Nov. 16, 1937. A. G. PERKINS 2,099,076

PIPE COATING APPARATUS

Original Filed Sept. 27, 1932 4 Sheets-Sheet 1

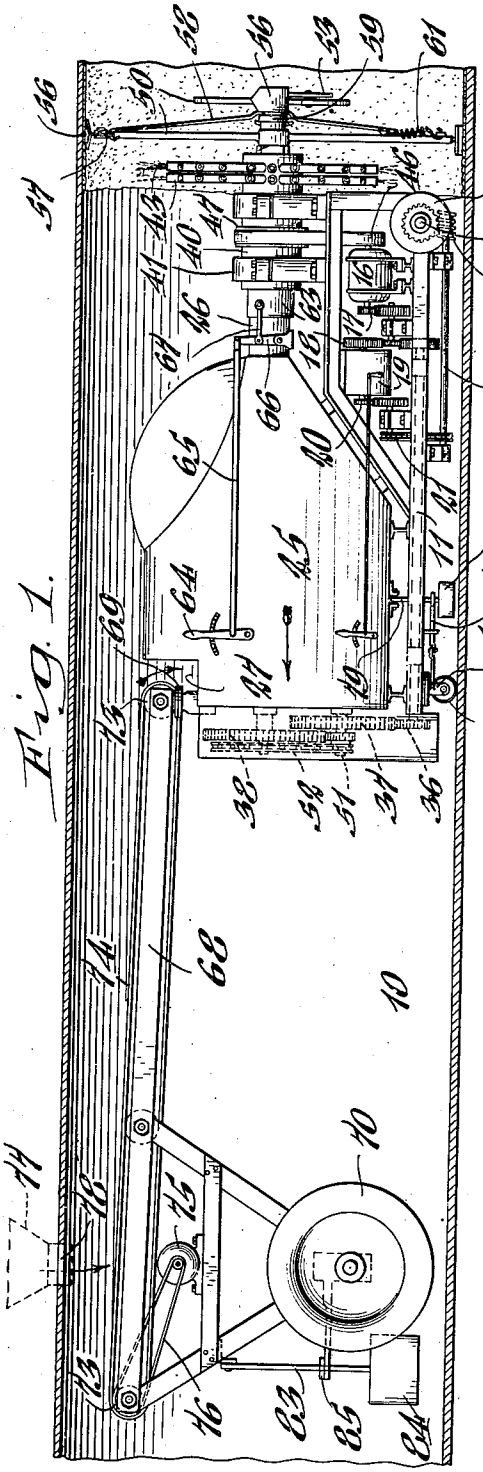


Fig. 1.

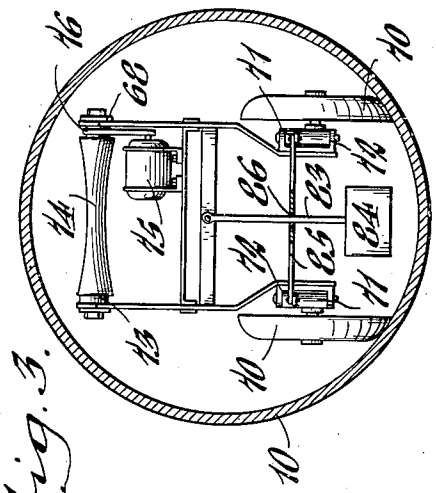


Fig. 3.

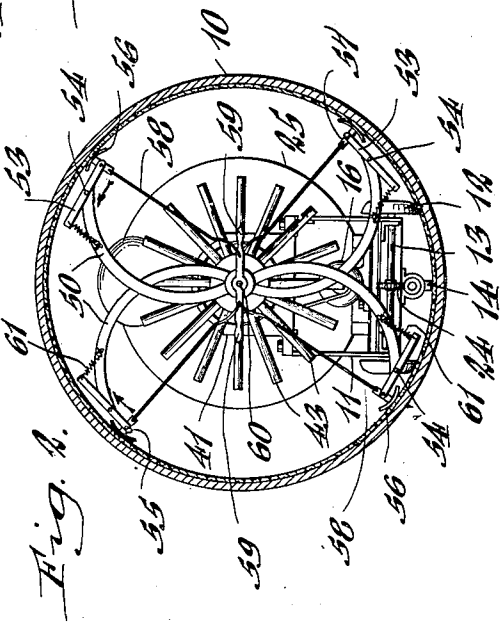


Fig. 2.

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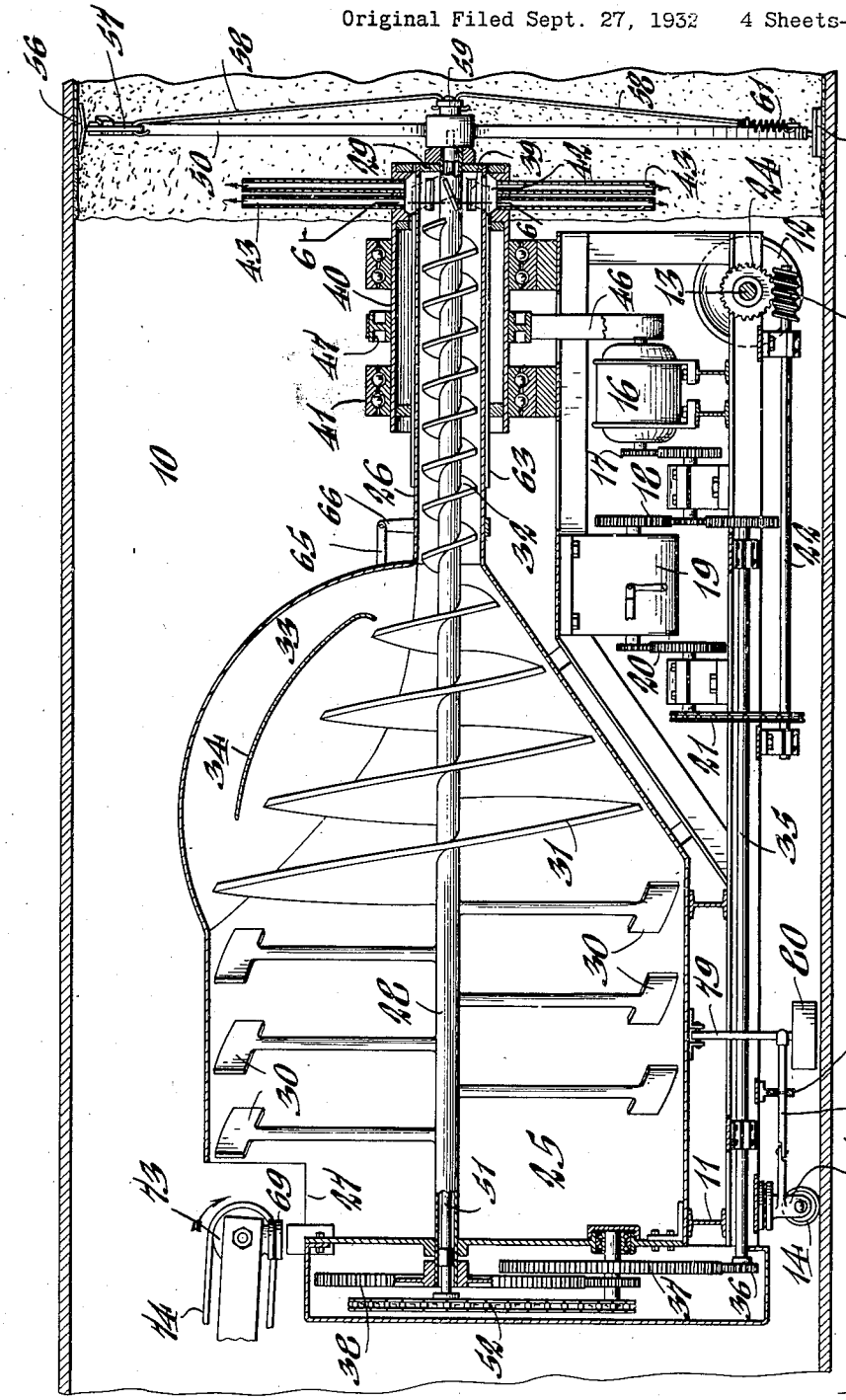


Fig. 4.

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PIPE COATING APPARATUS

Original Filed Sept. 27, 1932 4 Sheets-Sheet 3

Fig. 5.

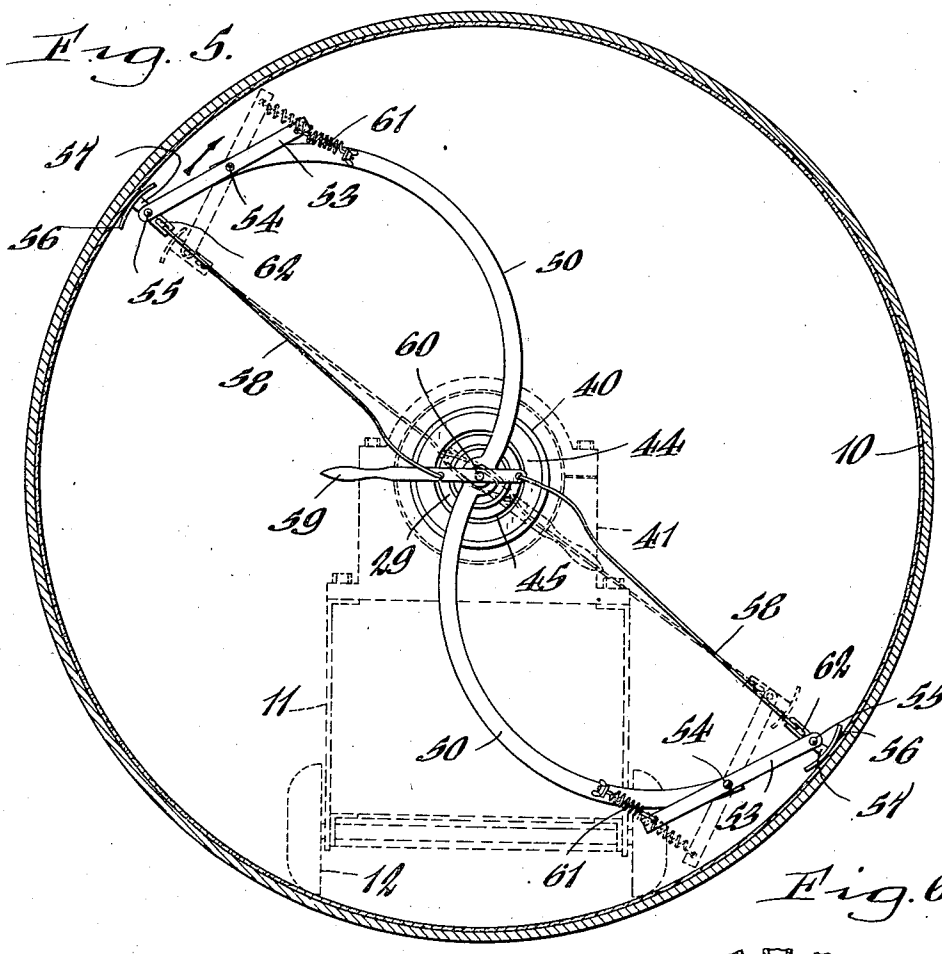
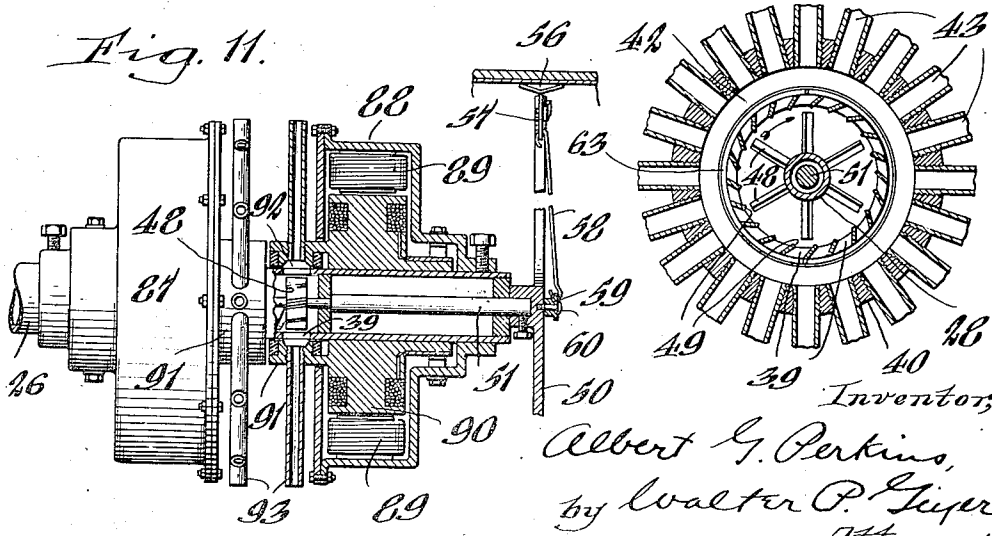


Fig. 6.

Fig. 11.



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PIPE COATING APPARATUS

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Fig. 7.

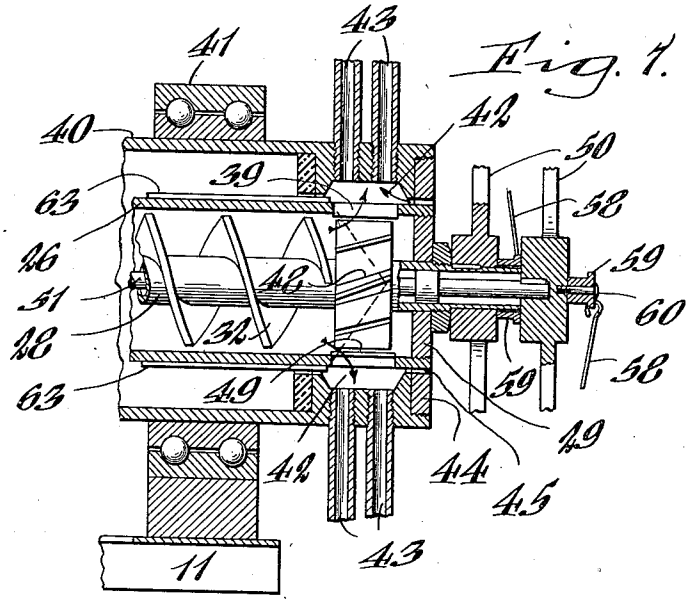


Fig. 8.

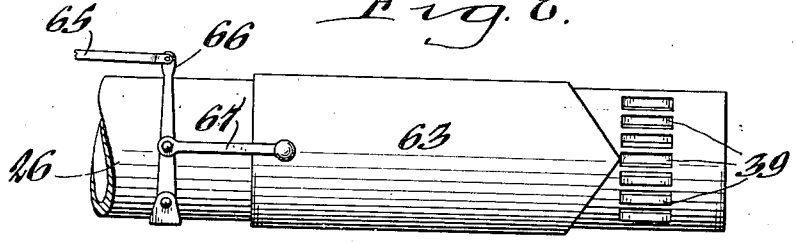


Fig. 9.

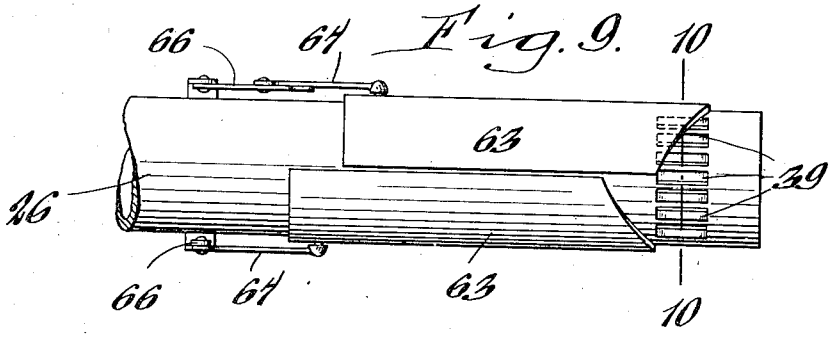
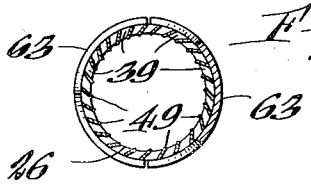


Fig. 10.



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UNITED STATES PATENT OFFICE

2,099,076

PIPE COATING APPARATUS

Albert G. Perkins, Warsaw, N. Y.

Application September 27, 1932, Serial No. 635,038
Renewed February 28, 1936

17 Claims. (Cl. 25—38)

This invention relates to an apparatus which has been designed more particularly for applying a protective coating or lining to the inner walls of pipe lines, such as steel pipe lines, to prevent the formation of barnacles thereon.

One of its objects is the provision of an efficient apparatus of this character which is designed and constructed to travel through the pipe line and as it does so automatically apply onto the pipe-wall an even and durable coating of protective material, such as concrete.

Another object of the invention is to provide simple and effective means for conveying the coating material to its point of discharge, and for thoroughly and effectually agitating and breaking up the material just prior to its discharge, in combination with means for delivering or discharging the material by centrifugal force and impacting it against the pipe wall.

Another object of the invention is the provision of an efficient trowel mechanism for troweling the material as it is applied to the pipe wall.

Another object is to provide a pipe coating apparatus of this character having a feed mechanism associated therewith which is designed to receive the coating material from a point externally of the pipe line and thence deliver it to the conveying mechanism of the apparatus which in turn delivers the material to the point of discharge.

Other features of the invention reside in the construction and arrangement of parts hereinafter described and particularly pointed out in the appended claims.

In the accompanying drawings:—Figure 1 is a side elevation of my improved coating apparatus, the same being shown within a pipe line for treating the interior wall thereof with a protective coating. Figure 2 is a front view of the apparatus arranged within the pipe. Figure 3 is a rear view of the same likewise arranged within the pipe. Figure 4 is an enlarged central longitudinal section of the apparatus showing the same in operation in a pipe line. Figure 5 is an enlarged face view of the troweling mechanism. Figure 6 is an enlarged transverse section taken in the plane of line 6—6, Figure 4. Figure 7 is an enlarged fragmentary vertical section of the dispensing head of the apparatus. Figure 8 is a fragmentary side elevation of the control means of the dispensing head. Figure 9 is a top plan view of the same. Figure 10 is a cross section taken on line 10—10, Figure 9. Figure 11 is a sectional elevation showing a modified arrangement of the dispensing head of the apparatus.

Similar characters of reference indicate corresponding parts throughout the several views.

While my apparatus may be employed for coating different kinds of work, it has been primarily designed for treating the inner walls of steel pipe lines with a protective coating, such for example, as a plastic-like material as concrete. To this end, the apparatus consists generally of a carriage which is adapted to be propelled through the pipe line and which carries the working parts of the apparatus, such working parts comprising essentially a hopper or container for the coating material having a conduit or feed pipe connected therewith, means for conveying the material from the hopper to the conduit, a dispensing or discharge head into which the material is delivered and from which it is discharged by centrifugal force onto the pipe wall, means for troweling the material after it has been applied to the pipe-wall, and means for selectively controlling the discharge of the material from the dispensing head, as when the machine is traversing a curved section in the pipe line. In addition to these features, the apparatus includes a feed mechanism which is operatively associated with the feed hopper and which is propelled through the pipe of the carriage, this feed mechanism being adapted to continuously or intermittently receive coating material from a point externally of the pipe line.

Referring now to the drawings, 10 indicates a section of the steel pipe line through which my apparatus is designed to travel for treating or coating the inner wall thereof with a covering of concrete or like plastic or semi-solid material. The carriage of the apparatus, which carries its working parts, may be of any appropriate construction, that shown in the drawings by way of example, consisting of a structural steel frame 11 provided at one end with traction or supporting wheels 12 mounted on a transverse axle 13 journaled on said frame and provided at its opposite end with a steering wheel or caster 14 mounted on a swiveling fork 15 suitably supported on the frame. Motion is transmitted to the traction wheels from an electric or like motor 16 mounted on the carriage-frame, the drive from the motor consisting, for example, of gear trains 17 and 18, a speed transmission 19, a third gear train 20 and thence by a sprocket drive 21 to a longitudinal shaft 22 having a worm 23 thereon meshing with a worm wheel 24 fixed on the axle 13. The speed transmission 19 is

preferably employed for the purpose of propelling the carriage through the pipe at different speeds and thereby govern the thickness of the coating material applied to the pipe wall. For the purpose of this description, the wheels 12 may be considered as mounted at the rear end of the machine and the steering or caster wheel 14 arranged at the front end of the machine.

Disposed at the front end of the machine is a feed hopper or container 25 for the coating material which is substantially funnel-shaped and terminates at its rear or smaller end in a substantially cylindrical feed conduit or passage 26 which is disposed lengthwise and centrally of the machine and approximately axially of the pipe 10. At its upper front end this hopper has an inlet or opening 27 through which the prepared coating material is delivered to the feed hopper. Extending axially through this hopper and its communicating conduit is a tubular shaft 28 which is journaled at one end in the end wall of the hopper and at its opposite end in a closure plate or plug 29 fitted in the rear end of the conduit 26. Applied to the front end of this shaft and operating in the cylindrical or front portion of the hopper 25 are a series of paddles 30 which act to propel the coating material into the conical portion of the hopper, and disposed within such conical portion and mounted on the said shaft 28 is a conical-shaped screw conveyor 31 which forces the material to the mouth of the conduit 26 and through which it is conveyed by an extension 32 of the screw conveyor 31. To prevent an undue pressure being exerted by the material as it is propelled by the conical conveyor 31, and particularly the creation of a pressure at the mouth of the conduit 26, I preferably provide the hopper with a relief passage or compartment 33 which is disposed at the top side of the hopper and formed between its top wall and a partition wall 34 disposed in arcuate-like fashion in the conical portion of the hopper, as seen in Figure 4. By this construction and arrangement of parts, any surplus of the coating material is allowed to be directed outwardly through the passage 33 and thence return back and empty into the front portion of the hopper. While relieving the pressure of the material at the mouth of the conduit 26, this construction does not interfere with a continuous and proper supply of the coating material being conveyed through the conduit 26.

The tubular shaft 28, upon which the paddles 30 and screw conveyor 31, 32 are mounted, is driven at a comparatively slow speed by the motor 16, as for example, by a driven shaft 35 journaled on the frame 11 and connected at one end to the gear train 18 and having at its opposite end a pinion 36 meshing through interposed reduction gearing 37 with a gear 38 mounted on the front end of said shaft 28.

The means for dispensing or discharging the coating material by centrifugal force and impacting it onto the pipe wall is preferably constructed as follows:

At its rear or discharge end, the feed conduit 26 is provided with an annular row of discharge ports 39 which are disposed in a more or less tangential fashion to permit the ready discharge of the material from the conduit. Surrounding the rear end of the feed conduit and in concentric spaced relation thereto about the discharge ports 39 is a revolving tubular member 40 which may be journaled in suitable bearings 41 applied to the rear portion of the carriage-frame 11. Formed between the ported ends of the conduit 26 and the revolving member 40 is an annular space or chamber 42 into which the material is directed from the discharge ports and from which it is discharged onto the pipe wall. For effecting the discharge of the material from this chamber onto the pipe wall, I preferably employ a plurality of radial discharge nozzles, jets or pipes 43 which are disposed in more or less contiguous relation about the tubular member 40 and revolve therewith at a comparatively high speed, say about 1000 R. P. M., whereby the material is discharged from these jets in comparatively thin sheets, strips or streams with the result that it is impacted against and distributed uniformly and evenly over the pipe wall. A suitable closure ring 44 may be applied to the rear end of the chamber between the feed conduit 26 and the tubular member 40 and air inlets 45 are provided which open into the chamber 42 for the purpose of delivering air thereto, the air being drawn into the same by the centrifugal force created by the revolving jet-carrying member 40 and acting to break up and agitate the coating material and to discharge it from the jets in the form of a stream-like mass. The tubular member 40 which carries the revolving jets 43 may be rotated from the motor 16 through the medium of a belt 46 and pulley 47.

For the purpose of keeping the coating material at its proper consistency before being discharged through the ports 39 into the chamber 42, the material is kept in motion at the discharge end of the feed conduit by a suitable agitator or bladed wheel 48 which may be mounted directly on the feed screw extension 32, tending to direct the material toward said ports.

As shown in Figure 6, the discharge ports 39 in the feed conduit 26 are so disposed that during the rotation of the agitator wheel 48, the coating material is delivered therefrom in a continuous, free-flowing manner, the bladed wheel rotating the coating material, such as concrete, and forcing it through the tangentially-disposed ports 39 into the chamber 42, from whence it is discharged from the jet pipes 43 and impacted against the pipe-wall, the moisture in the concrete being centrifugally forced outwardly and acting to adhere the coating to the wall, after which the moisture works itself to the surface. For the purpose of directing the coating material from the conduit through these ports, the inner ends of such ports have a portion of their walls projecting inwardly beyond the inner periphery of the conduit, as indicated at 49, in Figure 6, to form teats or burrs which cut into and intercept the material as it is agitated by the bladed wheel.

Mounted on the rear end of the machine is a troweling mechanism for the purpose of smoothing out the coating material after it has been applied to the pipe-wall. In its preferred construction this troweling mechanism consists of one or more revolving arms 50, two being shown in the drawings disposed side by side, one being mounted on the rear end of the tubular conveyor shaft 28 and the other one on a drive shaft 51 which extends through the tubular shaft and is suitably supported thereby. Said shaft 51 is driven by a chain and sprocket drive 52, which in the example, shown in Figure 4, is geared to the reduction gearing 37, so as to rotate in a direction opposite to that of the tubular shaft 28. Each of the arms 50 extends substantially diametrically across the pipe 10 and at each end is provided with a trowel-carrying lever 53 which is preferably loosely

fulcrumed thereto intermediate its ends, as seen at 54. Riveted or otherwise fixedly secured at 55 to each lever 53 is a trowel 56 which may be arcuate in cross section, as shown, its convex outer surface bearing against the coating material on the pipe. The attaching shank 57 of each trowel is connected by a link with an actuating or control lever or handle 59 fulcrumed intermediate its ends to swing vertically, the lever companion to the outer arm 50 being pivoted on a stud 60 secured thereto, and the lever companion to the inner arm being fulcrumed on the tubular shaft 28, as seen in Figure 7. As shown in Figure 5, the trowel-carrying levers 53 are disposed in opposing relation circumferentially of the pipe and to this end the lever-carrying arm 50 is substantially S-shaped in plan so that during the rotation of the trowel mechanism both trowels 56 ride over the coating material in a trailing like fashion. Springs 61 between the levers 53 and the adjoining portions of the arm 50 serve to constantly urge the trowels 56 into yielding contact with the pipe-wall. To accommodate the trowel to any unevenness of the pipe-wall and to permit it to at all times follow in contact with the coating material, the shank 57 of each trowel contains a longitudinal slot 62 which permits a certain amount of movement of the trowel and its carrying lever 53 relative to the link 58. By swinging the control levers 59 about their pivots, the trowels 56 may be retracted from the pipe-wall and may be held in such position by any appropriate means, or by shifting each lever to a position past a dead center line between its fulcrum and the points of connection of the respective links 58.

For the purpose of effecting an even distribution of the coating material over the pipe walls at a bend in the pipe line, I provide means for controlling the discharge of the coating material from the ports 39 in such a manner that a less amount of material is discharged on the inside curved portion of the pipe than on the outside curved portion thereof. To accomplish this result, shutters or valve-like elements 63 are applied longitudinally on the outside face of the conduit 26, each of these elements being substantially semi-circular in cross section and being adapted to slide lengthwise of the conduit to cover or uncover the ports 39 bounded thereby. These semi-circular valve sleeves may be pointed at their forward ends, as seen by dotted lines in Figures 4–8, so as to effect a gradual covering or uncovering of the ports and thereby gauge the proper amount of coating material to be discharged from one side or the other of the conduit. These valve sleeves may be actuated, for example, by a control handle 64 connected by a link 65 to a rock lever 66 which is in turn connected by a link 67 with the corresponding valve sleeve. By shifting this lever forwardly or backwardly, the corresponding sleeves are shifted in a like direction to control the amount of material to be discharged through the ports 39.

Operatively connected with the carriage and movable therewith through the pipe line during the coating operation, is a feed mechanism which keeps the feed hopper constantly supplied with the necessary charge of coating material, and which feed mechanism is arranged to receive the coating material from a point externally of the pipe. For this purpose, I provide an auxiliary frame structure 68 which extends forwardly from the carriage-frame 11 and which is connected at one end therewith by a swivel connection 69. At its opposite end this auxiliary frame carries supporting wheels 70 which are mounted on steering knuckles 71 supported on yokes 72 secured to said frame. Mounted at the front and rear ends of this auxiliary frame are drums or pulleys 73 and passing about these is a conveyor belt 74 which may be driven from a suitable motor 75 through the medium of a belt and pulley connection 76. This conveyor belt is adapted to receive, from a point externally of the pipe, a supply of coating material to be delivered to the hopper 25 and in the example shown in the drawings, the material may be fed to the conveyor through a suitable chute 77 whose discharge end extends through an opening 78 in the pipe-line, the latter being provided with a series of such openings throughout its length. By this construction, the hopper 25 is kept supplied with a charge of coating material, the same being discharged from the rear end of the conveyor belt 74 into the opening 27 of the feed hopper.

It is desirable, inasmuch as pipe lines are more or less curved, to provide means for steering the carriage of this apparatus so that it travels axially in the true path of the pipe line, and for this purpose it is likewise desirable that the steering means be automatic in operation. To this end, I provide the steering wheel or caster 14 of the carriage-frame 11 and the supporting wheels 70 of the auxiliary or conveyor frame 68 with automatic means for keeping the machine in its proper position within the pipe, so that in the event the machine would start to climb the pipe-wall, as when encountering a curved section of the pipe, said wheels 14 and 70 would be turned in the proper direction to steer the machine in its proper course. The preferred means for effecting the automatic steering of the machine, in the case of the caster 14, consists of a pendant vertically swinging arm 79 pivoted to the carriage frame rearwardly of the caster and provided at its lower end with a weight 80. Connecting this weighted arm with the swiveling fork of the caster is a horizontally swinging lever 81 fulcrumed intermediate its ends to a bracket 82, so that as the weight is caused to swing in one direction or the other the caster fork is turned in a direction to properly guide the carriage in an axial course through the pipe.

It will be noted that the traction wheels 12, 12 and steering wheel 14 are so disposed as to provide a three-point wheeled contact of the carriage with the pipe, the traction wheels contacting the bottom of the pipe at opposite sides of its center and the steering wheel contacting the bottom of the pipe at its longitudinal center. The dispensing member of the coating apparatus is disposed at that end of the carriage bearing the traction wheels and where there is the least lateral movement of the carriage, whereby the traction wheels constitute a centralizing means for maintaining the dispensing member substantially axially of the pipe at all times and keeping the discharge nozzles 43 at a constant and predetermined distance from the pipe-wall to assure an even distribution of the coating material thereon.

The means for automatically steering the wheel 70 of the conveyor-frame 68 is similar to that just described for the caster wheels 14, such means consisting of a pendant arm 83 suspended from the conveyor frame forwardly of the wheel 70 and provided at its lower end with a weight 84. This weighted arm is operatively connected to the

steering knuckles 71 of the wheels 70, so that any movement of the weighted arm out of its normal vertical position would be transmitted to these knuckles and steer the wheels in the proper direction to guide the conveyor frame properly through the pipe. In the example shown, the steering knuckles of the respective wheels 70 are connected by a tie bar 85 and the pendant arm 83 extends through an opening 86 in such bar, so that any movements of the weighted arm are promptly transmitted to the tie rod to automatically steer the conveyor frame in its proper course.

In Figure 11 I have shown a modified form of dispensing head, the same consisting of a plurality of units mounted to revolve in opposite directions so as to effectually and thoroughly coat the pipe, whether the same be smooth-bored or whether it be provided with longitudinal seams, ribs or like projections. By way of example, I have shown two of such dispensing units, indicated generally by the numerals 87 and 88, mounted side by side at the discharge end of the feed conduit 26, whose construction is identical with that heretofore described. As these dispensing units are identical in construction, a description of one will suffice for both. Each of these units preferably embodies a self-contained driving mechanism which may be in the form of an electric motor including a stator or field 89 rigidly secured to the feed conduit in encircling relation thereto, and a rotor or armature 90 revolvably mounted on the feed conduit and having a sleeve-like extension 91 projecting axially therefrom and in spaced concentric relation about the feed conduit ports 39 to provide a dispensing chamber 92. Projecting radially from the armature sleeve 91 are a plurality of discharge jets or pipes 93 which revolve therewith about the ported end of the feed conduit, so that as these units are revolved in opposite directions the coating material is impacted against the pipe wall and applied thereto in layers, assuring the complete coverage of all portions of the pipe whether it be seamed or not.

I claim as my invention:—

1. An apparatus for lining pipe walls, comprising a structure adapted to travel through the pipe, means applied thereto for receiving a supply of coating material and having a feed conduit disposed substantially axially of the pipe, the discharge end of said conduit having discharge ports therein disposed substantially tangentially thereof and terminating at their inner ends in projections extending into the conduit, a revolving agitator arranged within said conduit adjacent its ports, the projecting ends of the latter cutting into and intercepting the agitated material and means for feeding the material through said conduit toward its discharge ports.

2. An apparatus for lining pipe walls, comprising a structure adapted to travel through the pipe, means applied thereto for receiving a supply of coating material and having a feed conduit disposed substantially axially of the pipe, the discharge end of said conduit having discharge ports therein disposed substantially tangentially thereof and terminating at their inner ends in projections extending into the conduit, means for feeding the material through said conduit toward its discharge ports, a revolving chamber in communicating relation with said ports and having means projecting radially therefrom for conducting the material by centrifugal force onto the pipe-wall, and a revolving agitator arranged within said conduit adjacent its ports.

3. An apparatus for lining pipe walls, comprising a carriage adapted to travel through the pipe, a motive unit applied thereto for propelling the same, a feed conduit for the coating material mounted on said carriage substantially axially of the pipe and provided at its discharge end with ports, a feed screw in said conduit for feeding the material toward its discharge ports and operatively connected to said motive unit to be driven at a comparatively slow speed thereby, and a revolving member applied to said feed conduit and having jet pipes radiating therefrom in communicating relation with said ports for applying the material by centrifugal force to the pipe-wall, said member being operatively connected to said motive unit to be driven thereby at a comparatively high speed.

4. An apparatus of the character described, comprising a substantially horizontal hopper having a conical portion terminating at its discharge end in a conduit, and a conical-shaped feed screw arranged in the conical portion of said hopper and having an extension disposed in said conduit, the conical portion of said hopper adjacent its juncture with said conduit having an enlargement forming a passage for conducting any surplus of material back to the enlarged end of the hopper.

5. An apparatus for lining pipe walls, comprising a carriage adapted to travel through the pipe, a feed conduit applied thereto and adapted for communication at one end with a source of coating material and having discharge ports at its opposite end, a tubular shaft extending through said conduit and having means thereon for propelling the material therethrough toward its discharge ports, a revolving dispensing member including a chamber in communication with said ports and having jet pipes projecting therefrom for delivering the material centrifugally onto the pipe wall, said chamber having an inlet opening into the same, an agitating element arranged in said conduit adjacent its discharge ports, a shaft extending through said tubular shaft, means on said last-named shaft and said tubular shaft for troweling the material after it has been deposited on the pipe-wall, and means for rotating said shafts and said dispensing member.

6. An apparatus for lining pipe-walls, comprising a feed conduit adapted for communication with a source of coating material and having discharge ports therein, means for feeding the coating material through said conduit and its discharge ports, a revolving dispensing member in communication with said ports for delivering the material centrifugally onto the pipe-wall, and means for troweling the material after it has been deposited on the pipe-wall, said troweling means consisting of a rotary arm having a lever pivoted thereto adjacent its outer end, a trowel applied to said lever, and means for yieldingly urging said trowel-carrying lever toward the pipe-wall.

7. An apparatus for lining pipe-walls, comprising a feed conduit adapted for communication with a source of coating material and having discharge ports therein, means for feeding the coating material through said conduit and its discharge ports, a revolving dispensing member in communication with said ports for delivering the material centrifugally onto the pipe-wall, and means for troweling the material after its has been deposited on the pipe-wall, said troweling

means consisting of a rotary arm having a lever pivoted thereto adjacent its outer end, a trowel applied to said lever, means for urging said trowel-carrying lever toward the pipe-wall, and manually-controlled means for shifting said lever in the opposite direction to retract the trowel from the pipe-wall.

8. A troweling mechanism for pipe coating apparatus, comprising a rotatable arm, a lever pivoted adjacent the outer end of said arm to swing in the plane thereof, a trowel applied to said lever, and means for yieldingly urging said trowel-carrying lever in a direction toward the pipe-wall.

9. A troweling mechanism for pipe coating apparatus, comprising a rotatable arm, a lever pivoted adjacent the outer end of said arm to swing in the plane thereof, a trowel applied to said lever, means for yieldingly urging said trowel-carrying lever in a direction toward the pipe-wall, a control handle fulcrumed at the inner end of said arm, and a connection between said handle and said trowel-carrying lever.

10. A troweling mechanism for pipe coating apparatus, comprising a rotatable arm, a lever pivoted adjacent the outer end of said arm to swing in the plane thereof, a trowel applied to said lever, means for yieldingly urging said trowel-carrying lever in a direction toward the pipe-wall, a control handle fulcrumed at the inner end of said arm, and a link between said handle and said trowel-carrying lever, said link having a loose connection with said lever to permit a radial movement of the trowel relative to the link.

11. The combination with an apparatus for lining pipe walls, of a carriage adapted to travel through the pipe, a conduit mounted thereon for communication with a source of coating material and having discharge ports therein, and valve elements applied to said conduit for governing the passage of material therethrough.

12. The combination with an apparatus for lining pipe walls, of a carriage adapted to travel through the pipe, a conduit mounted thereon for communication with a source of coating material and having discharge ports in the sides thereof, and valve-like sleeves applied to diametrically opposite sides of said conduit for movement lengthwise thereof to control the discharge of material at opposite sides of the conduit.

13. An apparatus for lining pipe walls, comprising a feed conduit adapted for communication with a source of coating material and having two annular rows of discharge ports therein, means for feeding the material through said conduit toward its discharge ports, a pair of revolving dispensing members applied to said conduit and each in communicating relation with a corresponding row of discharge ports for projecting the material by centrifugal force onto the pipe-wall, and means for rotating said dispensing members in opposite directions.

14. An apparatus for lining pipe walls, comprising a feed conduit adapted for communication with a source of coating material and having two annular rows of discharge ports therein, means for feeding the material through said conduit toward its discharge ports, a pair of revolving dispensing members applied to said conduit and each in communicating relation with a corresponding row of discharge ports for projecting the material by centrifugal force onto the pipe-wall, each of said dispensing members including a self-contained driving unit consisting of a stator, a rotor having an extension encircling said conduit and forming a chamber therewith in communicating relation with the corresponding discharge ports, and jet pipes radiating from said rotor-extension.

15. A troweling mechanism for pipe coating apparatus, comprising a rotatable arm, a lever pivoted adjacent the outer end of said arm to swing in the plane thereof, a trowel applied to said lever, means for yieldingly urging said trowel-carrying lever in a direction toward the pipe-wall, an actuating element and means connecting said trowel-carrying lever with said actuating element for shifting said lever and its trowel toward and from the pipe-wall.

16. An apparatus for lining pipe walls, comprising a feed conduit adapted for communication with a source of coating material having discharge ports therein, means for feeding the coating material through said conduit and its discharge ports, a revolving dispensing member in communication with said ports for delivering the material centrifugally onto the pipe wall, and valve elements applied to said conduit for governing the passage of material therethrough into the dispensing member.

17. An apparatus of the character described, comprising a feeding means for coating material, a dispensing member disposed for receiving material from said feeding means, and a motor for rotating said dispensing member, said motor having its stator connected to said feeding means and its rotor connected to said dispensing member.

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