June 13, 1961 W. E. PERKINS ET AL 2,988,042

PIPE LINING APPARATUS

Filed May 7, 1959 2 Sheets-Sheet 1

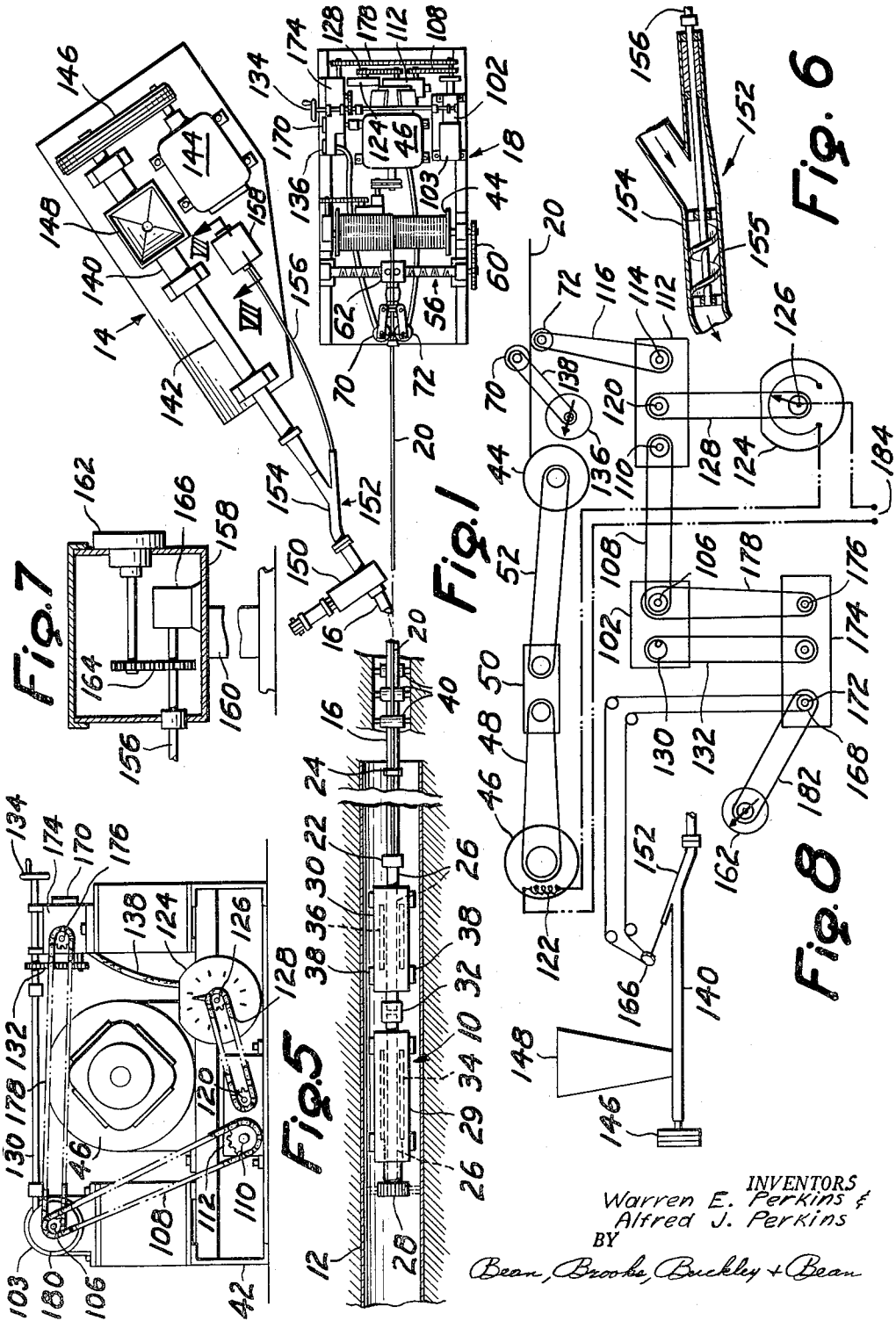


Fig. 1

Fig. 7

Fig. 5

Fig. 6

Fig. 8

INVENTORS
Warren E. Perkins &
Alfred J. Perkins
BY
Bean, Brooks, Buckley & Bean

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PIPE LINING APPARATUS

Filed May 7, 1959 2 Sheets-Sheet 2

Fig. 2

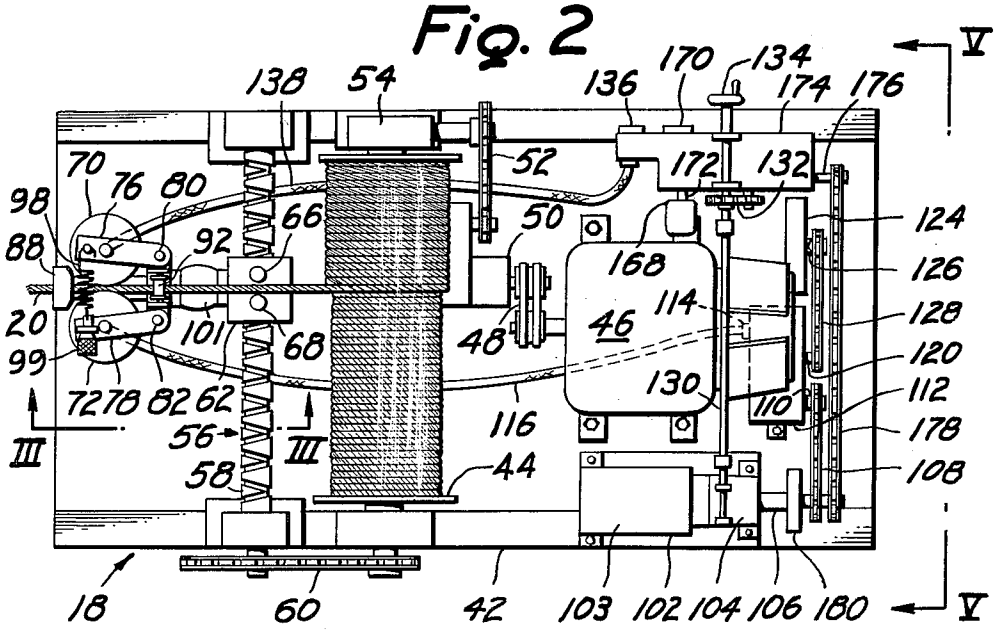
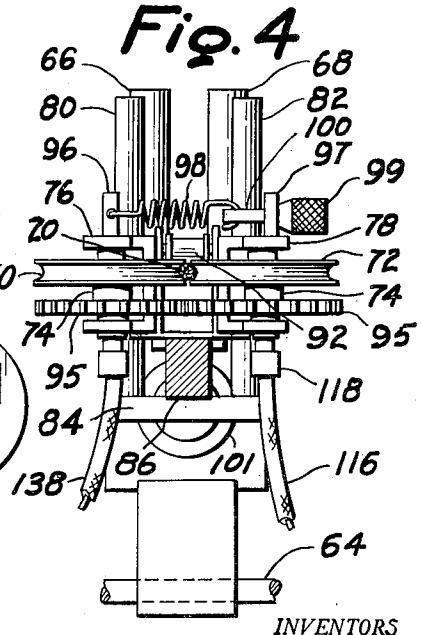


Fig. 4



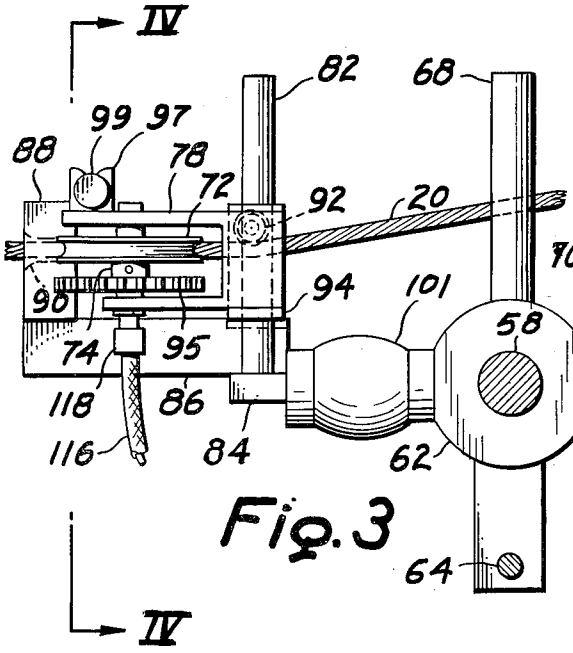


Fig. 3

INVENTORS
Warren E. Perkins &
Alfred J. Perkins
BY
Bean, Brooks, Buckley & Bean

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PIPE LINING APPARATUS

Warren E. Perkins, Grand Island, N.Y., and Alfred J. Perkins, Medulla, Fla., assignors to Perkins Pipe Linings, Inc., Grand Island, N.Y.

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13 Claims. (Cl. 118—7)

This invention relates to pipe lining apparatus and more particularly to improved lining applicator machine travel propulsion means therein.

The invention applies to the class of pipe lining apparatus wherein an applicator machine travels through a pipe line while applying a lining thereto by a spraying-like action. Typically, the lining material applied is cement mortar and the applicator means comprises a rotary distributor head which throws or flings the mortar to the interior surface of the pipe by centrifugal force. In the use of machines of this kind, the thickness of the resulting lining is a function of the rate of delivery of lining material to the distributor head and of the speed of travel of the machine through the pipe.

Particularly where the pipe to be lined is of small diameter, the lining material often is supplied to the traveling applicator machine through a hose line extending from that machine in advance thereof to a pump or other pressure source of the material located at a remote entrance to the pipe, toward which the machine travels as it applies the lining.

Typically, the hose is propelled through the pipe by means of a cable detachably secured thereto, which cable is drawn by a winch located at the pump end of the hose line. The speed of cable draw must match the speed of machine travel, and may determine that travel speed as in systems of the kind wherein the applicator machine is connected to the cable so that the cable propels not only the hose line but also the machine itself. In such cases, incorrect speed of draw on the cable will result in a lining thickness which deviates from that which is desired.

In accordance with the present invention, a pipe lining apparatus is provided wherein the winch device provides a steady speed of cable draw despite the fact that as the cable builds up on the winch drum the effective diameter of that drum increases. This increase is compensated for by a control system which measures the actual speed of cable draw, compares that speed to a standard, and adjusts the speed of the winch motor to maintain the desired relation between the draw speed and the standard.

A preferred kind of pipe lining applicator machine for use in the lining of small diameter pipe, is the type in which the lining material is conducted by a continuous conduit through the machine from the supply hose to the distributor head, whereby the rate of application of lining material to the pipe being lined is determined by the rate at which the material is supplied through the hose.

As the machine travels toward the pump, the excess hose may accumulate in the pump area, or, preferably, sections of the hose adjacent to the pump may be cut out of the hose line, as by employment of the apparatus shown in U.S. Patent No. 2,786,486. In either case, the flow resistance of the hose line is altered, tending to upset the balance between the flow rate through the hose and the travel speed of the machine desired for application of a lining of uniform thickness. Given a pump and hose line of a particular pressure capacity, it is usually preferable to restore the flow rate-machine travel speed balance by adjusting the speed of travel of the machine to match the changed flow rate through the hose line, thereby maximizing the average rate at which the lining is applied.

Accordingly, in the preferred embodiment of the apparatus of the present invention, means are provided which sense the flow rate of lining material to the applicator machine distributor head, which means are then given supervision over aforementioned standard, whereby the winch motor speed is adjusted not only to keep the draw cable speed at an even rate, but further to vary that draw rate in accordance with the rate at which lining material is delivered to the distributor head.

Accordingly, a major object of the present invention is to provide an improved pipe lining apparatus of the kind having a traveling lining material applicator machine.

Another object of the invention is to provide a pipe lining apparatus as aforesaid having a draw cable associated with the travel motion of the machine and improved means for controlling the speed of draw of the cable.

Another object of the invention is to provide apparatus as aforesaid having a winch for drawing the cable and improved means controlling the winch for fixing the cable draw speed.

Still another object of the invention is to provide apparatus as aforesaid having means sensitive to the rate of application of lining material by the applicator machine and arranged to supervise the speed of draw of said cable.

Another object of the invention is to provide an improved pipe lining apparatus adapted to apply a lining of uniform thickness.

Yet another object of the invention is to provide a pipe lining apparatus having improved control means whereby the speed of travel of the lining applicator part is adjusted automatically in accordance with the rate of application of lining material thereby.

Still another object of the invention is to provide an improved pipe lining apparatus as aforesaid capable of efficient operation in the lining of small diameter pipe in place in the ground, for example pipe of eight inch diameter and less.

Yet another object of the invention is to provide an improved pipe lining apparatus having the foregoing attributes while being rugged and reliable in use under field conditions.

Other objects of the invention will be apparent from the foregoing, from the following detailed description, from the claims, and from the drawings wherein:

FIG. 1 is a partly diagrammatic plan view of a pipe lining apparatus embodying the invention, in use;

FIG. 2 is an enlarged plan view of the winch portion of the apparatus of FIG. 1;

FIG. 3 is a further enlarged fragmentary sectional view taken about along line III—III of FIG. 2;

FIG. 4 is a fragmentary sectional view taken about along line IV—IV of FIG. 3;

FIG. 5 is an end elevational view of the winch apparatus of FIG. 2, taken about along line V—V of that figure;

FIG. 6 is an enlarged horizontal, fragmentary sectional view of the flow metering structure in the outlet portion of the pump apparatus of FIG. 1;

FIG. 7 is an enlarged fragmentary sectional view taken about along line VII—VII of FIG. 1; and

FIG. 8 is a schematic diagram showing control interrelationships of elements of the apparatus illustrated in FIG. 1.

Referring more particularly to FIG. 1, the preferred embodiment of the apparatus of the invention illustrated therein includes a pipe lining applicator machine **10** of the centrifugal distributor or "flinger" kind adapted to travel through a pipe line **12** in place in the ground while distributing lining material to the inner wall sur-

face thereof, a pressure source of the lining material, such as the pump apparatus **14**, a hose line **16** connecting the pump **14** to the applicator machine **10** for supplying the lining material thereto, and a winch device **18** having a draw cable **20** connected to the machine **10**, as at a coupling **22** thereon, and also connected detachably to the hose line at intervals therealong, as at the hose coupling indicated at **24**, for propelling the machine **10** through the pipe **12** and for advancing the supply hose **16**, ahead of the machine.

As indicated by the dotted showing of its lining material feed conduit part **26**, the applicator machine **10** is of the kind having a continuous feed conduit extending therethrough for conducting lining material from the hose **16** to the rotary distributor head **28** of the machine. Thus the rate at which the lining material is delivered to the machine by the hose **16** is determinative of the rate at which it is applied to the pipe **12** wall by the head **28**. Also, for simplicity of illustration, the machine is shown to be of the segmented type, that is one which has separate applicator and motion control sections **29**, **30**, joined by a flexible coupling **32** in the feed conduit **26**, the applicator section housing a hollow centered motor **34** passing the feed conduit and arranged for powering the distributor head rotor, and the motion control section housing a similarly hollow centered flywheel **36** coupled by suitable reversible transmission (not shown) to traction wheels **38**, **38** on the control section for storing energy in the fly wheel when the machine travel speed tends to increase and for paying out energy from the fly wheel to the traction wheels **38** when the machine travel tends to slow. It should be understood that the motion control section **30** in this kind of machine does not determine the long period average speed of travel of the machine; it merely smooths out the travel motion and prevents short period oscillations therein such as would ordinarily, in the absence of some sort of motion smoothing means, occur due to the length of draw cable **20** employed (typically up to 1000 feet) and the weight of the similarly long hose line **16** attached thereto.

Conveniently, the pump **14** and winch **18** devices may be located above ground adjacent an excavation or other suitable entrance to the pipe line **12**, and roller or sheave means, indicated at **40**, may be provided for guiding the cable **20** and the hose **16** as they emerge from the pipe to the ground surface, the cable being detached manually or otherwise from the coupling **24** on the hose as such couplings pass this point.

It will be seen from the foregoing that in an apparatus of the kind described, the speed of travel of the applicator machine **10** is controlled by the speed of draw of the cable **20**. In accordance with the present invention, means are provided for controlling accurately this speed of cable draw, despite the fact that as the cable builds up on the drum of the winch, the effective diameter of that drum increases. In the preferred illustrated embodiment of the invention, these means include level winding means for insuring that the cable winds onto the winch drum in an orderly manner, measuring means for gauging the actual speed of cable draw, a standard, and means for comparing the output of the measuring means with the standard and operative to adjust the speed of operation of the winch drum for maintaining a predetermined relationship between the measuring means output and the standard. These means are incorporated in the winch device **18**, which will now be described in greater detail.

Referring now to FIG. 2 the winch device **18** may be provided for convenient portability with a skid or base portion **42** upon which is mounted the cable winding drum **44** of the winch, and an electric motor **46** which operates the same, as through a belt drive **48** from the motor to a speed reducer **50** and a chain drive **52** from the latter to a conventional worm drive **54** on the winch drum **44**.

Although the winch device is provided with automatic means compensating for variations in effective diameter of the drum **44** as the cable **20** winds thereon, it is as aforesaid preferred that means be provided whereby the cable is wound in an orderly manner, since this obviates practical need for rapid reaction time in the control and therefore minimizes and effectively eliminates "hunting" problems therein. Accordingly, the winch is provided with a level winder mechanism **56** having an operator shaft **58** journaled on the skid **42**, and driven by a chain **60** from the drum **44** shaft in timed relation to the winch drum **44**. The operator shaft **58** is grooved as shown with oppositely pitched helixes interconnected in endless manner at their ends, and a follower or pillow block **62** is provided which has a part engaged on the shaft **58** to follow the endless groove therein, the block **62** being stabilized by sliding engagement on a fixed guide rod **64**, and mounting a pair of upstanding cable guide studs **66**, **68**, all in accordance with the general arrangement found commonly in fishing reel level winders. As shown in FIG. 2, the operation of the level winder is so timed as to result in the deposit of full and even layers of cable on the drum **44** as the winch is operated to draw the machine **10** through the pipe **12**; nevertheless, the effective diameter of the drum **44** does increase with each succeeding layer of cable thereon.

Accordingly, the apparatus of the invention includes means for measuring the actual speed of cable draw. In the illustrated apparatus, this means comprises a pair of speed take-off wheels **70**, **72** riding on the cable **20** to be turned thereby. As shown, each of these wheels includes a stub axle portion **74**—**74** by which it is journaled in a corresponding fork-arm **76**, **78**. The two fork-arms are mounted hingedly on pivot studs **80**, **82** carried by a mounting plate **84**, which also carries a forwardly extending arm **86** having guide part **88** provided with an aperture **90** through which the cable **20** passes for being guided to the wheels **70**, **72** in alignment therewith. A second guide, in the form of a roller **92** is provided for guiding the cable as it emerges from between the wheels, this guide roller being bearinged in an inverted "pi" shaped bracket **94** fixed on the arm **86** and acting also to space the roots of the arms **76**, **78** therefrom, as shown. Preferably, the stub axles **74** are interconnected by intermeshing gears **95** on the same, for distributing the loads driven by these axles, as referred to hereinafter, between the two cable speed take-off wheels **70**, **72**. For biasing the two wheels **70**, **72** into engagement with the cable **20**, each of the fork arms **76**, **78** carries a clamp mounting bracket **96**, **97**, one of which anchors one end of a tension coil spring **98**, the other end of which spring is adjustably and removably anchored by a knob **99** threadedly engaged on a stud **100** connected to the spring and seated in a U-shaped notch in the other clamp bracket **97**, as shown. The take off mechanism mounting plate **84** is mounted on the level winder pillow block **62**, preferably through a rubber or other flexible coupling **101**, so that the wheels **70**, **72** not only follow the level winder but also follow, by the action of the guides **90**, **92** the angle of the cable **20** as it approaches the winch, for minimum strain on the mechanism.

In the preferred automatic operation of the apparatus, the cable speed as sensed by the take-off wheels **70**, **72** is compared to a standard source **102** to provide an error signal. In the construction shown, the standard signal is a rotary mechanical one provided by an electric motor **103** of a synchronous or otherwise substantially predetermined speed type having in its output an infinitely variable speed, positive mechanical transmission **104**, which may be of any of the many known constructions, for providing a variable but accurately pre-setable speed at the output shaft **106** of the standard. The output shaft **106** is connected, as by a chain drive **108**, to one of the input shafts **110** of a differen-

tial gearing 112, while the other input shaft 114 of the differential 112 is driven through a flexible shaft 116 by one of the cable speed take-off wheels 72, as through a connection 118 (FIG. 4) from the stub axle of that wheel to the flexible shaft. It will be seen, then, that there is provided at the output shaft 120 of the differential 112 a rotary error speed proportional to the deviation of the speed of the take-off wheel 72 from a predetermined relationship to the standard speed at the shaft 106. Since their design is well within the knowledge of mechanics skilled in the gearing art, the internal details of the differential gearing 112, as well as the similar second differential gearing 174, referred to hereinafter, are omitted from the drawing, so as to avoid confusingly excessisve detail therein. For example, the gearings employed may be of the type wherein the input shafts are connected to drive corresponding ring gears in normally opposite directions, and the output shaft may be arranged to be driven by a spider which carries pinions engaged between the two ring gears so that if the velocities of the ring gears are equal and opposite, the spider remains stationary, but if the speed of one ring gear exceeds that of the other, the spider turns in the corresponding direction.

In the illustrated system, the winch drive motor 46 is of a direct current kind having a shunt field coil 122 (FIG. 8), and the speed of this motor 46 is controlled by a rheostat 124 interposed in the circuit of that coil. As shown, the rheostat 124 is of the kind having rotatably operable control shaft 126, and a control sprocket on that shaft is connected by a chain 128 to be driven by the error signal output shaft 120 of the differential 112. Accordingly, the rheostat is adjusted automatically one way or the other as the actual speed of the cable 20 exceeds or falls short of a predetermined relationship to that of the standard at the shaft 106, for varying the speed of the winch motor 46 in a cable speed corrective manner.

From the foregoing it will be apparent that the cable 20 speed, and thus the speed of travel of the lining applicator machine 10 is maintained automatically at a value which is a function of the speed signal output of the standard 102. As aforesaid, the preferred illustrated kind of standard is variable by reason of the incorporation of the variable speed transmission 104 therein, the control of the transmission being, in the illustrated structure, by rotary adjustment of a speed setting shaft 130. Adjustment of this control 130 may be and preferably is automatic, through a chain drive 132 thereto as will be set forth more fully hereinafter, but the control 130 is also provided with a hand wheel 134 by which it may be adjusted manually when desired, with the chain drive 132 uncoupled and removed or the control otherwise freed from the same for this purpose. Accordingly, precise control of the speed of travel of the lining applicator machine can be had by simple manual adjustment of the hand wheel 134. While this hand wheel could be provided simply with a scale for enabling pre-setting of the same for effecting a desired machine travel speed, it is preferred that the attendant have direct information as to the machine speed for insuring greatest accuracy and reliability of control thereof.

Accordingly, a tachometer 136, which may be of a form similar to those commonly employed as automobile speedometers, is provided, and takes its input from a part which has motion related to the machine 10 speed, as from one of the cable speed take-off wheels 70. The connection from the take-off wheel 70 to the tachometer 136 may be through a second flexible shaft 138, similarly to the first described, differential gear operating flexible shaft 116. Preferably, the machine speed tachometer 136 is located adjacent to the control hand wheel 134, as in the arrangement shown, so that the attendant can, while watching this tachometer, adjust the hand wheel until the desired speed of machine 10 travel is reached, whereupon that speed will be maintained automatically by the error signal controlled rheostat 124 as previously described.

A major consideration in determining the desired machine 10 travel speed is the rate at which lining material is fed to the distributor head 28 of the applicator machine, since the thickness of the lining applied to the pipe 12 wall is a direct function of this rate and an inverse function of the speed of travel of the machine 10.

A number of factors may cause this rate of feed to the head 28 to vary, and in a uniform thickness of lining is to be applied, then the speed of travel of the machine 10 should be adjusted in a compensating manner. For example, in the system illustrated in FIG. 1, the pump apparatus 14 is shown to comprise a screw conveyor type pump 140 having a barrel 142 housing a screw element (not shown) which is operated by an electric motor 144, through a belt drive 146, and to which the lining material is fed from a supply of the same in a feed hopper 148 or the like. This kind of pump is common in the handling of viscous materials such as the cement mortar usually used as a pipe lining material, and, because of the back slip along the screw element, has a more or less constant pressure characteristic when driven at constant speed. In any case, the bursting strength of the hose line 16 is a limiting factor so that the pressure delivered by the pump has a practical maximum, for example five hundred pounds per square inch. Since it is desirable that this pressure be maintained at about its maximum value for enabling lining of the pipe 12 at the maximum rate in feet per minute, it is the flow rate through the hose which desirably is allowed to vary as resistance to such flow changes.

More particularly, the system preferably includes a hose section remover 150, such as one of the kind disclosed in U.S. Patent No. 2,786,486, for removing sections of the hose 16 as the machine 10 advances toward the pump 14 and the needed length of the hose 16 decreases. Accordingly, the actual length and thus the flow resistance of the hose 16 decreases as sections thereof are removed, and since the pressure delivered by the pump 14 is desirably substantially constant, the flow rate through the hose 16 and to the machine distributor head 28 increases, and it is desired that the rate of travel of the machine 10 through the pipe 12 be increased correspondingly.

As aforesaid, the operator can make adjustments in the travel rate of the machine 10 by manipulation of the hand wheel 134 on the winch control. For enabling accurate employment of this control 134, flow meter means are provided for gauging the actual flow rate of lining material to the distributor head 28 on the machine 10. Referring to FIGS. 1 and 6, in the illustrated arrangement a screw element type meter 152 is employed, the meter comprising a conduit section 154 at the outlet end of the pump 14 having a screw conveyor-like element 155 journaled therein so as to be turned by the flow from the pump. A flexible shaft 156 is coupled to the screw element 155 as shown to be operated rotatively thereby at a speed corresponding to the flow rate from the pump, which is the same, of course, as the flow rate through the entire continuous conduit system to the distributor head 28 on the applicator machine. Referring to FIG. 7, the other end of the shaft 156 is bearinged in a meter box 158, mounted on the pump apparatus base as by a column 160, and drives a tachometer 162 mounted therein, as through gears 164 shown semi-schematically in that figure. The tachometer may be of the type instrument used commonly for automobile speedometers and may, of course, be calibrated in terms of flow rate of the lining material.

Conveniently, this flow rate information may be made available adjacent to the hand wheel 134 on the winch

device 18. For this purpose, the meter box 158 on the pump apparatus 14 may house also a signal transmitter of a self-synchronous electrical transmitter-repeater system, such as a "Selsyn" transmitter 166, coupled as shown to the flexible shaft 156 of the flow meter 152 to be operated thereby, and the winch device 18 may include a corresponding "Selsyn" receiver or repeater 168 electrically connected to the transmitter 166 to be operated thereby and drivingly coupled to a tachometer 170 on the winch device. It will be understood that the tachometer 170 on the winch may be structurally similar to the tachometer 162 on the pump, and repeats the same flow rate information at the more convenient location. Accordingly, intelligent manipulation of the control hand wheel 134 on the winch is enabled and facilitated.

Preferably, however, means are provided whereby adjustment of the cable speed standard control 104 is made automatically in response to the lining material flow rate. Accordingly, in the illustrated arrangement, the shaft 172 of the repeater "Selsyn" 168, in addition to driving the tachometer 170, serves as one input shaft of a differential gearing 174, the other input shaft 176 of which is driven, as by a chain 178, from the output shaft 106 of the winch control standard 102. The differential output of the gearing 174 is connected by the chain drive 132 to the control shaft 130 of the standard, and therefore it will be seen that, with the chain 132 employed, the control 104 of the standard will be adjusted automatically by operation of the differential 174 to maintain the speed of the standard output rotary signal at 106 in predetermined relation to the flow rate from the pump 14 as evidenced by the speed of rotation of the shaft 172 of the receiver "Selsyn" receiver at the winch.

For protecting the control mechanism, an overload slip clutch 180 may be interposed in the output shaft 106 of the standard, and an over-all cover (not shown) may be provided for the entire winch device 18, arranged, of course, to admit the cable 20 and to allow access to the meter 136, 170 dials and to the control handle 134.

The over-all operation of control features of the pipe lining apparatus of the invention as hereinabove described may be summarized and visualized with reference to the schematic diagram shown in FIG. 8. For clarity, this schematic shows all rotational connections as belt drives, including the connection from the flow meter 152 to the second differential 174, which has been described as being actually through the "Selsyn" transmitter and receiver 166, 168, the connection between the "Selsyn" receiver 168 and the flow indicating tachometer 162, which is actually internal of the second differential 174 but is shown in FIG. 8 by a belt connection 182, and also the connections driven by the cable speed take-off wheels 70, 72, which have been shown in the other figures as actually being flexible cables 138 and 116, respectively.

Referring to that figure, the draw cable 20, which pulls, and thus controls the speed of, the lining applicator machine through the pipe, is wound onto the winch drum 44 by the power of the winch motor 46, as communicated to the drum by the transmission 48, 50, 52. The speed of the cable 20 is detected by the take-off wheel 72 and is communicated through the connection 116 to one input 114 of the first differential 112, wherein it is compared to the speed of the output shaft 106 of the standard 102, this speed being communicated to the other input shaft 110 of that differential by the chain 108. The cable speed error signal is then taken from the differential output shaft 120 of the gear unit 112 by a chain 128 which operates the control 126 of the winch speed control rheostat 124, the rheostat being connected in the circuit by which the speed control shunt field winding 122 of the winch motor 46 is energized, the field current being supplied from any suitable source, as indicated by the terminals 184. Thus the cable 20 speed is maintained in predetermined relation to the standard 102 speed, that is, the speed of the shaft 106.

For automatic control of the standard 102, the flow rate from the pump 140 is detected by the flow meter 152 and this information is relayed from the transmitter 166 to the receiver 168 by which one input shaft 172 of the second differential 174 is driven, the other input shaft 176 of this gearing 174 being driven through a chain 178 from the output shaft 106 of the cable speed control standard 102. Thus the speed of the output 106 of the standard is compared to the flow rate from the pump, and the error signal at the differential output shaft of the second differential 174 is communicated to the control shaft 130 of the standard 102 for effecting adjustment thereof until the speed of the standard output shaft 106 reaches a predetermined relation to the flow rate from the pump 140. Accordingly, the speed of draw of the cable 20, and thus of travel of the applicator machine 10, is maintained at a value determined by the rate of flow of lining material from the pump 140 to the distributor head 28 of the machine, for application by the machine of a lining of predetermined, constant thickness.

It will be understood that the various predetermined ratios may be set by choice of drive ratios in and between the several parts. For example, the choice of lining thickness to be applied to pipe 12 of a given diameter may be made by choice of relative sprocket sizes at the opposite ends of the standard-to-second differential input drive 178, and the speed of response of the control may be adjusted by choice of sprocket sizes at the opposite ends of the rheostat drive chain 128. However, these and other specific means described above, and their arrangement and positions in the system, may be varied substantially while retaining some or all of the advantages of the invention. For example, while mechanical rotational signals are employed extensively, some or all of these could be replaced by electrical or hydraulic signals and appropriate comparison means could be utilized in place of the mechanical differentials shown. Also less than the full system may suffice in some instances; for example, as aforedescribed, the chain drive 132 to the standard speed control 130 can be detached and the hand wheel 134 employed manually in its stead, the cable speed and flow rate indicating tachometers 136, 170 facilitating this as well as providing facile means for checking operation when the full control is used.

Furthermore, were it not for the fact that the accuracy of the meter 152 is affected by the work it must expend, the meter speed itself might be used at the input shaft 110 of the rheostat-driving differential 112 for direct comparison to the draw speed of the cable 20. In the preferred construction shown, the second differential 174 and the standard 102 are interposed to relieve the meter 152 of variable torque loading arising at the rheostat 124, the provision of the adjustably fixed standard 102 also being advantageous in that it provides a comparison signal at its output shaft 106 for employment in the rheostat-driving differential 112 when it is desired to employ the hand wheel 134 in lieu of automatic response to the flow meter.

Accordingly, while only one specific embodiment of apparatus of the invention has been illustrated and described in detail, it will be understood that the invention is not limited thereto, but may be embodied otherwise, within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, take-off means engaged on the cable and adapted to provide a cable speed

signal in accordance with the draw rate of said cable, standard means adapted to provide a comparison signal, and means connected to compare said speed signal with said comparison signal to provide a first difference signal and operative to adjust said operator means in accordance with said first difference signal for bringing said speed signal into a predetermined relation to said comparison signal, flow meter means operative to detect the flow rate of lining material through said hose line and adapted to provide a flow rate signal corresponding thereto, and means connected to compare said flow rate signal with said comparison signal to provide a second difference signal and operative to adjust said standard means in accordance with said second difference signal for bringing said comparison signal into a predetermined relation to said flow rate signal.

2. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, take-off means engaged on the cable and adapted to provide a cable speed signal in accordance with the draw rate of said cable, standard means adapted to provide a comparison signal, and means connected to compare said speed signal with said comparison signal to provide a difference signal and operative to adjust said operator means in accordance with said difference signal for bringing said speed signal into a predetermined relation to said comparison signal, flow meter means operative to detect and to display the flow rate of lining material through said hose line, and means operable to adjust said standard means, for enabling variation of said comparison signal in accordance with said flow rate.

3. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, take-off means engaged on the cable and adapted to provide a cable speed signal in accordance with the draw rate of said cable, standard means adapted to provide a comparison signal, and means connected to compare said speed signal with said comparison signal to provide a difference signal and operative to adjust said operator means in accordance with said difference signal for bringing said speed signal into a predetermined relation to said comparison signal.

4. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and variable speed operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, take-off means engaged on the cable and adapted to provide a signal in accordance with the speed of draw of said cable, and means sensitive to said signal and operative to adjust the speed of said operator means in accordance therewith for compensating for the change in effective diameter in said drum as said cable winds thereon.

5. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and adjustable speed operator means for the same, a cable wound on said drum and extending to said machine to draw said machine through the pipe by the power of said winch device, take-off means comprising a wheel engaged on said cable to be turned thereby and including means adapted to provide and display a cable speed signal in accordance with the draw speed of said cable as detected by said wheel, and control means operably connected to said operator means, for enabling adjustment of the speed of said operator means in accordance with said speed signal for accurate control of the speed of travel of said machine.

6. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and adjustable speed operator means for the same, a cable wound on the drum and extending to said machine to draw said machine through the pipe by the power of said winch device, level winder means operative automatically to guide said cable into even layers as it winds upon said drum, take-off means engaged on the cable and adapted to provide and display a cable speed signal in accordance with the draw rate of said cable, and control means operably connected to said operator means, for enabling adjustment of the speed of said operator means in accordance with said speed signal for accurate control of the speed of travel of said machine as said layers of cable build up on said drum.

7. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, take-off means comprising a wheel engaged on the cable to be turned thereby and adapted to provide a first rotary signal having a speed corresponding to the draw rate of said cable, standard means adapted to provide a comparison speed rotary signal, said operator means and said standard means each having a rotatively operable speed control, and first differential gear means connected to compare said first signal with said comparison signal to provide a first differential speed rotary output, said first output being connected to said operator means speed control to actuate the same for bringing said first signal into a predetermined relation to said comparison signal, flow meter means operative to detect the flow rate of lining material through said hose line and adapted to provide a flow rate rotary signal having a speed corresponding thereto, and differential gear means connected to compare said flow rate signal with said comparison signal to provide a second differential speed rotary output, said second output being connected to said standard speed control to actuate the same for bringing said comparison signal into a predetermined relation to said flow rate signal.

8. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, said operator means having a rotatively operable speed control, take-off means comprising a wheel engaged on the cable to be turned thereby and adapted to provide a first rotary signal having a speed corresponding to the draw rate of said cable, standard means adapted to provide a comparison speed rotary signal, and differential gear means connected to compare said first signal with said comparison signal to provide a differential speed rotary output, said output being connected to said speed control of said operator means to actuate the same for bringing said first signal into a predetermined relation to said comparison signal.

9. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, level winder means operative automatically to guide said cable into even layers as it winds upon said drum, take-off means engaged on the cable and adapted to provide a cable speed signal in accordance with the draw rate of said cable, standard means adapted to provide a comparison signal, and means connected to compare said speed signal with said comparison signal to provide a first difference signal and operative to adjust said operator means in accordance with said first difference signal for bringing said speed signal into a predetermined relation to said comparison signal, flow meter means operative to detect the flow rate of lining material through said hose line and adapted to provide a flow rate signal corresponding thereto, and means connected to compare said flow rate signal with said comparison signal to provide a second difference signal and operative to adjust said standard means in accordance with said second difference signal for bringing said comparison signal into a predetermined relation to said flow rate signal.

10. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, level winder means operative automatically to guide said cable into even layers as it winds upon said drum, take-off means engaged on the cable and adapted to provide a cable speed signal in accordance with the draw rate of said cable, standard means adapted to provide a comparison signal, and means connected to compare said speed signal with said comparison signal to provide a difference signal and operative to adjust said operator means in accordance with said difference signal for bringing said speed signal into a predetermined relation to said comparison signal.

11. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, said operator means having a speed adjustment, speed detector means operable by said cable to provide a signal corresponding to the speed of travel of said cable, and speed control means responsive to said signal and connected to control said operator means speed adjustment.

12. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and adjustable speed operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, speed detector means comprising a wheel engaged on the cable and including means adapted to provide an output in accordance with the draw rate of said cable as detected by said wheel, flow meter means operative to detect the flow rate of lining material to said distributor head and adapted to provide an output corresponding thereto, and means responsive to said speed detector output and to said flow meter output and operative to adjust said winch operator means for maintaining the two outputs in predetermined relationship, for correlating the speed of travel of said machine with said flow rate.

13. In a pipe lining apparatus having a pipe lining applicator machine adapted to be drawn through a pipe while applying a lining thereto by means of a centrifugal distributor head on the machine, a remote source of the lining material, and a hose line communicating from said source to said machine, a winch device having a cable winding drum and operator means for the same and a cable wound on the drum and extending to said machine to draw said machine through the pipe, said operator means having a rotatively operable speed control, speed detector means operable by the moving system comprising said cable and said machine to provide a first rotary output having a speed corresponding to the speed of travel of said system, flow meter means operative to detect the flow rate of lining material to said distributor head and adapted to provide a second rotary output having a speed corresponding thereto, and differential means connected to compare said first and second outputs and to provide a third rotary output having a speed corresponding to the speed difference between said first and second outputs, said third output being connected to drive said speed control for bringing the speed of travel of said machine into predetermined relationship to said flow rate.

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