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Harris et al.

[11] **3,924,562**

[45] **Dec. 9, 1975**

[54] **APPARATUS FOR COATING PIPE**

[75] Inventors: **Robert J. Harris**, Marrero; **Irvin J. Lee**, Gretna, both of La.

[73] Assignee: **H. C. Price Co.**

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[52] **U.S. Cl.** **118/320**; 118/DIG. 11

[51] **Int. Cl.²** **B05B 13/04**

[58] **Field of Search** .... 118/308, 313, 320, DIG. 11, 118/DIG. 16; 117/94, 105.4

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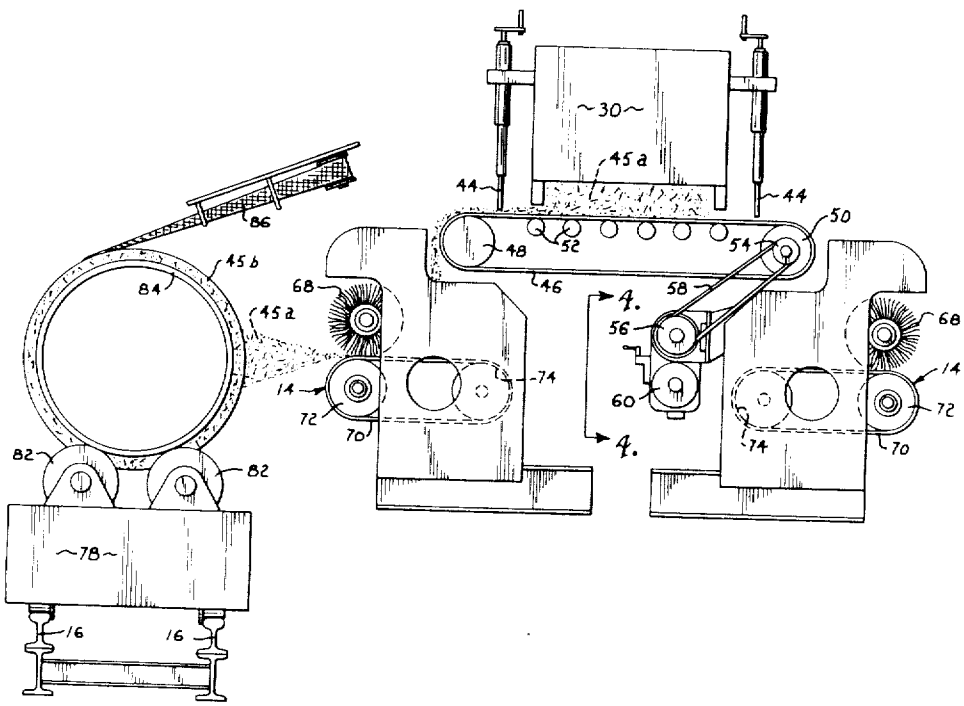
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Primary Examiner—Mervin Stein
Assistant Examiner—Steven Hawkins
Attorney, Agent, or Firm—Lowe, Kokjer, Kircher, Wharton & Bowman

[57] **ABSTRACT**

Method and apparatus for coating pipe utilizes a central coating station to coat pipe joints moving on two parallel spaced apart coating lines. Two coating applicators disposed in opposed relationship adjacent the respective coating lines both receive coating material from a single central coating preparation station by a reciprocal conveyor. Coating material is alternately supplied to the opposite applicator as different pipe sections are moved at intervals to first one applicator and then the next. The conveyor is moved by a reversible prime mover. A brake is automatically activated to slow the conveyor whenever a reversing switch is thrown. This assures that the coating operation at the opposite applicator will begin in a minimal amount of time. A holding hopper is also provided for receiving prepared coating prior to deposit on the reciprocal conveyor. The holding hopper has a capacity adequate to allow it to continue receiving coating material for a period of time during reversal of the conveyor thus eliminating the need to stop the coating preparation apparatus.

11 Claims, 5 Drawing Figures



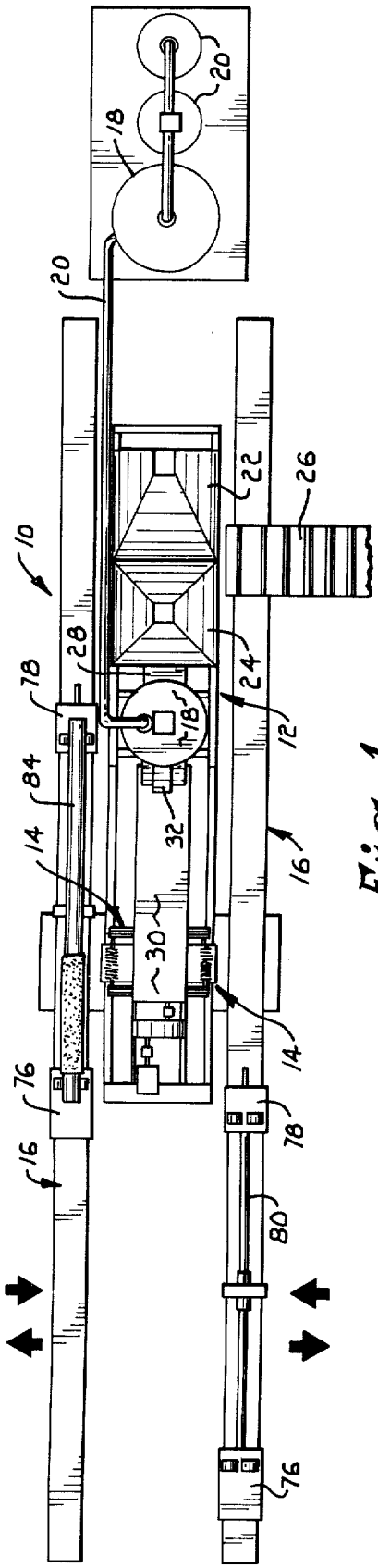


Fig. 1.

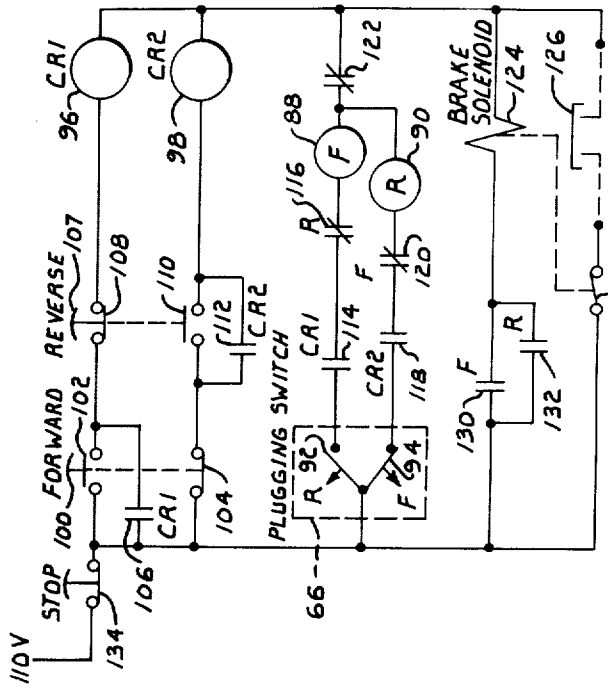


Fig. 5.

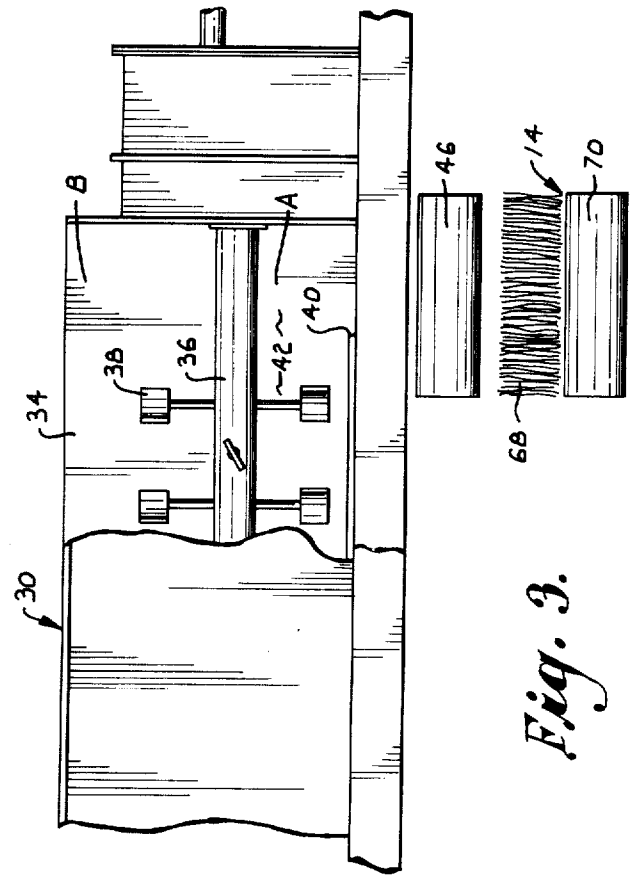


Fig. 3.

Fig. 2.

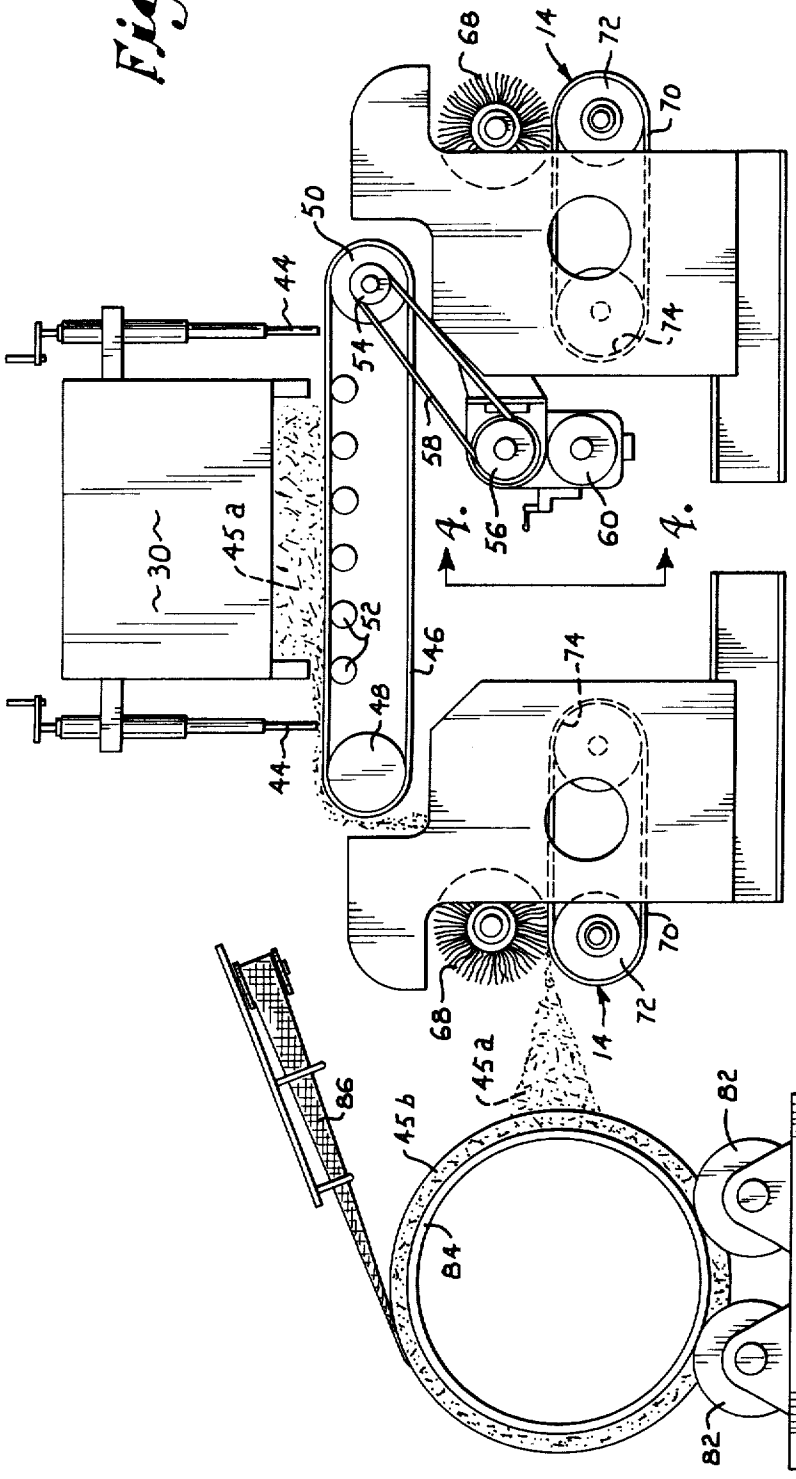
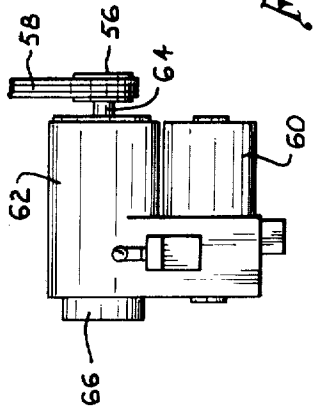

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Fig. 4.


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66

APPARATUS FOR COATING PIPE

This invention relates generally to a method and apparatus for coating pipe and, more particularly, to a method and apparatus for coating two sections of pipe in closely spaced time intervals utilizing a single coating preparation station.

Whenever pipe is to be placed in the ground, and for some above ground installations, a protective coating is always applied to the pipe. In marsh country or for marine applications, it is usually necessary to also apply a concrete aggregate material to the pipe for weight purposes.

An improved method and apparatus for applying coating material to pipe is disclosed in our earlier U.S. Pat. Nos. 3,674,546 issued July 4, 1972 and 3,777,705, issued Dec. 11, 1973. The present invention relates to improvements in the method and apparatus disclosed in the foregoing issued patents.

It is an object of the present invention to provide a method and apparatus for coating pipe sections wherein two sections of pipe are coated in close time intervals at two spaced apart coating applicators which receive coating material from a common coating preparation station and wherein the time required to change the flow of material from one coating applicator to the other is minimized by having the applicators positioned in closely spaced relationship.

As a corollary to the above object, an aim of the invention is to provide a method and apparatus for coating pipe wherein the time required for transfer of coating material from one applicator to the other is minimized by placing the two applicators in closely spaced relationship and utilizing a single relatively short reciprocal conveyor for transferring coating material between the two applicators.

Still another corollary to the object second above is to provide a method and apparatus for coating pipe utilizing two coating applicators wherein the time required to change the direction of flow of coating material from one applicator to the other is minimized by utilizing a braking mechanism to automatically slow the conveyor whenever it is desired to change the direction of movement of the conveyor.

It is also an objective of this invention to provide a method and apparatus for coating pipe utilizing a single coating preparation station to supply two applicators and wherein it is possible to continuously supply coating material from the preparation station, without interruption, as a result of a holding hopper having a capacity to receive coating material for a period of time even if neither of the coating applicators are in operation.

Still another object of the invention is to provide a method and apparatus for coating pipe wherein two coating applicators are fed from a single coating preparation station with versatility to allow continued uninterrupted operation of the coating operation even when two pipe sections are not moving in the optimum 180 degrees out-of-phase orientation.

It is also an aim of the present invention to provide a method and apparatus for coating pipe utilizing a single coating preparation station to supply two coating applicators wherein the coating from the preparation station is moved along a single unitary linear path of travel to each applicator thereby minimizing waste and dry out of the coating.

Other objects of the invention will be made clear or become apparent from the following description and claims when read in light of the accompanying drawing wherein:

FIG. 1 is a partially schematic top plan view showing a typical plant lay out incorporating the apparatus and utilizing the method of the present invention;

FIG. 2 is a front elevational view, on an enlarged scale, of the apparatus of the present invention showing the relationship between the two coating applicators and the coating preparation station;

FIG. 3 is an enlarged side elevational view, with portions broken away, of the apparatus shown in FIG. 2;

FIG. 4 is an elevational view of the drive for the reversible conveyor looking in the direction of line 4—4 in FIG. 2; and

FIG. 5 is an across the line electrical diagram showing the controls for the reversible drive motor.

Referring initially to FIG. 1 of the drawings, a pipe coating plant constructed according to the present invention is designated generally by the numeral **10** and includes a coating material preparation station designated generally by the numeral **12**, two coating applicators **14** and spaced apart longitudinally extending tracks **16** disposed in parallel relationship on opposite sides of preparation station **12.**

The coating preparation station **12** includes cement storage tanks **18** and **20** which are coupled with a cement surge tank **18** by a conduit **20.** First and seocnd hoppers **22** and **24** are disposed in side-by-side relationship and hold a quantity of iron ore aggregate and/or sand (not shown) which is utilized in the coating material. A first conveyor **26** moves ore into the hoppers and a second conveyor **28** moves the ore from hoppers **22** and **24** to a pug mill designated generally by the numeral **30.** A third conveyor **32** transfers cement from surge tank **18** to the pug mill.

Referring additionally to FIGS. **2** and **3**, pug mill **30** includes an elongated, flat, open top mixing chamber **34** provided with shafts **36** (one of which is visible in FIG. 3) having paddles **38** extending radially therefrom for mixing the components of the coating material. Paddles **38** are also disposed to have an auger effect thereby advancing the coating material to one end of the chamber. One end of chamber **34** is free of paddles **38** and also has an opening **40** in the bottom of the chamber, thus presenting a hopper area **42** for holding a quantity of the prepared coating material prior to delivery to applicators **14.**

Referring additionally to FIG. **2**, it is seen that disposed on opposite sides of chamber **34** in closely spaced relationship to the hopper area **42** are control gates **44** which may be manually adjusted for metering the flow of coating material as will be explained in greater detail hereinafter.

Coating material (designated by the numeral **45***a*) is transferred from hopper area **42** to each of the aapplicators **14** by a reversible conveyor belt **46** mounted on rollers **48** and **50.** A plurality of idler rollers **52** are disposed in spaced apart relationship beneath the upper stretch of belt **46** for supporting the belt when loaded with coating material. Roller **50** is coupled with a driven pulley **54** which in turn is coupled with a drive pulley **56** by drive belts **58.** Drive pulley **56,** in turn, is driven by an electric motor **60** through a reduction gear box **62** and a drive shaft **64.** A directional plugging switch **66** is also coupled with shaft **64** for purposes to be explained more fully hereinafter.

Each of the applicators **14** is identical and only one of the same will be described in detail. Applicator **14** is of the impinger type and comprises a rotatable brush **68** disposed in contact with an applicator belt **70** mounted on closely spaced rollers **72** and **74.** Both brush **68** and belt **14** are driven at a high rate of speed to throw coating material **45***a* outwardly with substantial force in the manner illustrated in FIG. **2.**

Referring again to FIG. **1,** each set of tracks **16** mounts two spaced apart vehicles in the form of buggies **76** and **78** joined together by a rigid coupling shaft **80.** Each of the buggies **76** and **78** is provided with a pair of spaced apart roller wheels **82** (FIG. **2**) which form a carriage for a section of pipe **84.** At least one set of wheels **82** in each pair of buggies is driven for rotating the pipe about its longitudinal axis as coating material is applied. Normally, a reinforcing wire mesh **86** is also wrapped around the pipe during the coating operation to form an integral part of the completed pipe coating **45***b*. The arrows in FIG. **1** indicate the loading and unloading areas for incoming and outgoing pipe adjacent the respective tracks **16.**

In operation, the constituents for the coating material are fed into pug mill **30** where they are homogeneously mixed and a limited amount of watter is added through conventional apparatus which has been omitted from the drawings for clarity. In the method and apparatus described in our original patents, it was thought to be preferred to utilize a total of three conveyor belts to transfer coating material **45***a* from pug mill **30** to applicators **14.** While it is possible to utilize the three belt arrangement shown in the earlier patents, it has been found that substantial advantages result when a single belt rather than a three belt system is utilized.

Thus, coating material **45***a* passes through hopper area **42** on to the reciprocal conveyor belt **46** where it is delivered directly to applicators **14.** In FIG. **2,** coating material **45***a* is illustrated being directed to applicator **14** which is on the left hand side of the drawing. The coating material passes beneath gate **44,** the height of which may be varied to control the flow of coating material. It will be appreciated that coating material **45***a*, once deposited on belt **46,** travels along a linear path parallel to the belt until such time as it drops from the belt on to applicator belt **70.** Not only is the path of travel of the coating material shortened but, by eliminating the multiple steps down through which the coating travels on its way to applicators **14,** dry out and waste of the coating material is minimized.

As the coating material drops on to applicator belt **74,** it is picked up by brush **68** and thrown at a high rate of speed on to the pipe section **84.** Section **84** is being rotated in a counterclockwise direction, when viewing FIG. **2,** so as to expose the entire area of the annular pipe to the coating material while also wrapping reinforcing mesh **86** around the pipe. The pipe **84** is advanced longitudinally as it is rotated to cover the entire length of the pipe with coating material **45***a*.

When pipe section **84** is covered with a completed coating **45***b*, applicator **14** on the left side in FIG. **2** is stopped and reciprocal conveyor **46** which is moving in a counterclockwise direction is also stopped. As the stop switch for the conveyor belt **46** is throw, a brake is actuated to slow drive pulley **56** and hence belt **46,** in the shortest possible time period. As the speed of rotation of the shaft mounting pulley **56** slows down, plugging switch **66** is closed to release the brake and energize the reversing starter relay. Thus, the direction of rotation of belt **46** in the opposite direction is commenced.

While it is possible to complete the change over in the directional flow of coating material **45***a* from one applicator to the other in a time period of only slightly more than one second, in some cases if problems are encountered in loading a section of pipe **84,** the pipe will not be at the opposite applicator **14** in this minimal time period.

While it would be possible to stop the flow of coating material **45***a* from pug mill **30** to await the arrival of the next pipe section **84,** this is obviously undesirable. Accordingly, hopper area **42** has been provided at the end of chamber **34** so as to accommodate a substantial build up of coating material. Thus, although the normal depth of material **45***a* in chamber **34** will be approximately at the level "A" indicated in FIG. **3,** coating material may build to the height indicated by level "B" without the need to shut down the pug mill. If the normal operating capacity of applicator **14** is X tons per second, it is desirable for h opper area **42** to have a capacity of at least 10 X although preferably not over 25 X. This permits up to a 25 second delay before operation of the second applicator **14** is commenced.

By utilizing the single short reciprocal conveyor belt **46,** as opposed to a multiple belt system, the presence of "dead" material on the conveyor belt during change over from one applicator to the other is completely eliminated. This assures that fresh coating material is always supplied to applicators **14** for placement on the pipe sections. Thus, the quality of the coating material is enhanced while the equipment necessary to convey the coating is substantially reduced.

The circuitry for carrying out the operation of motor **60** is shown in detail in FIG. **5** and will now be described. Motor **60** is preferably a variable speed, reversing motor controlled by a forward starter relay **88** and a reversing starter relay **90.** Plugging switch **66** is a centrifugally operated control switch having two sets of controls **92** and **94.** Both sets of controls open and close in response to centrifugal forces. When the shaft **64** is rotating in a forward direction, at or above a predetermined speed, R contacts **92** are closed and F contacts **94** are open. When the shaft is rotating in reverse F contacts **94** are closed and R contacts **92** are open so long as the speed of rotation remains above a predetermined level. Starter relays **88** and **90** are connected in parallel with each other and relay **88** is connected in series with the R contacts **92** of plugging switch **66.** Similarly, relay **90** is connected in series with the F contacts **94** of the plugging switch.

Connected in parallel with both of relays **88** and **90** as well as plugging switch **66** is forward control relay **96** and reversing control relay **98.** The two relays **96** and **98** are connected in parallel with one another. A spring biased double pole, double throw forward control switch **100** has a first set of normally open contacts **102** and a second set of normally closed contacts **104.** The two sets of contacts **102** and **104** are disposed in parallel with one another and also in parallel with a first set of normally open forward control relay contacts **106.**

A reversing control switch **107** is also of the double pole, double throw type having a first set of contacts **108** connected in series with contacts **102** and a second set of contacts **110** connected in series with contacts **104.** The contacts **108** are normally closed and the contacts **110** are normally open with each being connected in parallel with the other and in parallel with a

first set of normally open reverse control relay contacts **112.**

A second set of normally open forward control relay contacts are designated by the numeral **114** and are connected in series with forward starter relay **88.** Also connected in series in the same circuit is a set of normally closed reversing starter relay contacts **116.** Similarly, a second set of normally open reverse starter relay contacts **118** is connected in series with reversing starter relay **90** and normally closed forward starter relay contacts **120** are connected in series in the same circuit. A normally closed, manually operable override switch **122** is connected in series with plugging switch **66.**

Connected in parallel with plugging switch **66** and forward and reversing starter relays **88** and **90** is brake solenoid **124.** The brake solenoid controls a normally energized brake **126** through a braking switch **128.** Manifestly, brake **126** and switch **128** are connected in parallel with the brake solenoid. Disposed in series with solenoid **124** are second sets of forward and reversing starter relay contacts **130** and **132,** respectively. Each set of contacts **130** and **132** is normally open and the two sets are connected in parallel with each other. Finally, a master control switch **134** is connected in series with the power supply for the above described circuitry.

The circuitry is shown as it would appear when motor **60** is operating in its reverse direction. Swtiches **100** and **107** are spring biased into the positions illustrated. Contacts **104** are closed as are contacts **112,** the latter having been closed when reversing control switch **107** was closed to energize control relay **98.** F contacts **94** of plugging switch **66** are also closed by virtue of the fact that the shaft to which this switch is coupled is traveling in the reverse direction. Manifestly, contacts **118** and **120** are also closed and reversing relay **90** is energized. Contacts **132** are closed and brake solenoid **124** is energized so as to hold brake **126** in a releasing position.

When it is desired to reverse the direction of belt **46,** forward control switch **100** is pushed. This closes contacts **102** while opening contacts **104.** Thus, control relay **98** is de-energized while control relay **96** is energized. Contacts **106** will close to maintain the closed circuit after switch **100** is released. De-energizing of control relay **98** opens contacts **118** thereby de-energizing relay **90** and opening contacts **132** to de-energize solenoid **124.** This immediately applies brake **126** to commence slowing of the drive pulley **56.**

As the drive shaft for pulley **56** slows to a predetermined speed, R contacts **92** will close thereby energizing relay **88** by virtue of the fact that contacts **114** have already been closed upon energizing of relay **96.** This closes contacts **130** to energize solenoid **124** and release the brake while simultaneously starting the motor **60** in the opposite direction.

A particular advantage of the improved method and apparatus of the present invention is the versatility with which it may be employed for coating pipe. The system is designed for optimum efficiency in operation when two pipe sections are moving along parallel tracks **16** approximately 180° out of phase with each other. This allows time for one pipe section to be coated and moved back to the unloading area while a second pipe section is moved into position to begin the coating operation. To this end, the circuitry above described provides for a change over in the direction of flow of coating material from one applicator to the other of approximately 1 second. On the other hand, if minor problems are encountered in the loading, unloading or coating steps, our improved method allows for a time lapse of approximately half of a minute without requiring shut down of the coating preparation station. This is of considerable advantage in minimizing the disturbances resulting from the minor difficulties which inevitably are encountered, however infrequently, in any coating operation.

Having thus described the invention, we claim:

1. Pipe coating apparatus comprising:

means for moving first and second pipe sections along spaced apart fore and aft extending paths of travel;

first and second coating applicators disposed adjacent to the respective paths of travel;

a coating preparation station disposed intermediate said paths of travel;

reciprocal conveyor means disposed for receiving coating material from said station and transferring the material to each of said applicators;

power means coupled with said conveyor means for moving the latter in opposite directions; and

brake means coupled with said power means and operable to slow said power means when moving said conveyor means in one direction prior to movement of said conveyor means in the opposite direction.

2. The invention of claim **1,** wherein said reciprocal conveyor means defines a unitary linear path of travel for the coating material after the latter is received from said station and until the material is discharged from the conveyor for deposit at said applicators.

3. The invention of claim **2,** said power means comprising a reversible electric motor and including electrical control means for said brake means, circuit means coupling said control means with said motor, and switching means in the circuit means for reversing said motor, said brake means being activated to slow said motor whenever said switch means is thrown.

4. The invention of claim **3,** wherein said switching means comprises a directional plugging switch having two sets of centrifugally activated parallel contacts operable at a predetermined speed of rotation to release said brake means and reverse said motor.

5. The invention of claim **4,** wherein said switching means comprises forward and reversing control relays, and circuit means coupling each of said control relays with one set of contacts of said plugging switch whereby when power to one of said control relays is interrupted power to a corresponding set of plugging switch contacts is interrupted.

6. The invention of claim **5,** wherein is included a brake solenoid for controlling said brake means, forward and reversing starter relays for said motor, said forward and reversing starter relays connected in series with said forward and reversing control relays, respectively, and circuit means connecting said brake solenoid with said forward and reversing starter relays whereby said brake solenoid releases said brake means whenever one of said starter relays is energized.

7. The invention of claim **3** wherein said switching means comprises:

first and second double pole double throw switches, each of said switches having normally closed and normally open contacts with the closed contacts of one switch connected in series with the open contacts

of the other switch for simultaneously opening one circuit as the other circuit is closed;

forward and reversing control relays one of which is connected in series with one set of contacts of each of the first and second switches,

said plugging switch connected in parallel with each of said first and second switches;

forward and reversing control relay contacts corresponding to said forward and reversing control relays,

each of said relay contacts being normally open, closed by energizing the corresponding relay, and connected in parallel with the other relay contacts and in series with one set of contacts of the plugging switch;

forward and reversing starter relays for said motor, said forward and reversing starter relays connected in series with said forward and reversing control relay contacts, respectively;

forward and reversing starter relay contacts corresponding to said forward and reversing starter relays, respectively,

each of said starter relay contacts being normally closed, opened by energizing the corresponding starter relay and connected in series with the opposite starter relay to open a relay circuit when the opposite relay is energized;

a brake solenoid for controlling said brake means; and

circuit means connecting said brake solenoid with said forward and reversing starter relays for releasing said brake means whenever either of said starter relays is energized.

8. The invention of claim **1,** wherein each of said applicators has a capacity for delivery of a quantity of X tons per second of coating material and wherein said coating preparation means comprises hopper means for holding a quantity of said coating material in position for delivery to said conveyor means, said hopper means having a capacity for coating material of up to **25** X whereby said conveyor means may remain stationary for up to 25 seconds while coating material continues to be delivered to said conveyor means.

9. The invention of claim **8,** wherein said coating preparation means comprises a pug mill for mixing components of said coating material and said hopper means comprises an open end of said pug mill having an open bottom positioned above said conveyor means.

10. The invention of claim **9,** wherein is included means for rotating said pipe sections during application of said coating.

11. The invention of claim **10,** wherein is provided first and second spaced apart vehicles for moving each of said sections along said spaced apart fore and aft extending paths of travel and for rotating each section during application of the coating.

* * * * *