Feb. 26, 1963 J. D. CUMMINGS ETAL 3,078,823

INTERNAL PIPE COATING APPARATUS

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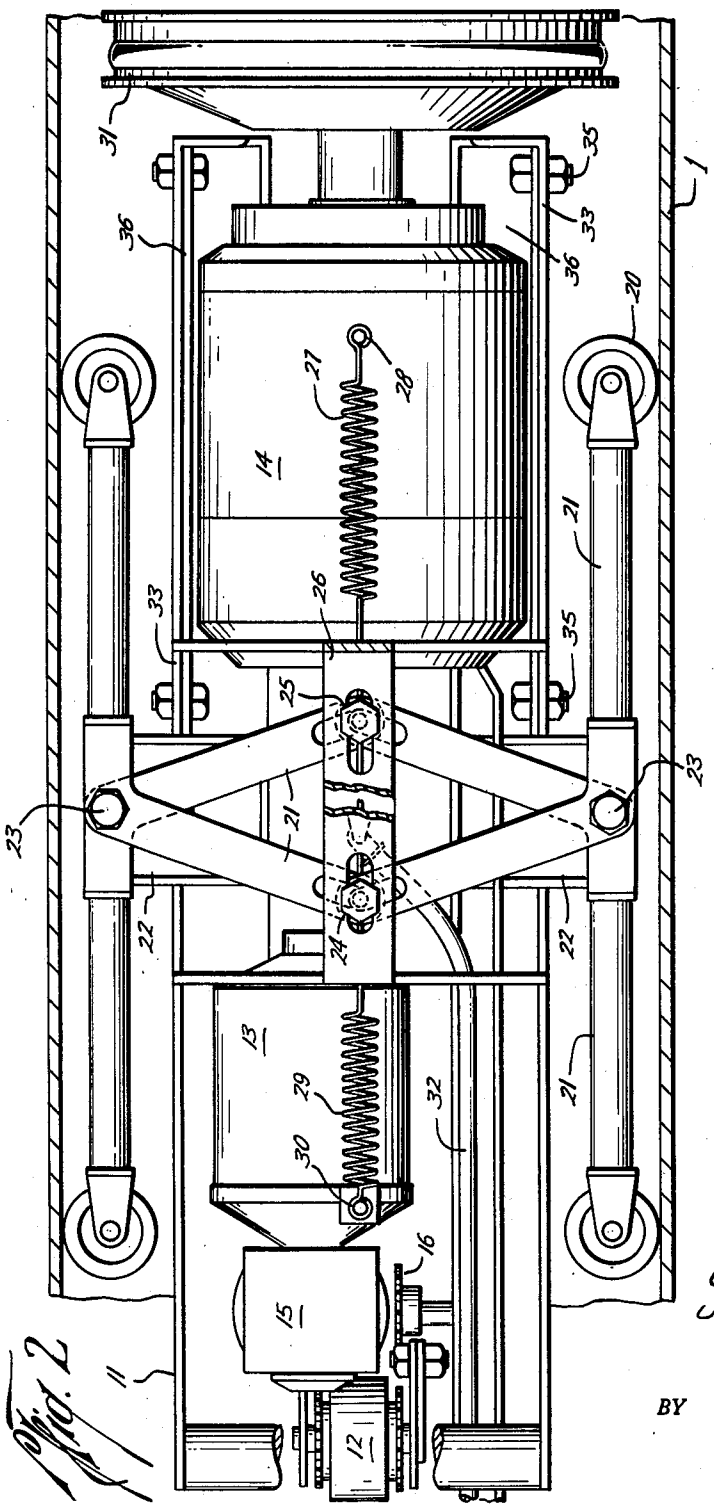

Fig. 2

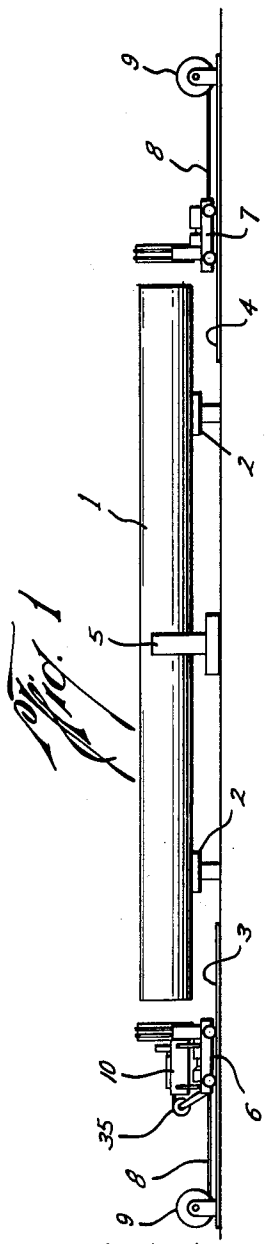

Fig. 1

C. E. Hatcher
J. D. Cummings
INVENTORS

BY G C Helmig
ATTORNEY

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Filed Jan. 18, 1960 5 Sheets-Sheet 2

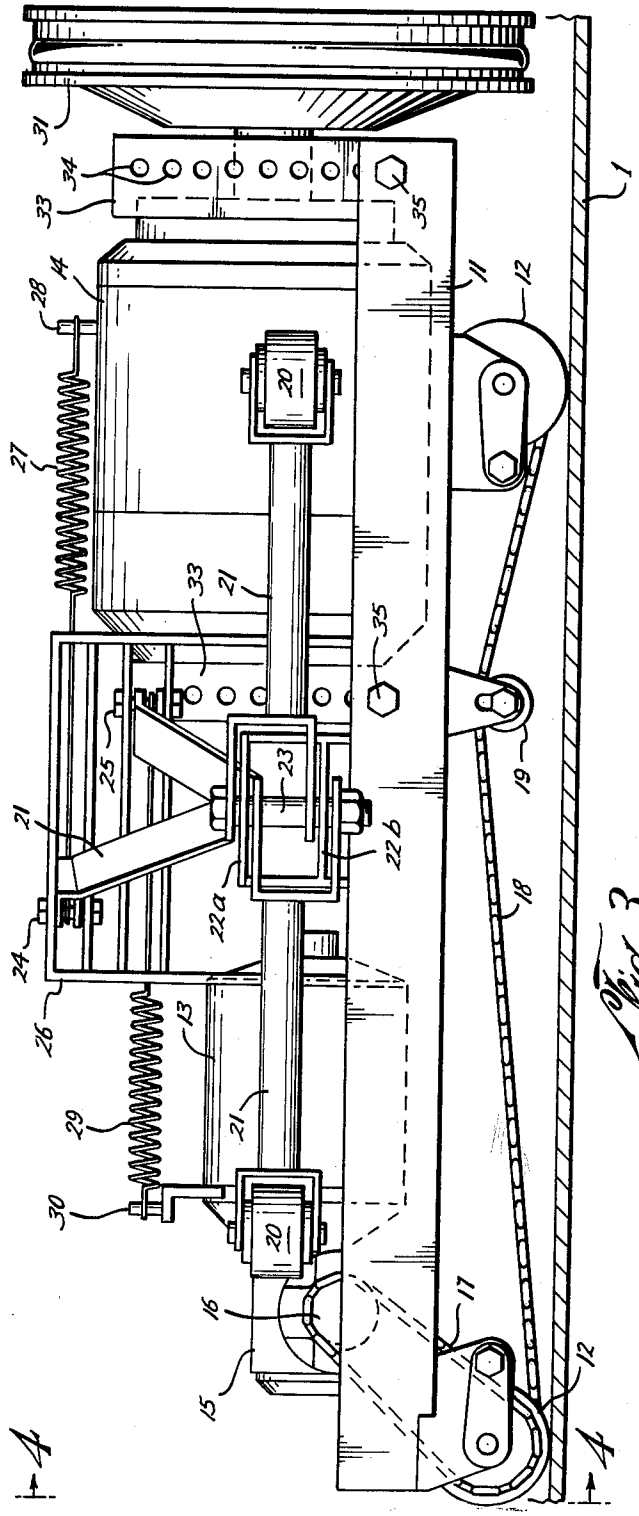


Fig. 3

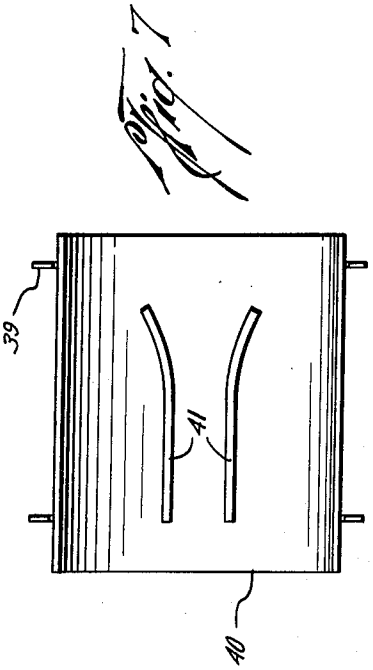


Fig. 1

C. E. Hatcher
J. D. Cummings
INVENTORS

BY Q C Helming
ATTORNEY

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INTERNAL PIPE COATING APPARATUS

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Fig. 4

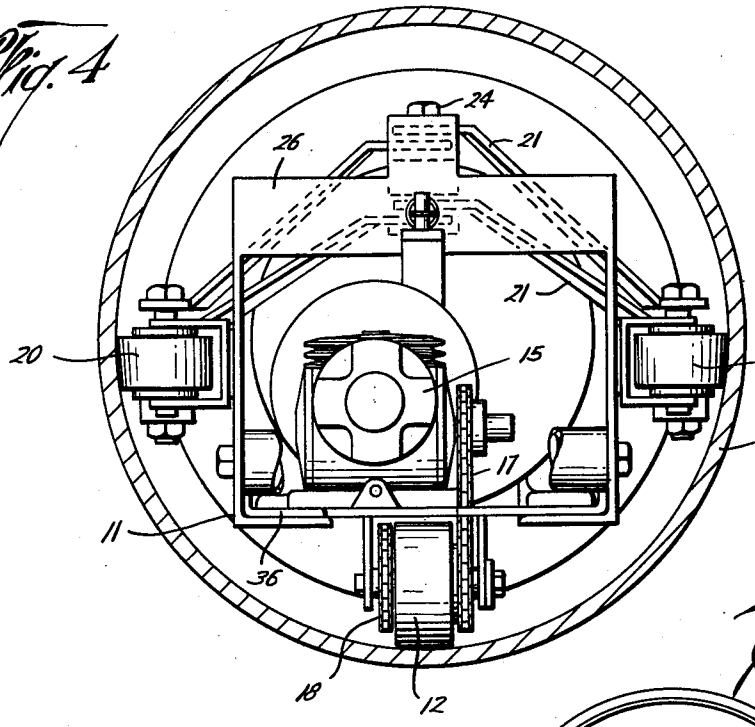



Fig. 6

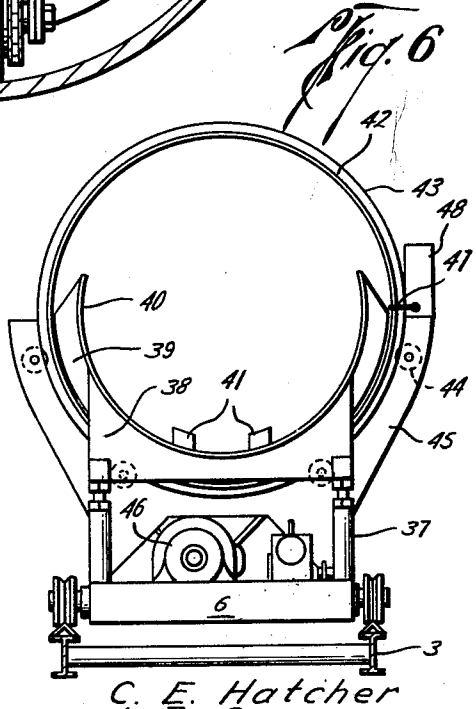
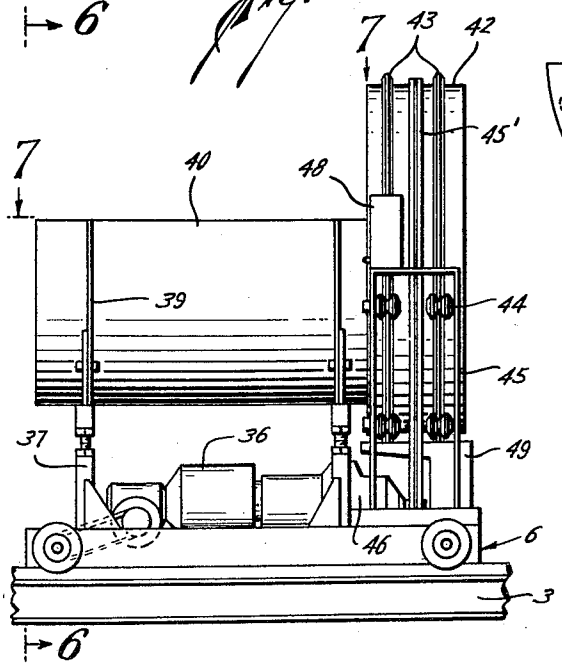



Fig. 5




C. E. Hatcher
J. D. Cummings
INVENTORS

BY G C Helwig
ATTORNEY

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INTERNAL PIPE COATING APPARATUS

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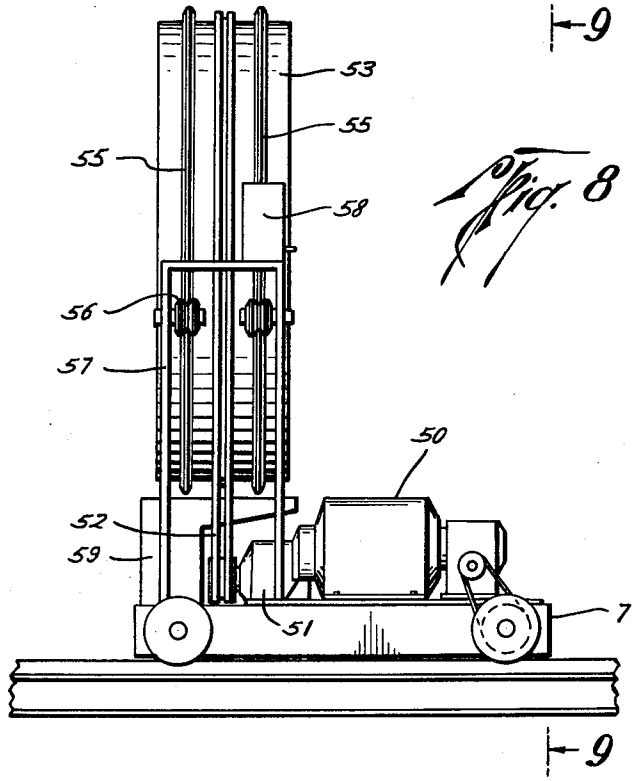


Fig. 8

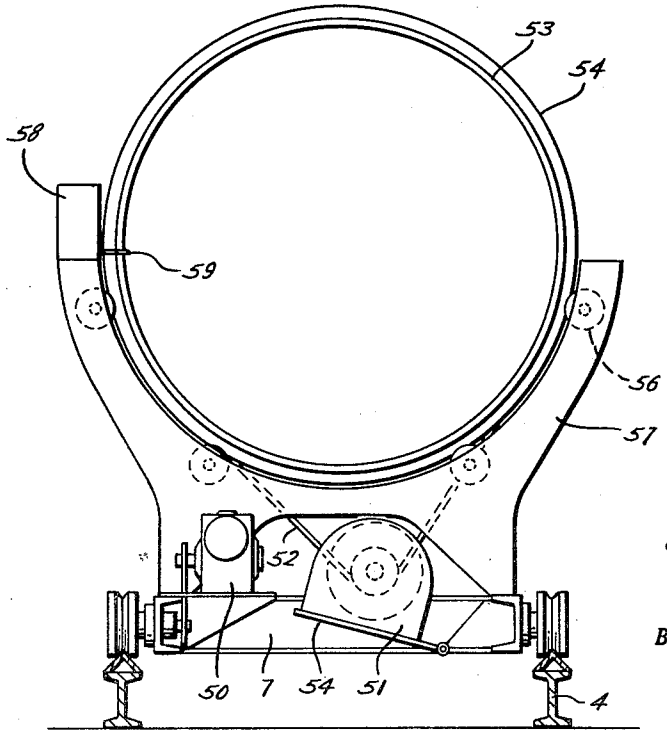


Fig. 9

C. E. Hatcher
J. D. Cummings
INVENTORS

BY G C Helwig

ATTORNEY

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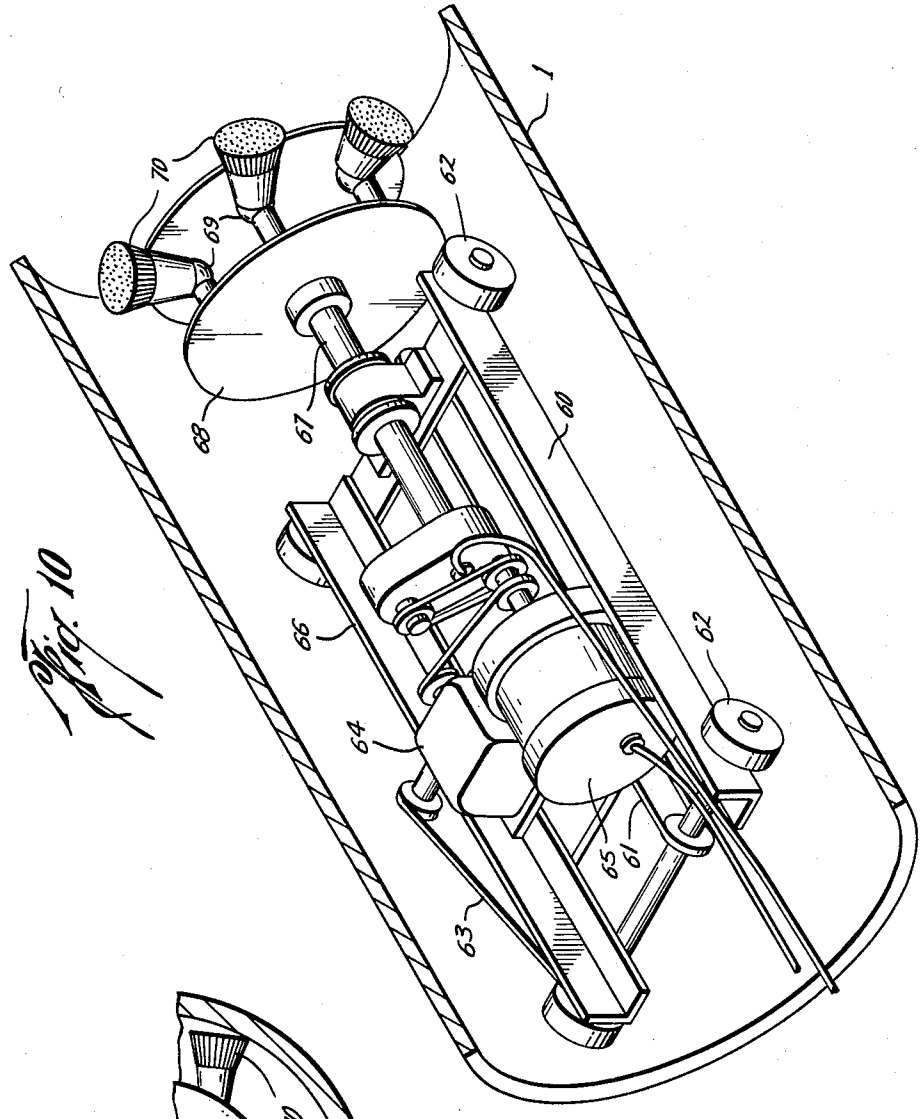


Fig. 10

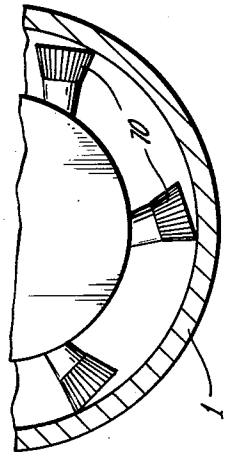


Fig. 11

C. E. Hatcher
J. D. Cummings
INVENTORS

BY G C Helwig

ATTORNEY

United States Patent Office 3,078,823 Patented Feb. 26, 1963



3,078,823

# INTERNAL PIPE COATING APPARATUS

James D. Cummings, San Marcos, and Craig E. Hatcher, Houston, Tex., assignors to Crutcher-Rolfs-Cummings, Inc., Houston, Tex., a corporation of Texas

Filed Jan. 18, 1960, Ser. No. 3,131
7 Claims. (Cl. 118—306)

Oil, gas and other fluid transmission pipe lines may advantageously have their interior surface smoothly coated with a corrosion resistant and friction reducing film and this invention relates to work performing and mechanical handling equipment for quickly and effectively coating the inside surface of hollow objects and particularly pipe sections or joints which later are to be connected in end to end and welded together succession in a conduit installation.

An object of the invention is to provide an improved compact and light weight carriage unit which is self contained and power driven to track on the inside of a length of pipe and to work the surface thereof during travel of the unit from one to the other end of the pipe.

Another object is to provide a carriage storage and transfer device for co-operation in aligned end to end relation with a pipe in enabling the transfer of a carriage to and from storage position and into and out of the pipe.

A further object of the invention is to provide an improved paint overspray collector baffle ring for co-operation with a pipe end portion and which baffle ring is mounted for rotation slowly during use and is continuously wetted with a liquid paint solvent in small amounts sufficient to reduce adherence of paint and to flow the solution toward the bottom of the slowly rotating ring for off-flow into a receiver tank.

A still further object is to provide fully automatic plant installation equipment involving a work station at which a pipe to be operated upon is positioned and is engaged at opposite ends by overspray baffles carried by movable carts, one of which also carries a transfer platform to be longitudinally aligned with a station positioned pipe so that a coating applying carriage can track on and travel from the platform to and through the pipe and back again into inoperative storage position on the transfer platform whereupon the two end carts spread apart for removal of the coated pipe in advance of the next succeeding pipe for repetition of the operating cycle.

Other objects and advantages will become apparent upon reference to the accompanying drawing wherein FIG. 1 is a small scale elevation of automatic equipment for co-operation with opposite ends of a pipe whose internal surface is to be worked and which equipment adjusts itself to any length of pipe within the usual production range; FIG. 2 is a top plan view of a unitary paint applying carriage embodying propulsion mechanism for transferring the paint applying carriage between the pipe interior and the dolly or cart shown at the left end of FIG. 1 and for driving the traveling carriage through and back and forth between opposite ends of the pipe; FIG. 3 shows the paint applying carriage in side elevation; FIG. 4 is an end elevation as on line 4—4 of FIG. 3; FIG. 5 is an enlarged side elevation of the left-hand cart of FIG. 1 on a scale smaller than that of FIG. 3; FIG. 6 is an end elevation as on line 6—6 of FIG.5; FIG. 7 is a top plan view of the carriage storage platform on line 7—7 of FIG. 5; FIG. 8 is an enlarged side elevation of the right-hand cart of FIG. 1; FIG. 9 is an end elevation on line 9—9 of FIG. 8; FIG. 10 is a prespective view of a pipe cleaning carriage; and FIG. 11 is a front elevation of a fragment of the pipe cleaning mechanism.

The arrangement of FIG. 1 will be of special utility for



handling pipe at a storage bank of a fabricating mill. Individual joints of pipe 1 are to be rolled forward on the supporting rails 2 to and from a horizontal position in longitudinal alignment with oppositely disposed trackways 3 and 4 and there securely held between a pair of pipe engageable clamp jaws 5 which are of a type pivoted at their lower ends in a base plate so that each can be dropped out of the path of the pipe 1. Mounted on and guided by the trackways 3 and 4 for travel toward and from opposite ends of the pipe 1 are motor driven wheeled dollies or mobile carts 6 and 7 each carrying a vertically disposed annular ring of substantially the same or somewhat larger diameter than the pipe for fitment to the pipe ends as baffles therebeyond to paint overspray while the pipe end portions are being coated. Each trackway is of a suitable length to enable cart retraction out of interference to pipe fed to and from clamped position and to provide a range of cart projection sufficient for end to end co-operation with different lengths of pipe to be processed. Such pipes may vary in length and with respect to ten to thirty-six inch pipe diameters, the lengths usually range between eighteen and forty feet. Flexible supply conduits 8 for electricity, air and paint flow as required, run to the carts from retrieving reels 9.

In addition to the overspray collecting baffle, the cart 6 has a transfer platform assembly 10 to support the mobile carriage for equipment by which work is performed on the interior wall surface of a pipe. A mobile paint applying carriage to crawl through the pipe is shown in FIGS. 2, 3 and 4 and includes a main frame or chassis 11 having dependent brackets near opposite ends in each of which is mounted a single load supporting wheel 12 which is to track on the lowermost wall portion of the pipe and on the storage platform assembly 10. The main frame 11 is made up of a pair of transversely spaced and longitudinally extending steel straps and transversely extending rail connecting members and mounts thereon a pair of drive motors 13 and 14. The rearward drive motor 13 includes as a unit therewith a gear reduction box 15 having a drive sprocket 16 joined by a flexible chain 17 to a driven sprocket fixed at one side of the rearmost wheel 12 whereby the drive is transmitted to the wheel for propelling the carriage frame either forwardly or backwardly as controlled by the direction of rotation of the motor 13. Preferably, but not necessarily, the front wheel 12 may also be employed for traction drive purposes, in which event the rearward wheel carries a drive sprocket for engagement by an endless chain 18 which passes over an idler wheel 19 and is entrained on a sprocket fixed to the side of the forward wheel 12. The treads of both wheels preferably are rubber tired for friction drive conformity to the curved interior surface of the pipe wall. The single front and rear wheels 12 are preferably disposed in the vertical longitudinal plane of the chassis and an effort is made to distribute the weight of the chassis and its components so that the load is centered adjacent the longitudinal central plane. To resist tilting of the frame, guide rollers 20 are carried at each side of the frame for engagement with the wall of the pipe at or just below the horizontal diameter of the pipe. These diametrically oppositely disposed side rollers 20 are mounted for an elastic outward biasing action whereby they will tend to center the chassis frame within the pipe and will serve to fit pipes of different diameters.

The biased mounting of the idler rollers 20 includes a bell crank lever for each roller. When four such rollers are employed, as indicated in FIGS. 2, 3 and 4, they are arranged in two sets, one on each side of the frame so that there are a pair of forward rollers and a pair of rearward rollers, all biased outwardly from the frame and pivotally mounted on vertical axes in the free ends of the bell crank

levers 21. The roller carrying arms of the bell crank levers 21 extend generally in the longitudinal direction of the frame and those on each side extend in opposite directions from a central journal support. The support includes an outrigger bracket 22 of channel section extending laterally of the frame and terminating in vertically spaced apart horizontal flanges 22*a* and 22*b* through which a pivot pin 23 projects and also projects through a pair of vertically spaced apart forks at the juncture of the two arms of each bell crank 21. From the journal pin 23, bell crank lever arms extend transversely inwardly to a point adjacent the frame center line, with one of the pair of arms terminating in vertically spaced relation to the other arm. As shown in the drawing, the two rearwardly extending bell cranks have their inwardly extending arms terminally overlapping one another at a lower level than that of the overlapping ends of the inwardly extending arms of the forwardly projecting bell crank levers. Each end has an elongated slot through which projects a stud 24 in the case of the upper arms and a stud 25 in the case of the lower overlapping arm ends. The stud 24 also extends through a longitudinally elongated slot or slots in a pair of vertically spaced apart and longitudinally extending straps of a locating frame 26 and has connected to the stud 24 one end of a coiled tension spring 27 whose opposite end is grounded on an anchor pin 28 so that the force of the spring, as seen in FIG. 2, exerts an elastic force on the forwardly extending bell crank arms to swing both of them outwardly at their free ends which support the side rollers 20. Similarly, the stud 25 extends through longitudinally elongated slots in a lower pair of straps forming a part of the mounting frame 26 and hooked to the stud 25 is one end of a coiled tension spring 29 whose opposite end is mounted on an anchor pin 30. Accordingly, the roller mounted free ends of the rearward set of bell crank levers are constantly biased outwardly by the force exerted by the spring 29.

A paint applying unit comprising a hollow spinner head 31 and its drive motor 14, is mounted in the forward end of the chassis frame and during drive of the spinner head a coating paint is supplied through a flexible hose or conduit 32 leading through the motor chassis to the center of the spinner head and is thrown centrifugally outwardly through small perforations in the periphery of the head. The paint applying spinner head 31 having its hub keyed to the shaft of the motor 14 and the motor as a unit, together with the side mounting brackets 22 for the side roller bell crank rollers as well as the guide frame 26, are mounted on a subframe which itself is carried by the main frame 11 in selected positions of vertical adjustment, which enables the spinner axis to be positioned substantially centrally within any pipe within a range of different pipe diameters. For purposes of vertical adjustment of the subframe, the main frame is provided at each side with a pair of longitudinally spaced apart upright posts 33, each carrying a group of vertically spaced apart bolt openings 34, into any selected one of which may be received a fastening stud 35 which also passes through an opening in an adjacent side rail 36 of the subframe.

Flexible conduits for delivering paint to the spinner and energy for operating the motors 13 and 14 will extend from the trailing end of the carriage to a retrieving reel or reels 35 on the transfer cart 6. This transfer cart includes a wheeled main frame having a motor and reduction gear drive unit 36 having a chain or belt to one of the supporting and traction wheels, as seen in FIG. 5. Structural detail of the platform assembly 10 is illustrated in FIGS. 5 and 6 wherein there are seen as extended upwardly from the frame, a series of four screw jack or vertically adjustable corner posts 37 for supporting front and rear mounting plates lying in vertical planes and having concave upper edges, there being fastened to one side of each plate 38 a semicircular strap 39 which extends vertically outwardly therefrom and is welded to the outer face of a semicylindrical plate or platform 40. The



platform plate 40 is bent on a radius to conform substantially to the diameter of the pipe with which it is to be used and its bolted connection to the mounting cradle plate 38 enables interchangeability of various sizes of transfer plates 40. Height adjustment through the screw jacks 37 permits height adjustment of the transfer plate for its longitudinal alignment with the pipe to be operated upon in order that the work performing mobile carriage can be transferred between the platform 40 and the pipe 1.

On the upper face of the bottom wall surface of the platform 40 there are prefereably secured as by welding a pair of transversely spaced apart guide ribs 41, as best seen in FIG. 7, and which toward the end near the pipe are bent outwardly from one another to provide a flared entrance mouth to the space between the rails 41. These rails serve to guide and center the traction wheels 12 of the mobile carriage as the carriage passes from the pipe to the storage position on the transfer platform. Contact of the wheels with the flared entrance mouth will serve to center the carriage against any tendency to rock from a proper upright position.

Immediately in advance of the forward edge of the transfer platform 40 and as best seen in FIG. 5 there is located an annular band 42 of a diameter preferably slightly in excess of the external diameter of the pipe for telescopic fitment to an end portion of the pipe. This band peripherally carries a pair of circular ribs 43 which track within guide rollers 44 carried within a U-shaped cradling frame 45 projecting upwardly from and being secured to the frame of the cart 6. A pair of drive belts 45′ are entrained over the upper portion of the rotatable band 42 and are engaged with pulleys on the shaft of a drive motor 46 forming a part of the cart 6. During a spray painting operation, the cart 6 is adjusted relative to the pipe end so that the band 42 projects outwardly from the pipe end and collects paint which is sprayed beyond the pipe end. The overspray collector protects the adjoining area from the deposit of paint and additionally enables recovery of any paint deposited on the interior of the ring. For facilitating such recovery, the ring is rotated slowly through the motor 46 and has fed to the inside thereof a suitable paint solvent, as, for example, through a delivery pipe 47 near the bottom of a solvent container 48 supported by one leg of the cradle 45, as seen in FIG. 6. The liquid solvent wets the interior of the band 42 to prevent the drying of paint thereon and tends to carry the paint downwardly therewith by gravity to the lower portion of the rotating band 42, from which the excess liquid drops at the sides into a collecting tray at the upper end of a storage bucket 49 carried below the ring 42 on the frame of the cart.

Except for the omission of a carriage transfer platform, the cart 7 at the opposite end of the pipe is much the same as the structure of the cart 6. It involves according to FIGS. 8 and 9, a chassis frame carrying a traction drive motor unit 50 coupled to one of the supporting wheels and a drive motor 51 having a pulley for drive belts 52 which runs on a circular collector ring 53. The motor 51, as seen in FIG. 9, has a support bracket 54 pivoted at one side so that the weight of the motor acts on the belt to eliminate drive slack. Peripheral guide ribs 55 on the rotatable ring run in grooved rollers 56 carried by a cradle frame assembly 57 projecting upwardly from the cart and a paint solvent supply tank 58 is carried by the cradle with a feed pipe 59 for dripping solvent on the inside surface of the ring. A solvent collector tank 59 is positioned by the frame to underlie the low part of the ring to catch and store the solvent and entrained paint.

In case the inside of the pipe has become dirty or corroded and contains mill scale which needs to be removed in advance of the spraying operation, a surface abrading unit can be employed and for that purpose there has been devised the power driven carriage shown

in FIG. 10. This involves a chassis or main frame 60 having front and rear drive axles drive connected with one another through a belt or chain drive 61 and carrying pipe engaging wheels 62. One of the shafts additionally is belted or driven through a chain 63 from a gear reduction box 64 and a drive motor 65 mounted on the frame. The drive motor 65 additionally acts through a gear box 66 to drive a shaft 67 extending longitudinally ahead of the frame and terminating in a rotatable head 68 on which are carried a circular succession of air motors 69 whose drive shafts extend in generally radial directions. Each shaft terminates in a rotary wire brush 70 for scraping contact with the pipe internal wall. The individual brushes rotate about the radially disposed axis and additionally revolve with the head 68 and co-operate with one another in scraping the internal circular surface of the pipe. Conveniently, the radial axis of the individual brushes is canted slightly from a true radial line and for convenience the relative inclination is shown in an exaggerated fashion in FIG. 11. By reason of the inclination of the rotating brush axis, each brush contacts with the pipe on one side of its rotary path and throws any scrapings in a longitudinal direction, thereby not only loosening any dirt but tending also to brush loose dirt ahead of the traveling machine for deposit at the pipe end and clear of the pipe surface.

This cleaning machine may be employed at a station immediately in advance of the station at which the painting carriage operates, although for some purposes it could operate at the same station and could be transferred to and from a platform similar to the transfer platform 40 but carried on the companion cart 7. When separate stations are used, the cart 7 can be eliminated completely at the cleaning station and the cart 6 used for storing the cleaning machine between its action on succeeding pipe, and of course with the elimination of the paint overspray ring 42. Alternately, in place of any transfer railed cart, the cleaning machine can be stored on the lift fork of an industrial truck and by manipulation of the truck can be brought into alignment with any pipe to be cleaned.

With the use of the internal pipe coating equipment as described, the sequential operations of the various parts may be manually controlled, as by means of electric switches mounted at a central control panel. Optionally, the sequential operation can be accomplished automatically and without manual attention through the use of proper positioned limit switches. Thus by reference to FIG. 1 and assuming that the jaw clamps 5 are ineffective and no pipe is in position, then the advance of a pipe on the rails 2 can be utilized at a given pipe position for actuating a switch and a closing of the clamp jaws. The response of the clamp jaws can be utilized to actuate switching mechanism for bringing the carts 6 and 7 toward one another and into co-operative abutment with the opposite ends of the pipe 1. Such abutment, acting through limit switches, will stop the cart traction motors and effect rotation of the overspray rings and also the forward actuation of the traction motor of the paint spraying carriage. The carriage will then advance from the transfer platform and through the pipe to the far end thereof and when the travel of the carriage reaches the far end, additional limit switches are brought into play for reversing the direction of the traction motor and effecting rotation of the paint spinner motor as well as feed of paint. The application of the surface coating will continue on the back stroke of the carriage until the carriage is transferred from the pipe and onto the storage platform of the cart, whereupon further switch actuation will discontinue operation of the carriage traction motor and spinner motor and paint supply and will direct current to the cart traction motors to effect their retraction away from the pipe ends to fully retracted position. When such position is reached, switching mechanism will respond for opening the clamp jaws so that the painted pipe can roll beyond the paint station and the next succeeding pipe roll into position to be clamped.



In compliance with the Patent Act, the foregoing specification has detailed the structure for fully disclosing the invention but it is to be understood that various modifications can be made without departing from the scope of the appended claims.

What is claimed is:

1. Equipment for coating the interior of pipe, including a pipe receiving station having means to locate the pipe being operated upon, a pair of trackways extending outwardly from opposite ends of the pipe receiving station and longitudinally of a pipe located therein, carts mounted for relative movement on the respective tracks to and from end to end relation with the opposite ends of a pipe located in said station, an overspray collecting ring carried by each cart for co-operation with an adjacent pipe end, a carriage transfer platform mounted on one of the carts, a traveling carriage having propulsion mechanism thereon for tracking on the platform and within the pipe and for transfer from one to the other thereof and a surface coating applicator mounted on the carriage.

2. In an overspray collector for use with the end of a pipe to be internally coated, a movable cart arranged for travel toward and away from the end of a pipe, an upwardly open semicircular cradle carried by the cart, a series of rollers rotatably mounted on the cradle in circularly spaced apart relation and on parallel axes extending in the longitudinal direction of cart movement, an annular ring of substantially the diameter of the pipe and bearing on said rollers and projecting upwardly through and above the upward opening of the cradle, a drive transmitting wheel on the cart and below said cradle, an endless belt entrained on the wheel and on the ring and operative to hold the ring downwardly on said rollers and to impart rotation to the ring and a cart supporting track extending in the longitudinal direction of the roller axes and accommodating cart movement to and from end fitment relation of the ring to the end of the pipe.

3. In an overspray collector for use at the end of a pipe to be internally coated, a movable cart, a cart support and guide accommodating cart movement toward and from the end of a pipe to be coated and in the longitudinal direction of the pipe axes, an annular baffle ring rotatably mounted on the cart for substantially coaxial relation to the pipe and of substantially the diameter of the pipe for movement with the cart into end to end relation with the pipe as a continuation thereof and to baffle overspray beyond the end of the pipe and drive means on the cart connected to rotate said ring.

4. In a collector as in claim 3 together with a liquid solvent supply tank mounted on the cart and provided with a drip feed pipe positioned to direct a coating liquid solvent on the interior surface of the ring and a collector tray positioned by the cart at the bottom of the path of ring rotation and into which the liquid solvent runs by gravity from the ring.

5. Means to fit the end of a pipe while an applicator is directing a coating material on the interior surface of the pipe and to collect coating material directed radially outwardly beyond said end, comprising an annular ring for end to end fitment with the pipe and in longitudinally projecting continuation of the pipe wall beyond the end thereof, a movable cart mounting said ring for travel into and out of end to end fitment with the pipe and thereby accommodate placement and removal of pipe in working relation with the applicator and a supporting track for the cart extending in the longitudinal direction of the pipe axis.

6. In a power driven carriage for longitudinal travel within a pipe, a centrifugal spinner head for applying coating on the internal pipe surface, a mounting frame therefor, longitudinally spaced apart wheels supporting the frame and depending therefrom to ride on the bottom

of the pipe internal surface, traction drive means connected with said wheels, two pairs of longitudinally spaced apart guide wheels, one pair of wheels at one side and the other pair at the other side of the frame adjacent a horizontal plane intersecting the pipe axis and to ride on opposite side wall portions of the pipe and mounting means for the wheels comprising two pairs of bell cranks arranged at opposite sides of the frame, frame carried pivot connections mounting one pair of cranks on a common vertical axis at one frame side and mounting the other pair of cranks on a common vertical axis at the other frame side with one arm of each crank extending longitudinally and oppositely from its pivot connection in relation to the corresponding longitudinal arm of a companion crank of the pair and with the other arm of each crank extending transversely inwardly of the frame and connected centrally of the frame with the transverse arm of a crank whose pivot mounting connection is on the opposite side of the frame, spring means active on each set of centrally connected transverse arms in a direction to resiliently bias the longitudinal arms outwardly from the frame and means mounting said guide wheels on vertical axes at the free ends of said longitudinal arms.

7. In a power driven carriage for longitudinal travel within a pipe, a centrifugal spinner head for applying



coating on the internal pipe surface, a main frame therefor having supporting wheels to track on the bottom of the pipe internal surface, traction drive means connected with the wheels, oppositely disposed guide wheels to ride on opposite side wall portions of the pipe, a pair of bell crank levers pivoted on vertical axes on opposite sides of the frame and each having one arm extending longitudinally beside the frame and the other arm transversely projected inwardly, means mounting said guide wheels on the free ends of the longitudinally extending arms and spring means interposed between the frame and the free ends of the inwardly disposed arms and active to bias the bell cranks in directions to urge the guide wheels outwardly of the frame.

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