

[54] PIPE CLEANING APPARATUS

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[58] Field of Search 51/9, 317, 319, 290, 51/245

[56] References Cited
UNITED STATES PATENTS

3,151,418 10/1964 Powell et al. 51/9

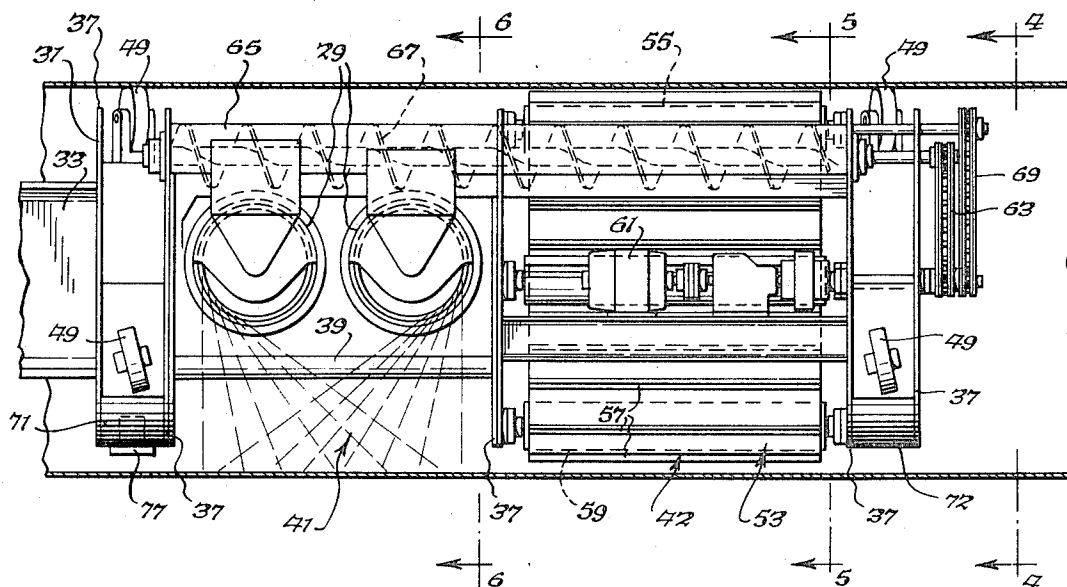
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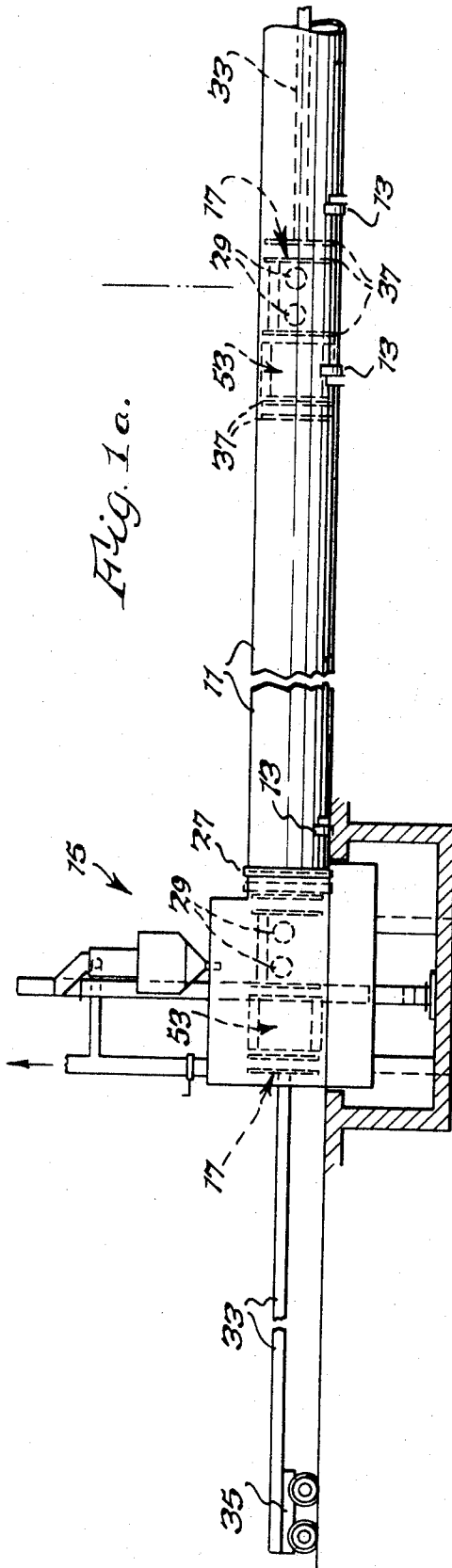
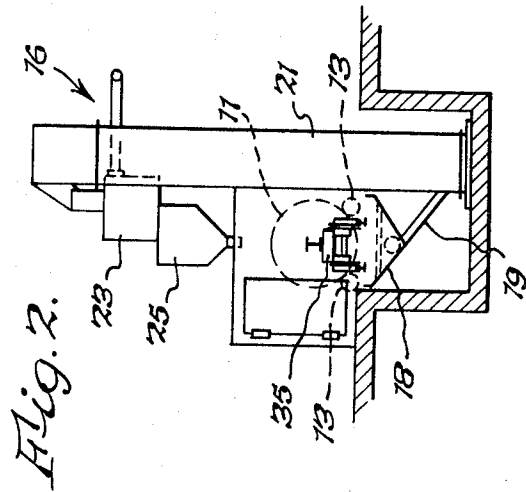
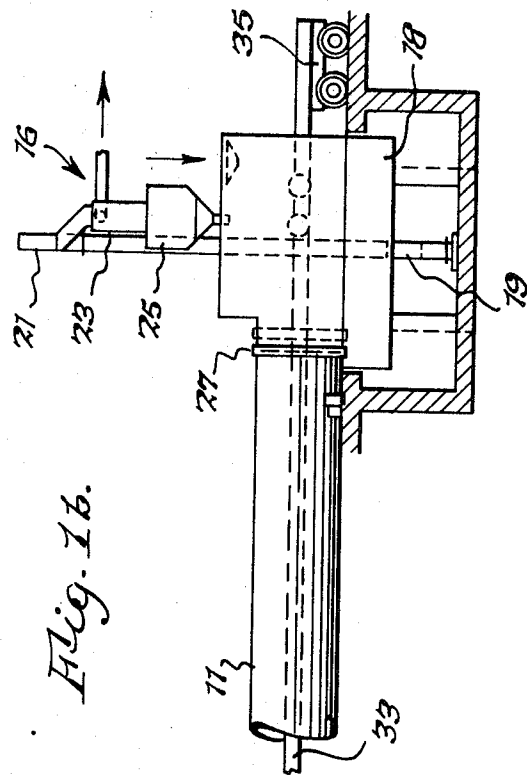
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[57] ABSTRACT

In an apparatus for cleaning the interior of a pipe or like tubular object, a working unit which moves longitudinally through the pipe has a throwing wheel for discharging abrasive particles against the interior surface of the pipe. As the working unit moves through the pipe, the spent abrasive is collected and returned to the throwing wheel for reuse.

12 Claims, 7 Drawing Figures





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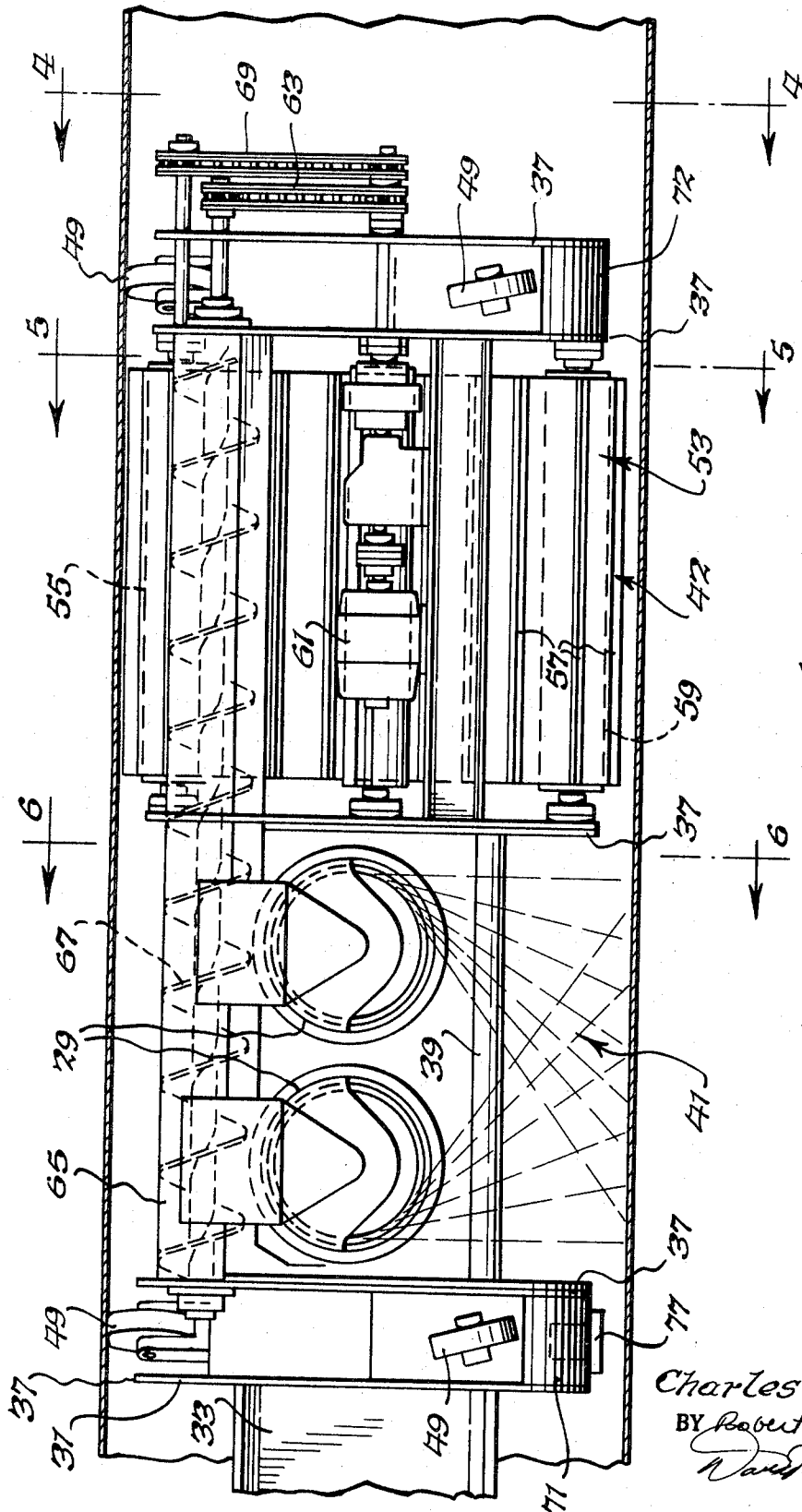


Fig. 3.

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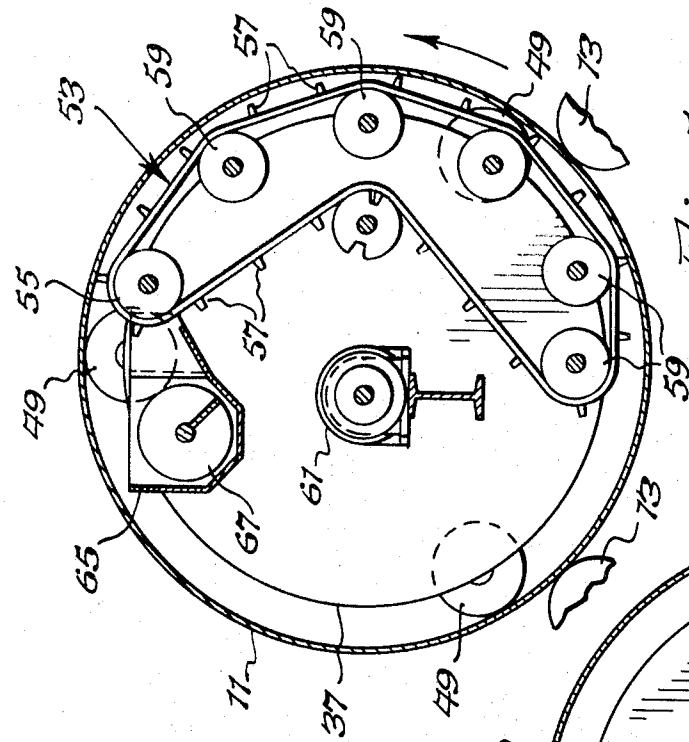


Fig. 5.

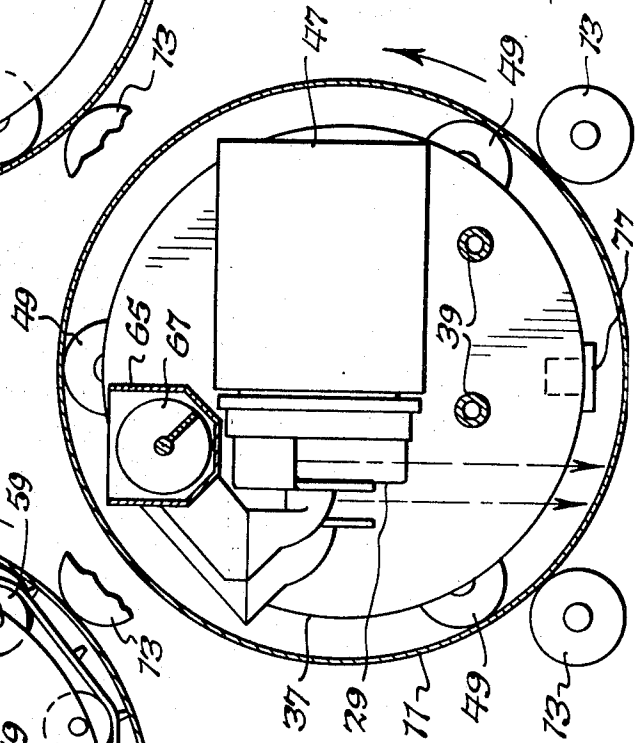


Fig. 6.

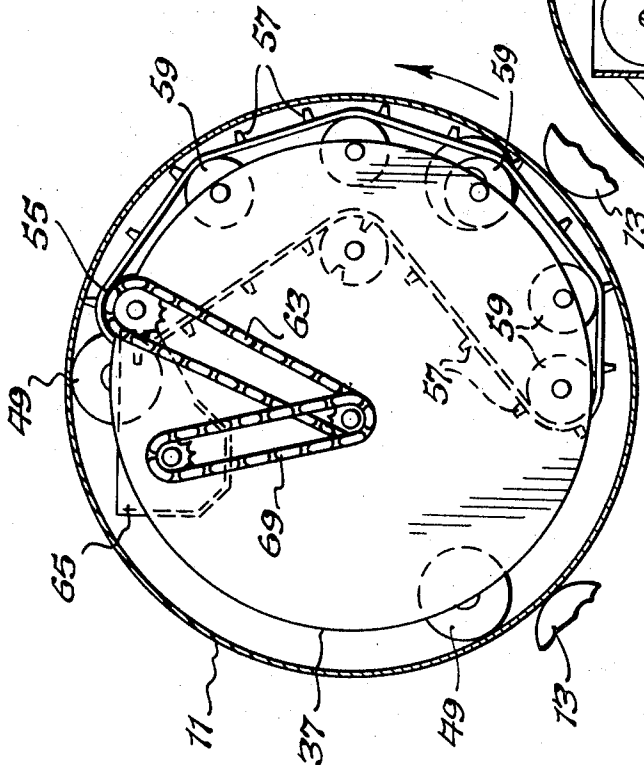


Fig. 7.

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PIPE CLEANING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for cleaning the interior of large diameter pipes.

One device, described in U.S. Pat. No. 3,151,418 to Powell et al., includes a carriage with an upper and lower arm, each arm supports a throwing wheel at the end thereof. The upper arm blast wheel cleans the outside surface while the lower arm blast wheel cleans the inside surface of the pipe. Abrasive is fed to the lower wheel through a trough which extends from the exterior of the pipe to the blasting wheel. For long pipes it becomes impractical to feed the shot over the great distance from the exterior of the pipe to the interior. Furthermore, it is desirable to eliminate as much of the spent abrasive that collects in the pipe during cleaning as possible. Heretofore, apparatus of the prior art have been found deficient in one or more respect for cleaning long, large diameter pipes.

SUMMARY OF THE INVENTION

According to the present invention, a working unit is adapted to be inserted into the interior of a pipe or tubular object for cleaning the interior surface thereof. The working unit includes supporting means for permitting rotational movement of the pipe with respect to the working unit as well as permitting the working unit to be inserted and retracted from the interior of the pipe. The working unit includes an abrasive blasting means for cleaning the interior surface of the pipe and conveyor system for collecting and returning projected abrasive to the abrasive blast means for reuse.

The apparatus of the present invention does not require a continuous supply of abrasive from the exterior opening of the pipe. Therefore, the working unit can more effectively clean great lengths of pipe. Furthermore, the accumulation of spent abrasive particles is reduced since the working unit of the present invention reuses the abrasive within the pipe. Thus, the present invention obviates many deficiencies of prior art devices.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a and FIG. 1b illustrate respective portions of one length of pipe with the abrasive cleaning apparatus of the present invention;

FIG. 2 is an end elevational view of the apparatus of FIG. 1b;

FIG. 3 is a side elevational view of the working unit of the present invention within a section of pipe;

FIG. 4 is an end elevational view along section 4—4 of FIG. 3;

FIG. 5 is an end elevational view along section 5—5 of FIG. 3; and

FIG. 6 is an end elevational view along section 6—6 of FIG. 3.

DETAILED DESCRIPTION

The overall apparatus of the present invention is illustrated in FIGS. 1a, 1b and 2. A long pipe 11 is supported by rollers 13 which are driven for rotating the pipe 11. At either end of the pipe 11, stations 15 and 16 are provided for receiving spent abrasive from a working unit 17 and recharging the working unit 17 with clean abrasive. Although the drawings illustrate two stations 15 and 16, it is to be recognized that only

one station is needed and for the sake of convenience, only one station 15 is hereinafter described.

The station 15 includes a hopper 18 for receiving spent abrasive from the working unit 17. Spent abrasive from the hopper 18 is fed through a tube 19 to the elevator 21 which conveys it to an air wash separator 23. The separator 23 is of the type described in U.S. Pat. No. 3,368,677 to Bradley, Jr., and effects a separation of the useful shot from waste material. This is accomplished by introducing an air curtain across a separating zone which includes a plurality of skimmer plates. The air curtain carries the lightweight contaminants over the skimmer plate and permits the heavier particles to fall downwardly.

The clean abrasive together with new make-up abrasive is stored in a hopper 25 which includes an abrasive gate for metering shot into the working unit 17. The stations 15 and 16 include retractable seals 27 for maintaining a sealing relationship with the ends of the pipe 11 and adapted to accommodate pipes of varying sizes. The seals are effective in confining the dust and debris generated by the cleaning process to the location of the stations 15 and 16.

As illustrated in FIGS. 1a and 1b a station 15 is provided at one end of the pipe 11 and station 16 at the other end. Each of the stations 15 and 16 includes a working unit 17 for cleaning one-half of the pipe 11.

The working unit 17 of the present invention includes an abrasive blasting means mounted on a frame 31 which is supported for longitudinal movement through the pipe 11. A boom or elongated member 33 is secured at one end to the working unit 17 and at the other end to a car 35 which drives the working unit or mole 17 into or out of the pipe 11. It is contemplated that other equivalent means can be used for inserting and retracting the mole or working unit 17, such as a hydraulic boom.

FIG. 3 is a side elevational view showing the working unit 17 within a section of pipe 11. The frame 31 of the working unit 17 consists of a plurality of vertical members 37 which are horizontally spaced and circular in shape. A suitable cross member 39 maintains the structural support and position of the vertical members 37. The vertical members 37 are spaced so as to form a plurality of compartments 41, 42. A pair of abrasive blasting wheels 29 with their respective motors 47 are positioned in an abrasive blasting compartment 41. The wheels or centrifugal throwing means 29 and related structure are mounted to a cross member 39 on the upper portion of the frame 31 above the axis of rotation of pipe 11. The wheels 29 rotate about an axis substantially perpendicular to the axis of the pipe 11 so as to form a blast pattern extending lengthwise of the pipe 11. Preferably, a pair of wheels 29 which rotate in opposite directions are utilized so that a uniform blast pattern can be established along the interior surface of the pipe 11.

The working unit 17 is supported to permit rotational movement of the pipe 11 with respect thereto so as to give a fixed blast pattern as the shot is sprayed downwardly from the abrasive blasting wheels 29. As the pipe 11 is rotated and the working unit 17 is moved gradually in a longitudinal direction so that entire inner surface of the pipe 11 is thus spray blasted and cleaned. The working unit 17 is supported at opposite ends thereof by rollers or casters 49 which are attached to the frame 31 for swivel movement to permit the work-

ing unit 17 to move forward while the pipe 11 rotates. As illustrated in FIG. 3, each end includes a plurality of casters 49 which engage the interior surface of the pipe 11 and maintain the alignment of the working unit 17 within the pipe.

An abrasive pickup or collecting compartment 42 which trails the blasting compartment 41 and is adjacent thereto includes means for collecting the spent abrasive. A conveyor system is mounted within the compartment between vertical support members 37. A conveyor surface or belt 53 is mounted for rotation in the same direction as the rotation of the pipe 11 and preferably moves at approximately the same speed as the pipe 11. One end of the conveyor surface 53 which is adjacent the lower end of the pipe 11 picks up abrasive which is fed thereto by the rotation of the pipe 11. Due to the closeness or proximity of the conveyor surface 53 to the interior surface of the pipe 11, the abrasive is held between the conveyor surface 53 and the interior of the pipe 11. As the pipe 11 and conveyor surface 53 move upwardly together, the abrasive particles are conveyed upwardly to a discharge end 55 of the conveyor. The conveyor surface 53 is preferably provided with a plurality of cleats 57 for contacting the interior surface of the pipe 11 to prevent abrasive particles from falling.

The conveyor surface 53 is preferably an endless belt which is trained about a plurality of rollers 59. Each of the rollers 59 is mounted for rotation between the vertical members 37 and within the compartment 42. At least one of the rollers 59 is driven by a suitable means, such as an electric motor 61 through a suitable drive train such as a chain 63 connected between a motor sprocket and a roller sprocket. In a preferred embodiment of the present invention, the rollers 59 can be mounted between a pair of plates pivotably mounted on the drive shaft. A pneumatic cylinder connected between a respective support member and hinged plate can be operated for retracting the conveyor system to allow clearance between the belt and the pipe 11 interior for fast mold retraction for movement forward.

The conveyor discharges the collected abrasive particles at the upper end 55 thereof into a trough 65 which extends axially from the collecting compartment 42 to the blasting compartment 41. A screw conveyor 67 is positioned in the trough 65 for transporting the abrasive along the trough 65 to the abrasive blasting wheel 29. The screw conveyor 67 is powered by a suitable means such as an electric motor 61 which can be the same electric motor 61 used to drive the belt 53. The driving connection between the electric motor 61 and the screw conveyor 67 can be accomplished by any suitable means such as an endless chain 69 connected between respective sprockets of the motor 61 and screw conveyor 67.

At either end of the working unit there are provided additional compartments 71 and 72. The compartment 72 trailing the abrasive blasting wheels 29 can be used to house ballast to lower the center of gravity and prevent rolling of the working unit 17. The compartment 71 adjacent to the abrasive blasting wheels 29 can be used for storage of abrasive particles to supplement and replace abrasive which is lost through ricocheting and breakdown. A valve 77 with a gate that can be remotely controlled can be used for releasing the stored abrasive at the proper time.

The suitable electrical connections needed for running the electric motors connected with the working unit and for energizing the controls associated therewith are provided through the elongated member 33 connected to the working unit 17 at one end thereof.

In operation the working units or moles 17 are in a retracted position when the pipe 11 is lifted onto the driving rollers 13 between the stations 15 and 16. Next the respective seals 27 of each of the stations 15 and 16 put into place over an end of the pipe 11. This permits the circulation of air from one end of the pipe 11 to the other thereby decreasing the pollution due to dust. The drive rollers 13 are actuated so that the pipe 11 rotates in a given direction. As illustrated in the drawings, the moles 17 are substantially identical with the abrasive blasting means 29 being located on one side and the collecting means on the other side. With this arrangement, the mole 17 which is associated with station 15 is utilized to clean the pipe as it is inserted into the end of the pipe 11, while the mole 17 which is associated with station 16 is utilized to clean the pipe 11 as it is retracted. With this arrangement, the conveyor system collecting spent abrasive follows the abrasive blasting apparatus. The unit is so designed so that each mole 17 cleans about one-half of the interior of the pipe 11. When it is determined that the abrasive in the working unit 17 is spent and can no longer be used for effectively and efficiently cleaning the interior of the pipe 11, the working unit 17 can be withdrawn rapidly into the station at a position over the hopper 18. In this position the spent abrasive is discharged into the hopper 18 and new abrasive is charged into the unit from an upper hopper 25. The working unit 17 can then be rapidly returned to its former position from which it can move slowly in a longitudinal direction to clean the remainder of the pipe 11.

While preferred embodiments of the present invention have been described and illustrated, it is to be recognized that modifications thereof may be made without departing from the broad spirit and scope of this invention as described in the appended claims.

What is claimed is:

1. A working unit adapted to be inserted into the interior of a pipe or tubular object for cleaning the interior surface thereof comprising:

- a. a frame;
- b. means supporting said frame to permit rotational movement of a pipe with respect thereto;
- c. an abrasive blasting means mounted on said frame and adapted to throw abrasive particles against the interior surface of a pipe when said working unit is inserted therein;
- d. means for feeding abrasive particles to said abrasive blasting means;
- e. a conveyor system mounted on said frame adjacent said abrasive blasting means for collecting abrasive particles thrown from said abrasive blasting means, said conveyor having a conveying surface adapted to be adjacent to and substantially conforming with the interior surface of the pipe and adapted to carry abrasive particles upwardly in the direction of rotation of the pipe, said conveyor adapted to convey projected abrasive particles to said feeding means.

2. Apparatus according to claim 1 wherein said conveying surface comprises an endless flexible belt, and

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said conveyor includes a plurality of rollers with said belt trained therearound.

3. Apparatus according to claim 2 including means for driving said belt at a speed sufficient to move the conveyor surface at about the same speed as the interior surface of the pipe when said pipe is rotated.

4. Apparatus according to claim 3 wherein said belt includes a plurality of cleats for contacting the interior surface of said pipe.

5. Apparatus according to claim 1 wherein said feeding means comprises a trough and a screw conveyor disposed within said trough.

6. Apparatus according to claim 1 wherein said abrasive blasting means includes a centrifugal throwing wheel adapted to have an axis of rotation above the axis of rotation of the pipe and substantially perpendicular thereto when said working unit is cleaning said pipe.

7. Apparatus according to claim 1 wherein said frame includes a plurality of substantially vertically aligned members forming a first and second compartment, said abrasive blasting means being mounted within said first

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compartment, and said conveyor being mounted within said second compartment.

8. Apparatus according to claim 7 wherein said surface comprises an endless flexible belt, and said conveyor includes a plurality of rollers mounted between a pair of vertical members with said belt trained therearound.

9. Apparatus according to claim 8 wherein said feeding means comprises a trough with a screw conveyor disposed therein

10. Apparatus according to claim 9 wherein said conveyor is adapted to discharge spent abrasive into said trough, said trough extending between said first and second compartments.

11. Apparatus according to claim 8 wherein said belt includes a plurality of cleats for contacting the interior surface of said pipe.

12. Apparatus according to claim 8 including means for driving said conveyor and said screw.

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