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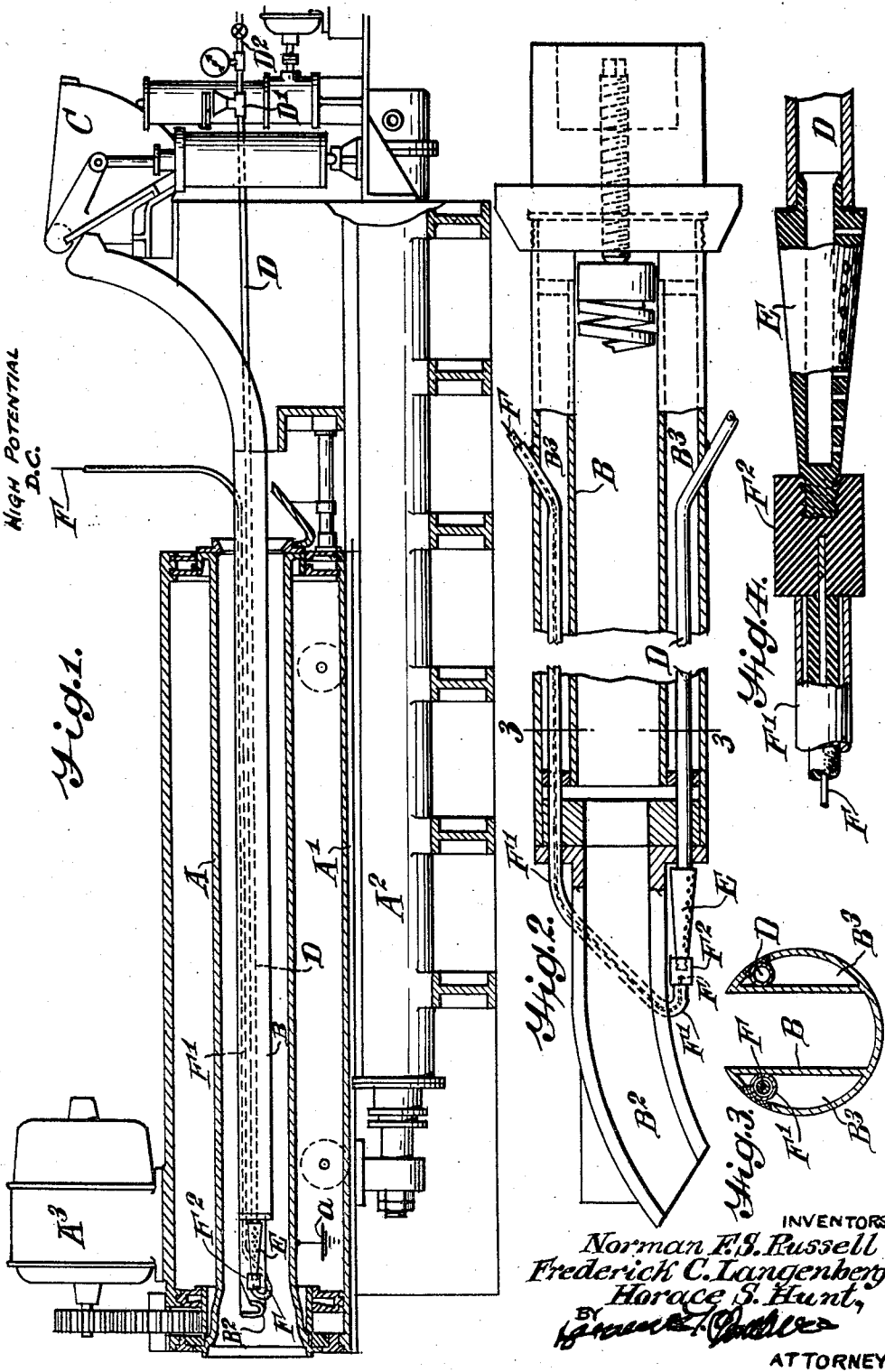
N. F. S. RUSSELL ET AL

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METHOD AND APPARATUS FOR COATING MOLDS

Filed Dec. 23, 1936

5 Sheets-Sheet 1



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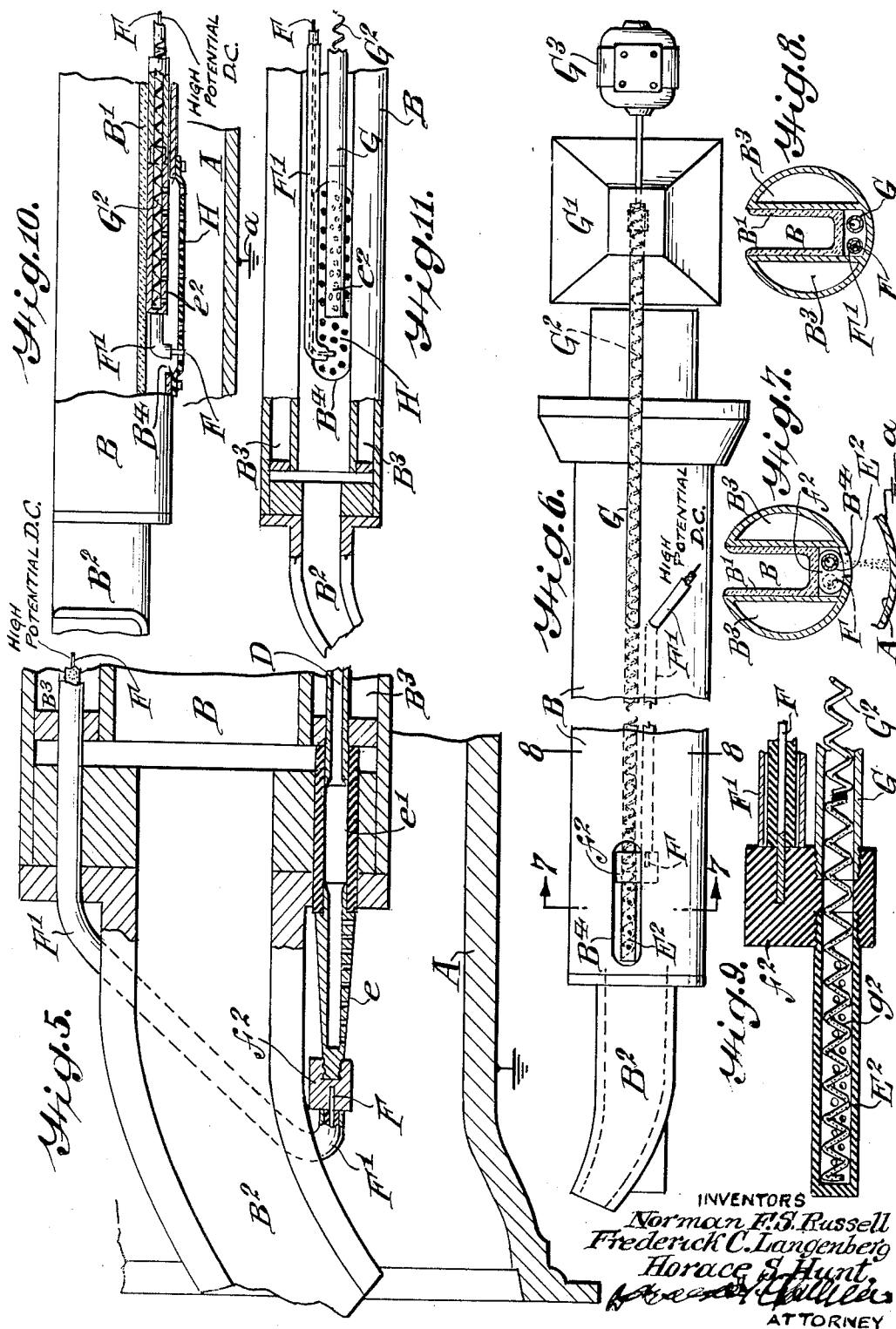
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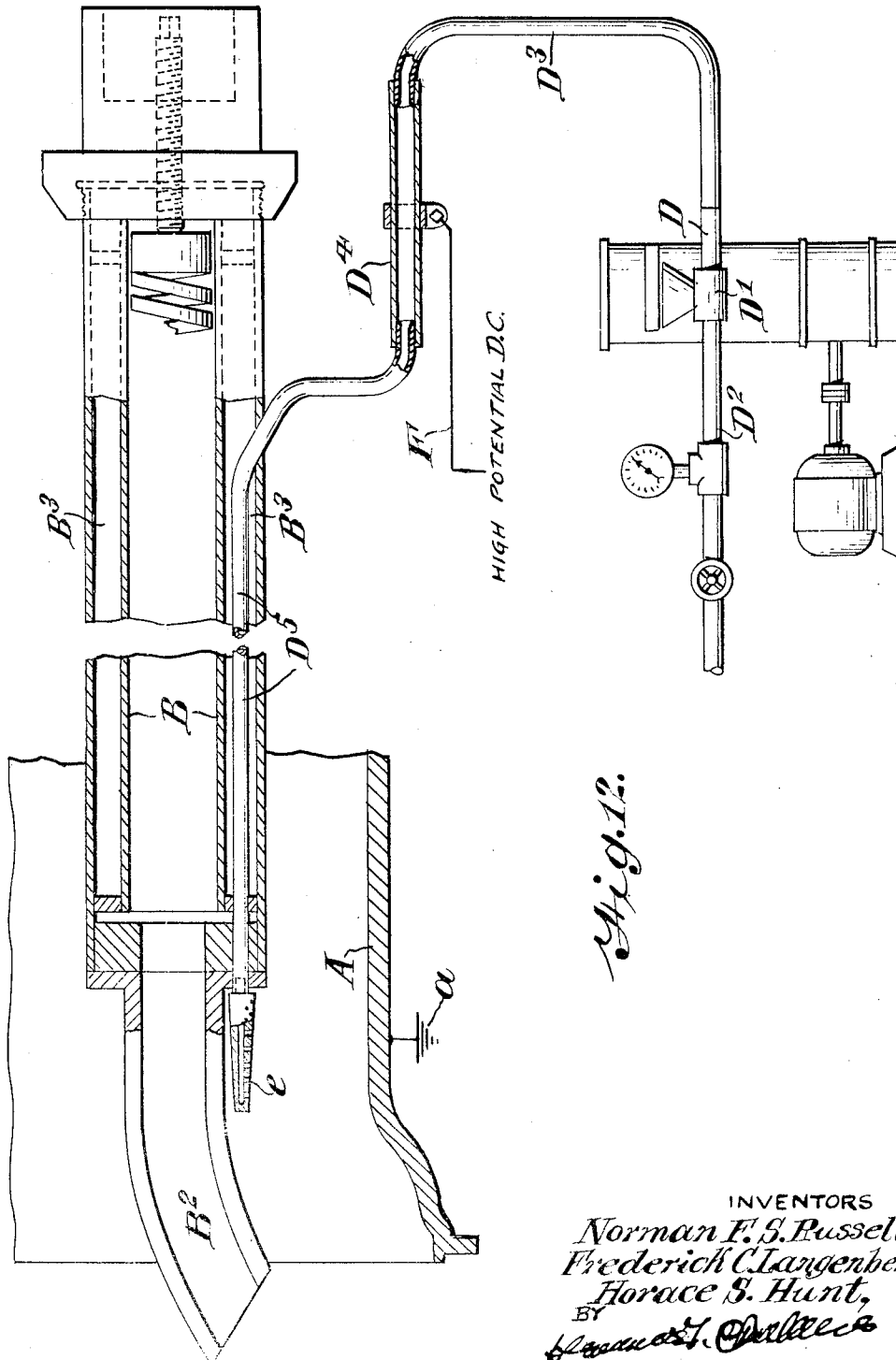
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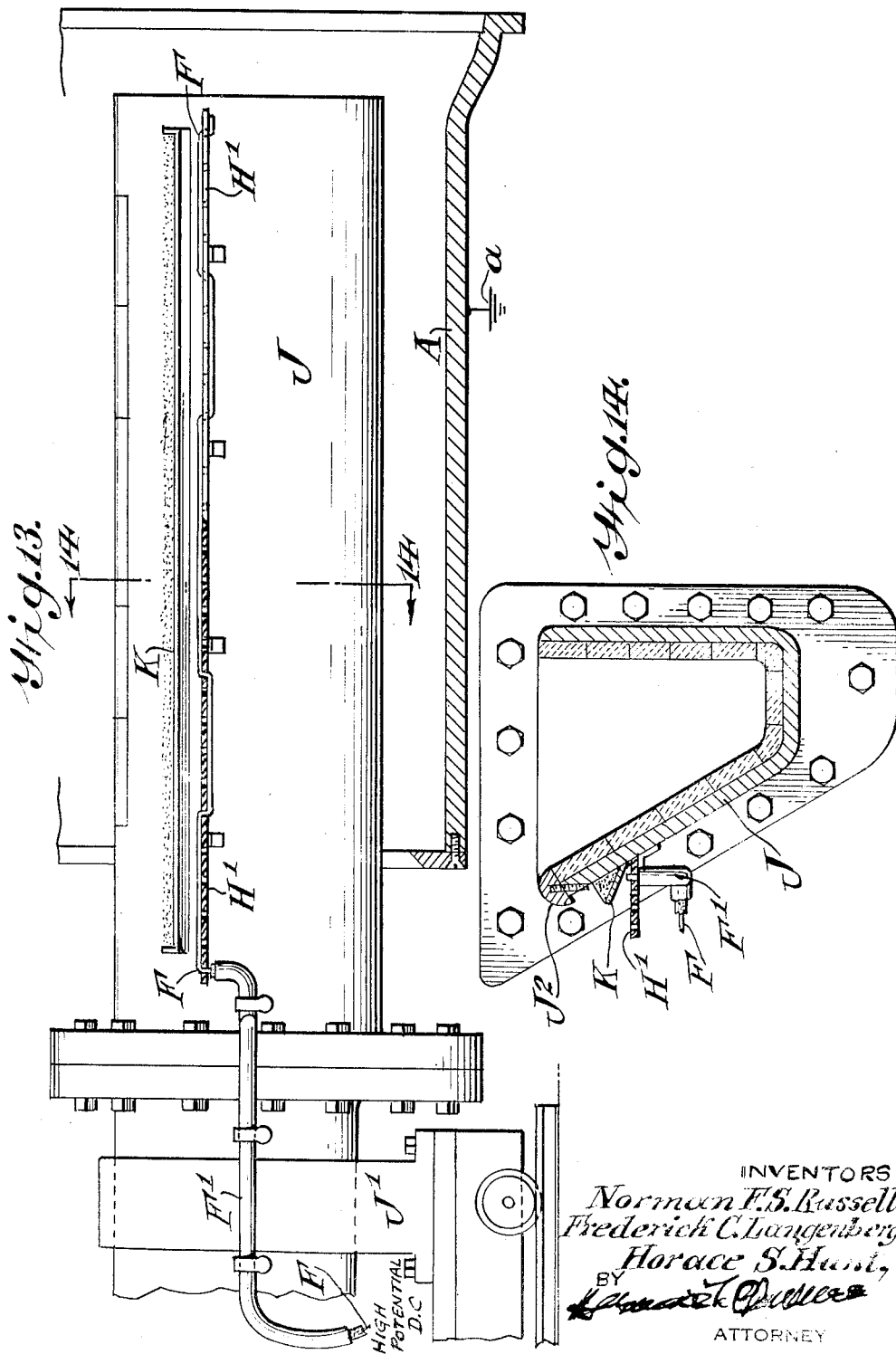
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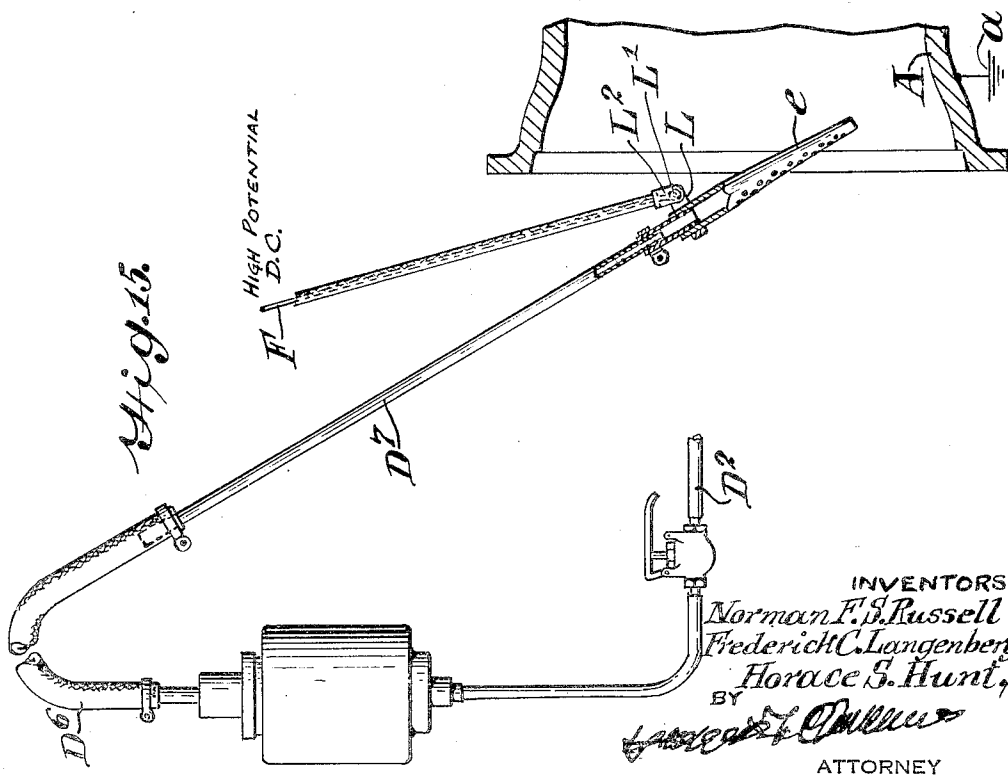
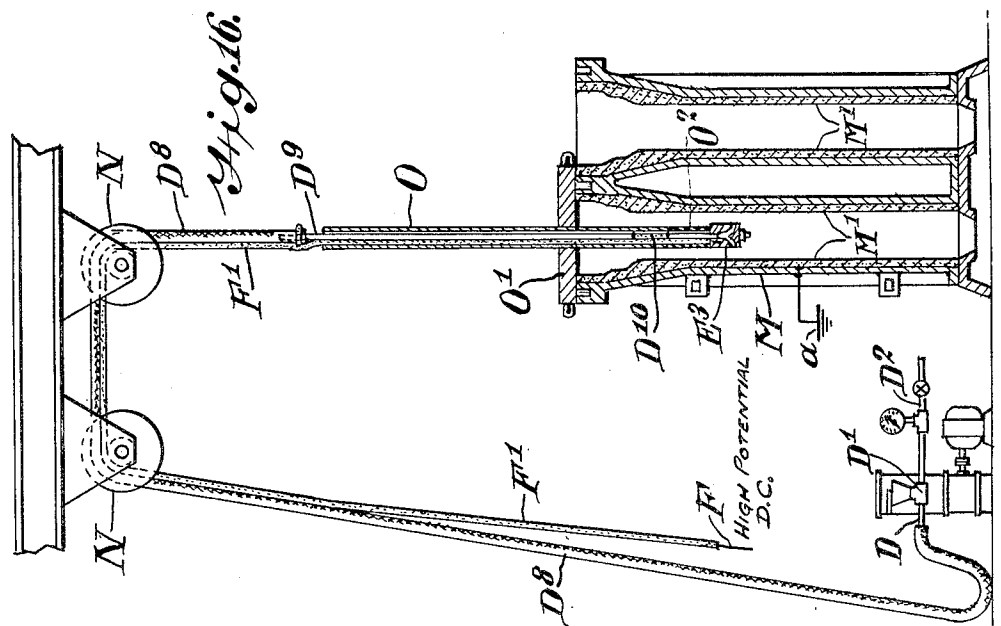
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METHOD AND APPARATUS FOR COATING MOLDS

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5 Sheets-Sheet 5



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2,128,327

METHOD AND APPARATUS FOR COATING MOLDS

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15 Claims. (Cl. 22—65)

Our invention relates to the coating of molds and, particularly, though not exclusively, to the coating of pipe molds with finely divided dry coating material. Heretofore, finely divided dry coating material has been applied to mold surfaces in several different ways, sometimes by dusting the molds, sometimes by feeding a stream of the finely divided coating material by mechanical conveying devices to the surface of a revolving pipe mold with reliance upon centrifugal action to effect distribution of the coating material on the surface of the mold and sometimes by the employment of a stream of carrier gas acting to convey and deliver a stream of finely divided dry coating material against the surface of the mold, as is described in the Russell and Langenberg patents, 1,949,433; 1,963,146; 1,963,147; 1,963,148; 1,963,149; 1,963,150. While the different methods have gone into practical use and the Russell and Langenberg method has proved to be remarkably effective in bringing about a uniform coating of the mold with a coat of definitely regulated thickness ascertained to be most effective, it is known that portions of the finely divided dry coating material are not included in the compacted coating applied to the mold, a percentage of the lighter particles being carried away with such current of air as may occur in the mold and a percentage of the heavier particles being non-adherent or loosely adherent in the make-up of the mold coating and it is also true that, as heretofore applied, the adherence of the coating to the mold and the adherence of its constituent particles to each other leaves something to be desired even with such coating materials as have been found to give the best results in practice while with other coating materials which, theoretically, should give good results, it has been found difficult to build up entirely satisfactory coatings and it is the object of our invention to provide a new or improved method of feeding finely divided dry coating material to the surface of the mold which will bring about a more complete utilization of the particles of coating material in the make-up of the mold coating to bring about a better structure in the coating and a coating of better adherence of its constituent particles to the mold and to each other; we also have in view making available for practical use in coating molds a wider variety of mold coating materials, and a further object of our invention is to provide improved mechanism for the effective carrying out of our new method of coating molds. All these objects we have found can be attained by electrically grounding the mold

and charging the finely divided dry particles of mold coating material with high voltage charges of static electricity before they come in contact with the mold with the result that substantially all particles are attracted to the mold and made, relatively speaking, more strongly adherent thereto and, broadly speaking, our invention lies in that improvement in a process for coating molds with finely divided dry coating material in which the particles of finely divided dry coating material are progressively fed to and delivered against the mold surface which consists in electrically grounding the mold and charging the particles of finely divided dry coating material with high voltage charges of static electricity prior to their contact with the mold surface.

The particles of coating material can be statically charged by causing the stream of such particles moving toward the mold to pass into and through a field of high potential static electricity which, by preference, and for the best results, should be located comparatively close to the mold as, for example, in the space intervening between the nozzle by which the particles are directed toward the mold and the adjacent mold surface as, for example, by charging the delivery nozzle itself with high potential static electricity, thereby bringing about a field of static electricity between the nozzle and the grounded mold through which the coating particles pass on their way to contact with the mold but provided proper precautions are taken to prevent the charged particles from being discharged prior to their contact with the mold they can, particularly where the coating particles are transported by a carrier gas, be charged at some distance from the delivery nozzle, that is to say, the field of static electricity in which the particles are statically charged may be spaced from the nozzle by a quite considerable distance.

Where, for any reason, it may be considered impractical or inconvenient to have the delivery nozzle statically charged but it is desired that the charging field should be located in comparatively close proximity to the grounded mold, such a field may be created by locating between the delivery nozzle and the mold a grid charged with high potential static electricity and causing a stream of finely divided dry coating material to pass through this charged grid and its surrounding static electrical field before the particles contact with the mold.

Where the finely divided dry coating material is fed to the mold surface through a charged metallic nozzle it is, of course, essential that the

nozzle should be electrically insulated but we have found that nonmetallic nozzles formed of nonconducting materials can be charged with high potential static electricity so as to build up a high potential static field between themselves and the mold and that, when charged, they remain effective even when they are in contact with grounded metal conductors.

While our invention can be usefully applied where any grounded metallic mold is provided and is applicable in the coating of molds of a semi-permanent character in which the semi-permanent coating is applied to a metallic flask or has incorporated in it metallic plates or rods and while it is also true that an ordinary sand mold contained in a metallic flask or backed by metallic plates or rods can be coated with finely divided dry coating material by our process, and to material advantage, our process is, we believe, especially applicable and useful in the application of finely divided mold coating material by the method described in the Russell and Langenberg patent, 1,949,433, or of such modifications of this process as are described in the other Russell and Langenberg patents to which we have referred above, that is to say, the particles are transported to and delivered by a nozzle in a current of a carrier gas or in other ways suspended in and transported by a jet or current of carrier gas directed against the mold surface to be coated.

With regard to the mechanical features of our invention, the essential feature lies in providing, in connection with appliances for delivering a stream of finely divided dry coating material to a grounded mold surface an electrode adapted to receive and retain a charge of high voltage static electricity and so located as to create a field of high voltage static electricity in the path of the stream of finely divided dry coating material and providing a source of high voltage electricity electrically connected to such electrode. In the accompanying drawings forming part of this specification, we have illustrated various forms of apparatus adapted for the practice of our method and novel features common to the preferential and modified constructions illustrated form the subject matter of our apparatus claims.

We are aware, of course, that it is well known that a current of air charged with finely divided solids or liquids can be cleaned of such particles by passing it through a field of high potential static electricity with the result that the particles are attracted to grounded portions of the enclosing conduit but it is, we believe, entirely new with us to apply the principle underlying the air cleaning systems to the coating of molds with finely divided dry coating material and in such manner as to bring about an improved coating in the features hereinabove referred to.

With regard to the voltage of the charge imparted to and maintained in the charged electrode, we have found that with an apparatus of the Russell and Langenberg type, a charge of from five to fifty thousand volts will give improved results and we believe that a charge of approximately thirty thousand volts will, under general conditions, be found satisfactory and efficient. Under varying conditions of application, the most satisfactory voltage will naturally be ascertained by experiment and observation.

Our invention will be best understood as fur-

ther described in connection with the drawings forming part of the specification in which

Figure 1 is a side elevation partly in section and partly diagrammatic of a pipe casting apparatus similar in general character to that described and shown in the patent to Russell and Langenberg, 1,949,433 of March 6, 1934, but provided with additional appliances and adaptations by means of which it is made operative to embody our present inventions.

Figure 2 is a plan view, partly sectioned, of the trough or runner through which metal is delivered to the mold together with the appliances for directing a jet of finely divided dry coating material against the mold and for insuring the charging of the particles of such mold coating material with high voltage static electricity prior to their contact with the mold surface.

Figure 3 is a cross-section on the line 3—3 of Fig. 2.

Figure 4 is a fragmentary view, partly in section and on a larger scale, illustrating the mechanism located at the delivery end of the metal carrying runner and the means by which the nozzle, through which the finely divided dry coating material is projected, is electrically charged.

Figure 5 is a plan view, partly in section, showing a modification of the construction shown in the prior views involving the use of a metallic nozzle for the projection of the finely divided dry coating material and the provision of an insulating connection between the metallic nozzle and the conduit through which the coating material passes to the nozzle.

Figure 6 is a plan view looking upward and partly diagrammatic of another construction of metal delivering runner and mold coating delivering mechanism together with appliances for charging mold coating material with high voltage static electricity prior to its contact with the mold surface.

Figure 7 is a cross-sectional view taken on the line 7—7 of Fig. 6, and showing, in addition, a section of the centrifugal mold with indication of the stream of mold coating material passing to the mold surface.

Figure 8 is a cross-section on the line 8—8 of Fig. 6.

Figure 9 is a fragmentary view in horizontal section and on a larger scale showing the conveyor for carrying coating material to the nozzle, the nozzle, and electrical connections for charging the nozzle with static electricity.

Figure 10 is a fragmentary elevation, partly in section, illustrating a modification of the apparatus indicated in Figures 6 to 9, in which a different provision is made for charging the particles of finely divided dry coating material with high voltage static electricity prior to their contact with the mold.

Figure 11 is a plan view of the modified construction illustrated in Fig. 10, with the liners of the runner removed and the end of the runner sectioned to indicate the location of the water jackets.

Figure 12 is a view indicating a modified construction embodying our invention and consists mainly of a plan view of the runner and its attachments partly in horizontal section at the rear of which is rather diagrammatically indicated means for feeding coating material to the conduit pipe leading to the nozzle and means for charging the particles of coating material with high potential static electricity located adjacent to the rear portion of the runner.

Figure 13 is a side elevation of a dump trough structure for charging the mold with molten metal with the mold shown in section, the dump trough being provided with means for feeding finely divided mold coating material to the surface of the mold, and means being indicated for charging the particles of mold coating material with high potential static electricity before their contact with the mold surface.

Figure 14 is a cross-section on the line 14-14 of Figure 13.

Figure 15 is an elevation of a hand appliance for feeding finely divided mold coating material to mold surfaces and for charging the particles of mold coating material with high potential static electricity prior to their contact with the mold surface, the device shown being that of a carrier, adapted in the manufacture of centrifugally cast pipe for coating the bell end of the mold prior to the insertion of the core and, of course, before the pouring of the molten metal and

Figure 16 is a sectional elevation of a conventional sand mold for casting cast iron pipe shown, together with appliances partly in section, for applying a coating of finely divided coating material to the surface of the sand mold and for charging the particles of mold coating material with high potential static electricity prior to their contact with the mold surface.

In all of the drawings, with the exception of Fig. 16, it will be understood that the mold indicated at A is a metallic centrifugal mold for casting pipe and that in all cases the mold is grounded, as is conventionally indicated at *a*. As shown, in Fig. 1, the mold, as is usually the case, is supported on a carriage A¹, to which reciprocatory movement is imparted by a cylinder A² and a motor and gearing is provided to rotate the mold, as indicated at A³, and it will be understood that the other modifications illustrated, with the exception of Figs. 13 and 16, are used with similar mold actuating mechanism. B indicates the trough or runner through which molten metal is delivered to the mold, the metal being supplied by a dumping ladle as indicated at C. The runner is ordinarily lined with blocks of cast iron, as indicated at B¹ in Figs. 7 and 8, and is provided with a delivery spout, as indicated at B². Water chambers, as indicated at B³, are provided for the cooling of the runner. D, Figs. 1, 2, 3, 4, 5, etc., is a pipe through which a current of gas, preferably air, charged with finely divided dry coating material is delivered to a terminal nozzle, indicated at E which, in Figs. 1, 2 and 4, is formed of some electrically nonconducting material and this we believe to be the preferable construction, although a nozzle of a conducting material may be successfully used, provided it is connected to the supply pipe by a nonconducting section, as indicated in Fig. 5, where the metallic nozzle is indicated at *e* and the insulating connection at *e*¹. The means rather diagrammatically indicated for feeding the conduit D with finely divided dry coating material in a current of a carrier gas is that indicated in the Russell and Langenberg patent, 1,949,433. The means for feeding finely divided coating material to the pipe is indicated at D¹ and the means for feeding the current of air to the pipe being indicated at D². The novel feature of the apparatus indicated in Fig. 1, consists in the provision of means for keeping the nozzle E charged with high potential static electricity and, as shown, this is accomplished by

connecting the nozzle to a source of high potential D. C. electricity by an insulated cable, such a cable being indicated at F and shown as passing through a pipe conduit F¹ located in the water jacket B³ on the opposite side of the runner to that in which the conducting material pipe D is located, the cable and its protective coating, where it issues from the water jacket of the runner, passing, as indicated in Figs. 1, 2, and 5, under the spout B² of the runner and having at its end a coupling F², preferably of nonconducting material, as indicated, attachable, as shown, to the end of the nozzle E. In the modified construction shown in Fig. 5, the insulated metal nozzle *e* is similarly connected to the electric cable except that the coupling, indicated at *f*², is of metal instead of nonconducting material. It will be understood that the nozzles, whether of nonconducting or conducting material, are maintained charged with high potential static electricity, creating within and adjacent to themselves fields of high potential static electricity in passing through which the finely divided dry mold coating material has its individual particles similarly charged so that in passing through the electrical field between the nozzle and the grounded mold they are strongly directed to the adjacent surface of the mold and on contact therewith and with particles previously adherent to the mold they are, for a not inconsiderable period, made more adherent than is the case with uncharged particles of coating material so that, in the first place, more of the mold coating material supplied by the nozzle remains in contact with the mold and, secondly, with better adherence than has heretofore been obtainable.

In Figs. 6, 7, 8, and 9, we have illustrated the application of our invention to a form of apparatus for supplying mold coating material to the surface of a centrifugal mold in which, instead of transporting the finely divided dry coating material by a carrier gas, the coating material is fed to a delivery nozzle by mechanical means and delivered from the nozzle to the mold by gravity. In this construction, the runner through which the metal is delivered to the mold is of somewhat different construction from that indicated in Fig. 1, having an opening in its bottom near its delivery end, as indicated at B⁴. Immediately above, this opening is located the delivery nozzle E² for the coating material which is connected to a feed conduit G, connected at its other end to a feeding device for finely divided mold coating material, as indicated at G¹ and provided throughout its length with a rotatable helix, as indicated at G², the end of which extends into the nozzle E², means for rotating the helix being indicated at G³. To adapt this form of apparatus for use in accordance with our invention we preferably make the nozzle E² of nonconducting material, coupling it to the conduit by means of the coupling block *f*² and form the end *g*² of the helix which extends into the coupling block and nozzle of nonconducting material and, as shown, we carry an electric cable F connected to a source of high potential D. C. electricity through the bottom of the runner and connect it with the coupling *f*². By means of the described mechanism, the finely divided dry coating material passes through a field of high potential static electricity in and adjacent to the nozzle so that the individual particles are similarly electrically charged and, by reason of being so charged, have a tendency to repulse each other in their passage from the nozzle to contact with the grounded mold, thereby bring-

ing about a better distribution of the coating material upon the mold than is obtainable by the use of the apparatus as previously constructed and used. The advantages of better adherence to the mold are also secured, although we do not believe that this form of apparatus is capable, even with our improvements, of building up as satisfactory a coating upon the mold as is obtained by the method and apparatus described in connection with Fig. 1.

Figs. 10 and 11 illustrate a modification of the general type of apparatus shown in Figs. 6, 7, 8 and 9, in which the nozzle e^2 through which the finely divided coating material is delivered is or may be of a conducting material and in which the insulated electric conduit F^1 is connected to a grid H of nonconducting material located below the runner opening B^4 . The finely divided dry coating material falling through this grid passes into a field of high potential static electricity, its particles becoming similarly charged, thereby bringing about a repulsion between the particles which tends to break up or prevent the formation of aggregates while, at the same time, the particles are strongly directed to and held by the portion of the grounded mold located immediately below the grid.

In Fig. 12, the conduit D through which the carrier gas charged with finely divided dry coating material is made up of three sections, the nonconducting section D^3 leading from the charging device, an intermediate section of conducting metal indicated at D^4 and a nonconducting section D^5 leading to the nozzle e , here indicated as of a conducting metal. The metallic section D^4 is connected to the electric cable F whereby it is charged with high potential static electricity and an electric field created within it whereby the particles of coating material as they pass through it are electrically charged with high potential static electricity which charge they retain in their subsequent passage through the insulated portion D^5 of the conduit and the insulated metallic nozzle e , on issuing from which the particles are strongly directed to the grounded mold surface. While we have found this construction practicable and, within limits, efficient, it is not, we believe, as efficient as are the constructions in which the field of high potential static electricity is created and maintained between the nozzle and the adjacent portion of the grounded mold.

In Figs. 13 and 14, A indicates the grounded centrifugal pipe mold and J a dump trough for supplying molten metal to the mold which is supported at one end by a longitudinally reciprocable carriage J^1 . It will be understood that the general type of apparatus is similar to that illustrated and described in the Russell and Langenberg Patents 1,963,146; 1,963,147; 1,963,148; 1,963,149, and 1,963,150. In the illustrated construction a trough K is secured to the side of the dump trough J and is so constructed that after having been charged with finely divided dry coating material the rotation of the dump trough will first result in the dumping of the trough K , delivering its charge into contact with the rotating mold surface and then to the pouring out of the contents of the metal dump trough over its lip J^2 . To charge the particles of finely divided dry coating material with high potential electricity, we locate a grid H^1 of non-conducting material in such relation to the trough K that, as this trough is dumped, its contents will pass through the grid and we connect the grid, as shown, with the cable F so as to maintain it charged with high

potential static electricity, with the result that the particles of coating material are similarly charged and an electrical field created and maintained between the grid and the adjacent portion of the grounded mold.

In Fig. 15, we have illustrated the construction of a hand apparatus especially designed for the coating by our improved process of the bell ends of centrifugal pipe molds although, of course, it will be understood that such an apparatus can be used for coating other forms of molds with appliances for feeding finely divided mold coating material to the conduit pipe and for feeding carrier gas to the conduit. In this construction a section of the conduit, indicated at D^6 , is, in this construction made of flexible tubing connected to a section of rigid tubing of a nonconducting material indicated at D^7 , this section being adapted to serve as a handle for the operator. To the end of this nonconducting section is secured a nozzle e , in this case as made of a conducting metal. L indicates a metallic clamping ring secured to the nozzle e by a bolt L^1 to which is pivotally connected, as indicated at L^2 , the terminal end of a flexible insulated metal cable, indicated at F which is, as indicated, connected to a source of high potential D. C. electricity. This apparatus is adapted to be held and manipulated by hand and when the charged nozzle is brought into proximity with the grounded mold a field of high potential static electricity is, of course, created through which the coating particles pass and are electrically charged before their contact with the mold surface.

In Fig. 16, we have indicated apparatus adapted for the coating of sand lined or semi-permanent molds in which the mold surface is in direct contact with metallic grounded backing, as indicated, a metallic flask as indicated at M , the sand lining being indicated at M^1 . We have found that a flask of this kind, when the flask is grounded, will attract and hold coating particles in much the same way as is the case with the metallic mold. In this construction the feeding device for the finely divided coating material and for the carrier gas, indicated at D , D^1 , and D^2 , is connected to a flexible tubing, indicated at D^8 . In this construction the flexible tubing is shown as passing over pulleys N and connecting with a rigid tube D^9 to the end of which is connected a nozzle, indicated at E^3 , of a character adapted to deliver an annular jet of the carrier gas and its charge of coating material. The nozzle E^3 is indicated as of metal but is insulated from the metal tubing by a sleeve of nonconducting material indicated at D^{10} . The insulated electrical cable F is connected to the metallic nozzle E^3 and is shown as passing over the pulleys N , its free end being connected to a source of high potential static electricity. To center the nozzle the pipe section D^9 and the electrical cable F are shown as being enclosed in a sleeve O which passes through a central hole in the cap O^1 removably secured to the top of the mold M . This sleeve is indicated as metallic but is insulated from the nozzle by an insulating section of nonconducting material, as indicated at O^2 . In operation it will be understood that the nozzle is progressively moved throughout the length of the mold while the jet of charged carrier gas is in operation and that a field of high potential static electricity is created between the nozzle and the grounded mold whereby the coating particles as they issue from the nozzle are electrically charged and directed to and held by the mold surface M^1 .

As in the case of the metallic molds a coating of better structure and greater adherence to the mold surface is obtained and, if desired, we have found that it is practicable to deposit a thicker coating upon the mold surface than has heretofore been found practicable.

Having now described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In the coating of metallic molds by the process in which a stream of finely divided dry coating material is progressively directed against contiguous portions of the mold surface to be coated, the improved method for securing a coating of improved structure and composition and more secure adherence to the mold surface which consists in electrically grounding the mold and charging the individual particles of mold coating material with high potential static electricity prior to their contact with the electrically grounded mold, thereby bringing about conditions under which all particles of mold coating material, regardless of size, are strongly attracted to the surface of the mold and an adherent coating built up thereupon.

2. In the coating of metallic molds by the process in which a stream of finely divided mold coating material is fed through a conduit and progressively delivered by said conduit against the contiguous portions of the mold surface to be coated through an intervening space, the improved method for securing a coating of improved structure and composition and more secure adherence to the mold surface, which consists in electrically grounding the mold and charging the individual particles of mold coating material with high potential static electricity prior to their contact with the electrically grounded mold by passing said stream of finely divided mold coating material through a high potential field of static electricity existing in the space between the delivery end of the nozzle and the grounded mold, thereby bringing about conditions under which all particles of the mold coating material, regardless of size, are strongly attracted to the surface of the mold and an adherent coating built up thereupon.

3. In the coating of metallic pipe molds with finely divided dry coating material by the process in which a mold is maintained in axial rotation during the application of the coating material and a stream of finely divided dry coating material is progressively delivered to contiguous portions of the mold until a coating of the desired extent and thickness is built up thereon, the improved method for securing a coating of improved structure and composition and more secure adherence to the mold surface which consists in electrically grounding the mold and charging the individual particles of mold coating material with high potential static electricity prior to their contact with the electrically grounded mold, thereby bringing about conditions under which all particles of the mold coating material, regardless of size, are strongly attracted to the surface of the mold and an adherent coating built up thereupon.

4. In the coating of metallic pipe molds with finely divided dry coating material by the process in which a mold is maintained in axial rotation during the application of the coating material and a stream of finely divided mold coating material is fed through a conduit and progressively delivered by said conduit against the contiguous portions of the mold surface to be coated through

an intervening space until a coating of the desired extent and thickness is built up thereon, the improved method for securing a coating of improved structure and composition and more secure adherence to the mold surface which consists in electrically grounding the mold and charging the individual particles of mold coating material with high potential static electricity prior to their contact with the electrically grounded mold by passing said stream of finely divided mold coating material through a high potential field of static electricity existing in the space between the delivery end of the nozzle and the grounded mold, thereby bringing about conditions under which all particles of the mold coating material, regardless of size, are strongly attracted to the surface of the mold and an adherent coating built up thereupon.

5. In the coating of molds with finely divided dry coating material by the process in which the particles of coating material are charged into and transported by a stream of carrier gas transported through a conduit to a delivery nozzle through which they are delivered through an intervening space into contact with progressively contiguous surfaces of the mold to be coated, the improved method for securing a coating of improved structure and composition and stronger adherence to the mold surface which consists in electrically grounding the mold to be coated and forming in the path traversed by the stream of coating particles a field of high potential static electricity, thereby charging the coating particles as they pass through said field with similar electric charges so that on passing through the space between the nozzle and the mold the individual particles are strongly attracted by the mold with the result that a coating of improved structure and composition and stronger adherence is built up upon the mold surface.

6. Apparatus for coating molds comprising an electrically grounded mold, means for progressively feeding a stream of finely divided mold coating material to the surface of the mold, a source of high potential electricity, an electrode adapted to retain a static charge of high voltage electricity electrically connected to said source and so located with regard to the path traversed by the stream of finely divided particles of dry coating material as to form in said path a field of high voltage static electricity whereby the particles of mold coating material are similarly charged before contacting with the mold surface.

7. Apparatus as called for in claim 6, in which the statically charged electrode is so located as to bring about the formation of a field of high voltage static electricity in the space intervening between the feeding means and the mold surface.

8. Apparatus as called for in claim 6, in which the statically charged electrode consists of the delivery nozzle of the means through which the stream of finely divided dry coating material is progressively fed to the mold surface.

9. In apparatus for coating molds with finely divided dry coating material comprising an electrically grounded mold, means for directing a current of carrier gas toward the surface of the mold and means for charging said carrier gas with finely divided dry mold coating material, the improvement which consists in locating an electrode adapted to receive and retain a high voltage charge of static electricity in such relation to the charged current of carrier gas as to form therein a field of high voltage static electricity and thereby similarly charge the particles of coating ma-

terial prior to their impact with the grounded mold surface and combining with said electrode a source of high potential electricity electrically connected therewith.

- 5 10. Apparatus as called for in claim 9, in which the electrode is so located as to bring about a field of high voltage static electricity in that portion of the space traversed by the charged current of carrier gas shortly before its impact with
10 the mold surface.

11. Apparatus for coating molds with finely divided dry coating material comprising in combination a pipe conduit for a carrier gas having a delivery nozzle for the outlet of the charged carrier gas and an electrode adapted to receive and
15 retain a charge of high voltage static electricity so located in relation to the pipe conduit as to bring about the formation of a field of high potential static electricity in the path traversed by the
20 carrier gas.

12. Apparatus as called for in claim 11, in which the electrode forms the outlet nozzle of the apparatus.

13. In mold coating and pipe casting apparatus
25 comprising a runner for molten metal having a delivery nozzle at its end, a relatively retractible centrifugal pipe mold, a conduit for carrier gas

secured to the runner and having a terminal nozzle arranged to deliver carrier gas charged with finely divided mold coating material against the mold surface at a point in advance of that at which the molten metal is delivered by the runner
5 nozzle and means for supplying a carrier gas conduit with carrier gas and with finely divided mold coating material, the combination therewith of an electrode adapted to receive and retain a high voltage charge of static electricity so located with
10 reference to the carrier gas conduit as to bring about the formation of a field of high voltage static electricity in the path traversed by the charged carrier gas and a source of high potential electricity electrically connected to said electrode.

14. Apparatus as called for in claim 13, in which the electrode is so located as to create a field of high voltage static electricity in the space traversed by the charged carrier gas as it issues from the delivery nozzle of the conduit.
15

15. Apparatus as called for in claim 13, in which the electrode forms the delivery nozzle of the carrier gas conduit.
20

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