the open top to the bottom to dump material within the premixing compartment into the main mixing compartment;

an auger conveyor adjacent lower portion of said main mixing compartment and in communication with the main mixing compartment;

main paddles rotatably mounted within said main compartment and adapted to force material within said main compartment into said auger conveyor;

pump means connected to said auger conveyor and adapted to receive material directly from the auger conveyor;

means for connecting said pump means to said orifice; and

means for driving said premixing paddles and main paddles and auger conveyor and pump means.

2. An apparatus according to claim **1** wherein said means for driving includes a main drive shaft having a first sprocket for driving said pump means and auger conveyor and a second sprocket for driving said premixing paddles and main paddles, said means for driving further including a clutch means adapted to operate the pump means and auger conveyor and the pump means and auger conveyor in conjunction with the premixer paddles and main paddles.

3. An apparatus for applying a coating of heavy, thick material comprising:

a spray assembly means including a baffle with an orifice therein and an aperture in spaced fixed relationship with said orifice;

means for supplying a compressed fluid to said aperture;

a premixing chamber rotatable mounted and having an open top;

premixing paddles rotatable mounted within said premixing chamber;

a main mixing compartment located directly below said premixing chamber and in communication with said premixing compartment;

means for rotating said premixing chamber approximately one-half a revolution to invert the open top to the bottom to dump material within the premixing compartment into the main mixing compartment;

an auger conveyor adjacent the lower portion of said main mixing compartment and in communication with the main mixing compartment;

main paddles rotatably mounted within said main compartment and adapted to force material within said main compartment into said auger conveyor;

pump means connected to ahe auger conveyor and adapted to receive material directly from the auger conveyor;

means for connecting said pump means to said orifice;

means for driving said premixing paddles and main paddles and auger conveyor and pump means; and

means for positioning said spray assembly.

4. An apparatus according to claim **3** wherein said means for positioning said spray assembly includes:

a post;

a boom having an inside section pivotably and rotatably connected at one end to said post and an outside section retractable connected to the end of said inside section remote from the outside section;

means for raising and lowering and rotating said spray assembly pivotably connected to the end of said outside section remote from the inside section;

means for rotating said boom about said post in a horizontal plane and for pivoting said boom about said post in a vertical plane and for retracting and extending said outside section in relation to said inside section and for pivoting said electrically controlled means in a vertical plane; and

means including two parallel pipes for connecting said spray assembly with said electrically controlled means, said two parallel pipes being partially coextensive with said means for supplying a compressed fluid to said aperture and with said means for connecting said pump means to said orifice.

5. An apparatus for applying a coating of heavy, thick material comprising:

a flat plate having an orifice therein, said flat plate having one rounded end and one square end and an axis of symmetry approximately passing through the center of said orifice;

means having an aperture therein with a longitudinal axis, said aperture and said flat plate being in a fixed spaced relationship, said longitudinal axis of said aperture and said axis of symmetry lying substantially in a common plane, said longitudinal axis of said aperture being approximately directed at the point of intersection of the periphery of the orifice and the axis of symmetry adjacent said square end, said axis of symmetry from the rounded end to said point of intersection forming an obtuse angle with said longitudinal axis of said aperture; said longitudinal axis of said aperture intersecting said flat plate at substantially right angles in a plane including said longitudinal axis of said aperture and be-

ing at substantially right angles to said common plane;

support means for holding said flat plate and aperture in a fixed spaced relationship, said support means having an air conduit therein connecting with said aperture and a material conduit therein connecting with said orifice;

an air pipe connected to said air conduit;

a material pipe connected to said material conduit, said air pipe and material pipe being closely spaced and parallel to one another;

a premixing chamber rotatbly mounted and having an open top;

premixing paddles rotatable mounted within said premixing chamber;

a main mixing compartment located directly below said premixing compartment and in communication with said premixing compartment;

means for rotating said premixing chamber approximately one-half a revolution to invert the open top to the bottom to dump material within the premixing compartment into the main mixing compartment;

an auger conveyor adjacent the lower portion of said main mixing compartment and in communication with the main mixing compartment;

main paddles rotatably mounted within said main compartment and adapted to force material within said main compartment into said auger;

pump means connected to the auger conveyor and adapted to receive material directly from the auger conveyor;

means for driving said premixing paddles and main paddles and auger and pump means, said means for driving including a main drive shaft having a first sprocket for driving said pump means and auger and a second sprocket for driving said premixing paddles and main paddles, said means for driving further including a clutch means adapted to operate the pump means and auger conveyor solely and the pump means and auger in conjunction with the premixing paddles and main paddles;

a post;

a mounting means for mounting said premixing chamber and said main compartment and said auger conveyor and said pump and said post and said means for driving;

a boom having an inside section pivotably and rotatably connected at one end to said post and an outside section retractable connected to the end of said inside section remote from said post;

a support cylinder pivotably connected to the end of said outside section remote from said inside section;

an inner cylinder rigidly encasing said air pipe and material pipe and being slideably and rotatably fitted within said support cylinder;

a drive means including a first hydraulic motor secured to said outer cylinder for slideably moving said inner cylinder within said outer cylinder;

a drive means including a second hydraulic motor secured to said outer cylinder for rotating said inner cylinder within said outer cylinder;

means including hydraulic cylinders for rotating said boom about said post in a horizontal plane and for pivoting said boom about said post in a vertical plane and for retracting and extending said outside section in relation to said inside section and for pivoting said support cylinder in a vertical plane, said hydraulic means including a hydraulic pump connected to said means for driving;

a flexible material hose connected to said pump and to said material pipe; and

a flexible air hose connected to said air pipe for supplying compressed air to said air pipe.

6. A spray assembly for use with an apparatus for applying a coating of heavy, thick material comprising:

a plate having an orifice therein, said plate having an inside end and an outside end, and a longitudinal axis approximately passing through the center of said orifice; and

means having an aperture therein with a longitudinal axis, said aperture and said plate being in a fixed spaced relationship, said longitudinal axis of said aperture and said longitudinal axis of the plate lying substantially in a common plane, said longitudinal axis of said aperture being approximately directed at the point of intersection of the periphery of the orifice and the longitudinal axis of the plate adjacent said inside end, said longitudinal axis of the plate from the outside end to said point of intersection forming an obtuse angle with said longitudinal axis of said aperture, said longitudinal axis of said aperture intersecting said plate at substantially right angles in a plane including said longitudinal axis of said aperture and being at substantially right angles to said common plane.

7. A spray assembly for use with an apparatus for applying a coating of heavy, thick material comprising:

a flat plate having an orifice therein, said orifice having a longitudinal axis at substantially right angles to said flat plate, said flat plate having one rounded end and one square end and an axis of symmetry approximately passing through said longitudinal axis of said orifice; and

means having an aperture therein with a longitudinal axis, said aperture and said plate being in a fixed space relationship, said longitudinal axis of said aperture and said longitudinal axis of said orifice and said axis of symmetry lying substantially in a common plane, said longitudinal axis of said aperture being approximately directed at the point of intersection of the periphery of the orifice and the axis of symmetry adjacent said square end, said axis of symmetry from the rounded end to said point of intersection forming an obtuse angle with said longitudinal axis of said aperture.

8. A spray assembly according to claim 7 wherein said obtuse angle is within a range of 120 to 150 degrees.

9. A spray assembly according to claim 7 wherein said obtuse angle is approximately 140 degrees.

10. An apparatus according to claim 7 wherein said obtuse angle is approximately 128 degrees.

11. An apparatus for applying a coating of heavy, thick material comprising:

a baffle having an orifice therein, said baffle having an outside end and an inside end;

means for delivering a compressed fluid, said means having an aperture therein with a longitudinal axis, said aperture and said baffle being in a fixed spaced relationship, said longitudinal axis of said aperture being approximately directed to a point of intersection on the periphery of the orifice adjacent said baffle from said outside end to said point of intersection forming an obtuse angle with said longitudinal axis of said aperture; and

means for forcing a heavy, thick material through said orifice from the end opposite from said aperture.

12. An apparatus for applying a coating of heavy, thick material comprising:

a spray assembly means including a baffle with an orifice therein and an aperture in spaced fixed relationship with said orifice;

means for supplying a compressed fluid to said aperture;

a mixing means;

an auger conveyor in communication with said mixing means;

paddle means rotatable mounted within said mixing means and adapted to force material within said mixing means into said auger conveyor;

pump means connected to the auger conveyor and adapted to receive material directly from the auger conveyor;

means for connecting said pump means to said orifice;

means for driving said paddle means and auger conveyor and pump means; and

means for positioning said spray assembly.

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EVERETT W. KIRBY, *Primary Examiner.*