June 2, 1942. L. W. GRAYSON 2,285,157

METHOD OF AND APPARATUS FOR CLEANING PIPES

Filed May 17, 1940 4 Sheets-Sheet 1

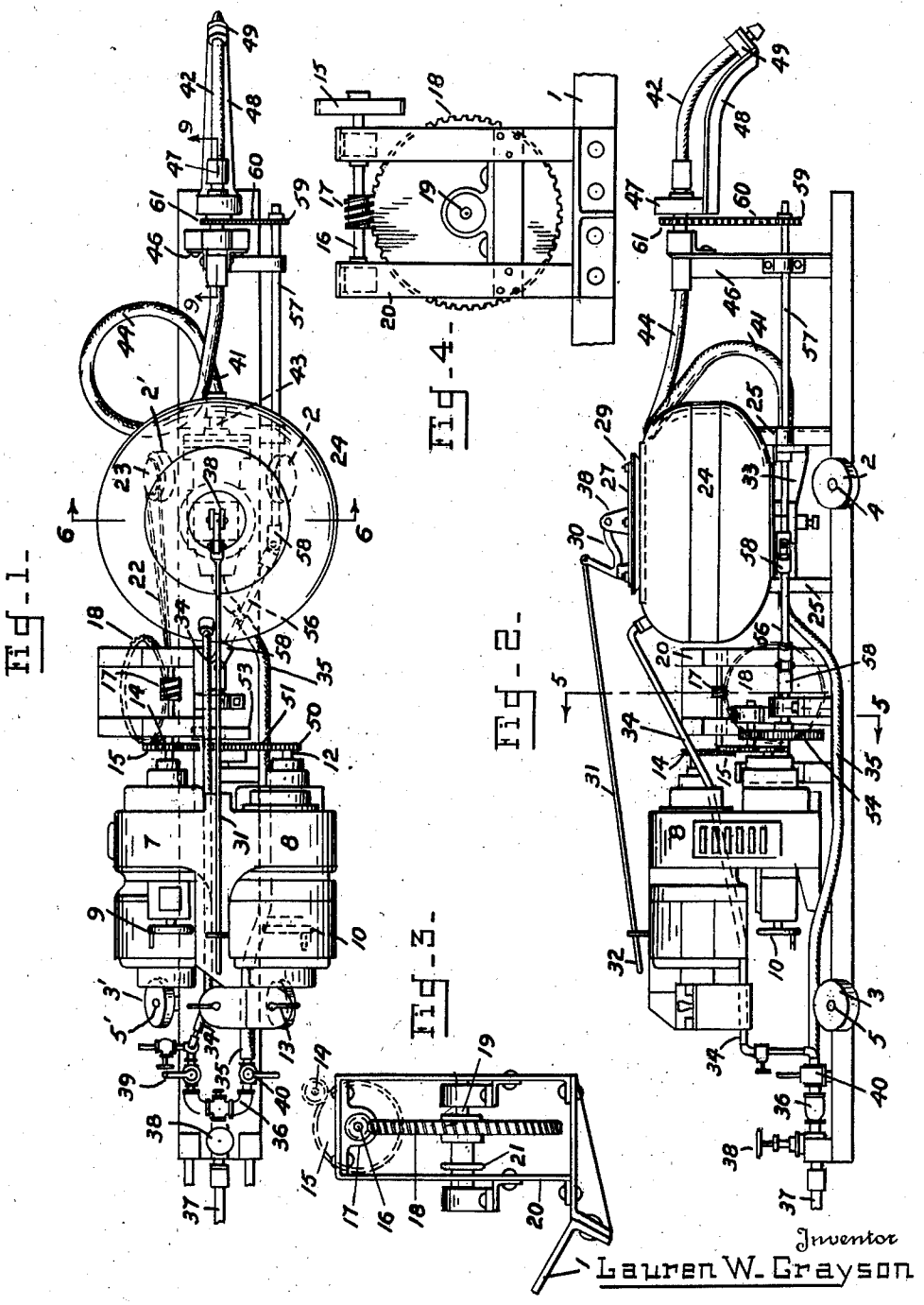


Fig-1-

Fig-4-

Fig-2-

Fig-3-

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METHOD OF AND APPARATUS FOR CLEANING PIPES

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Fig-5-

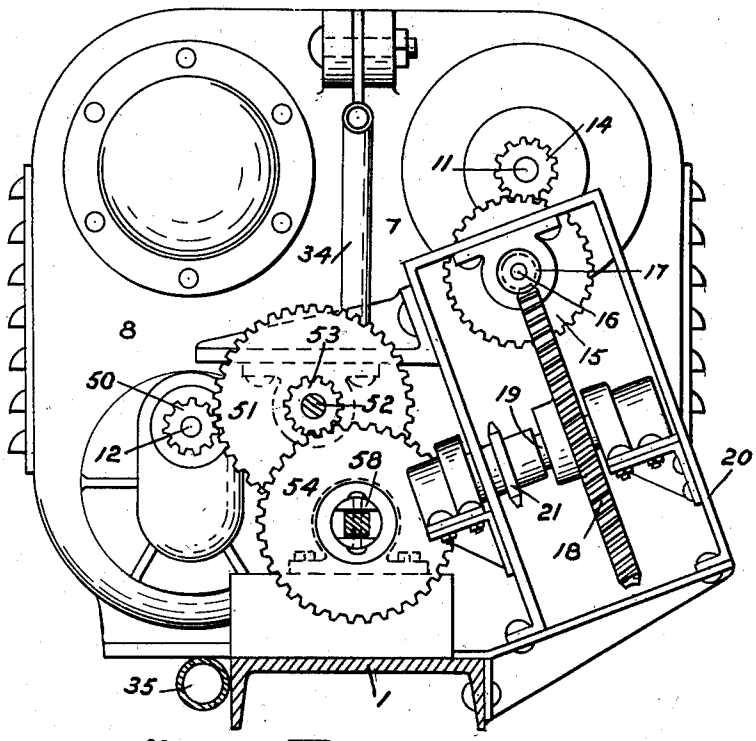
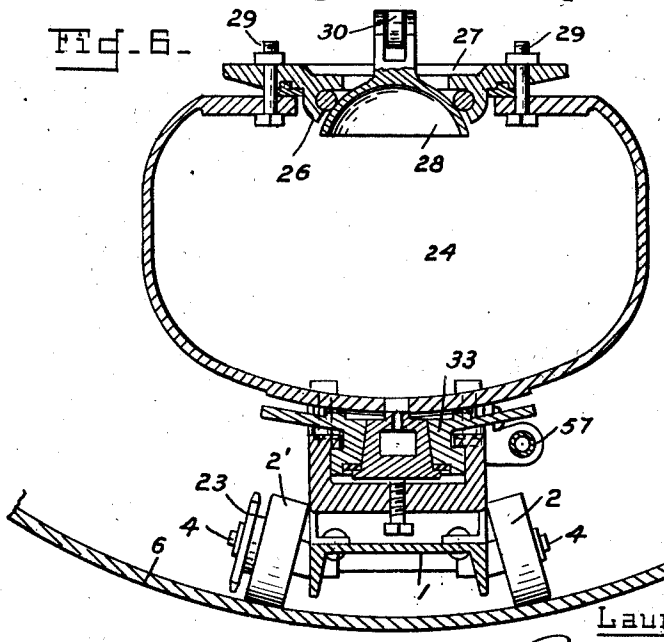



Fig-6-




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Fig. 9.

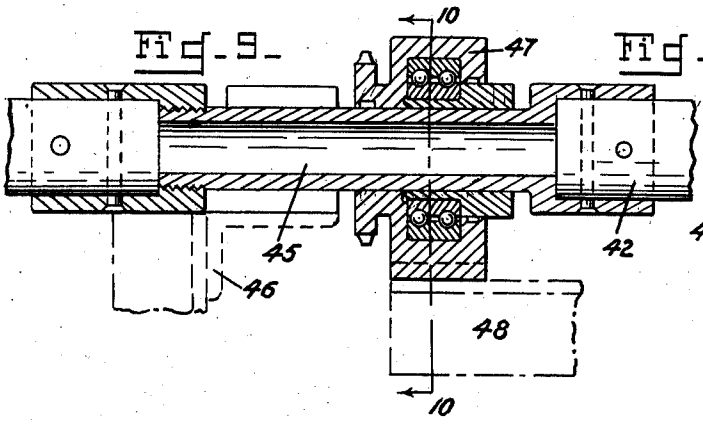



Fig. 10.

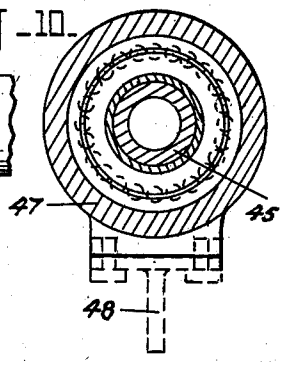



Fig. 7.

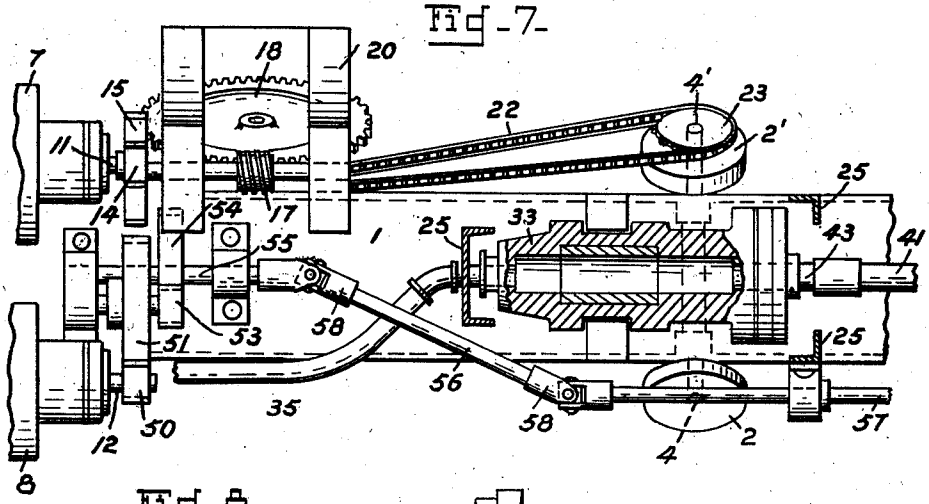
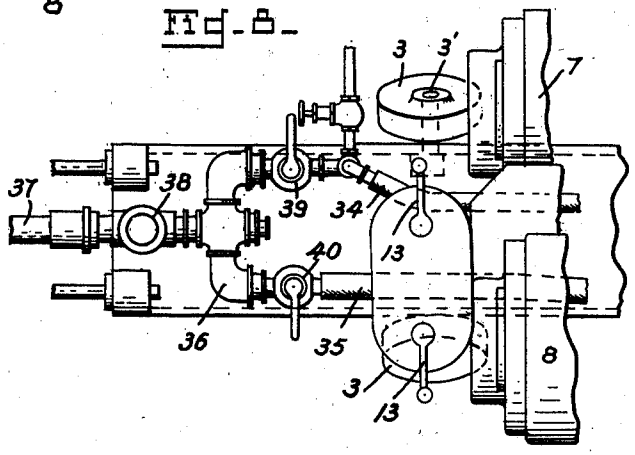



Fig. 8.




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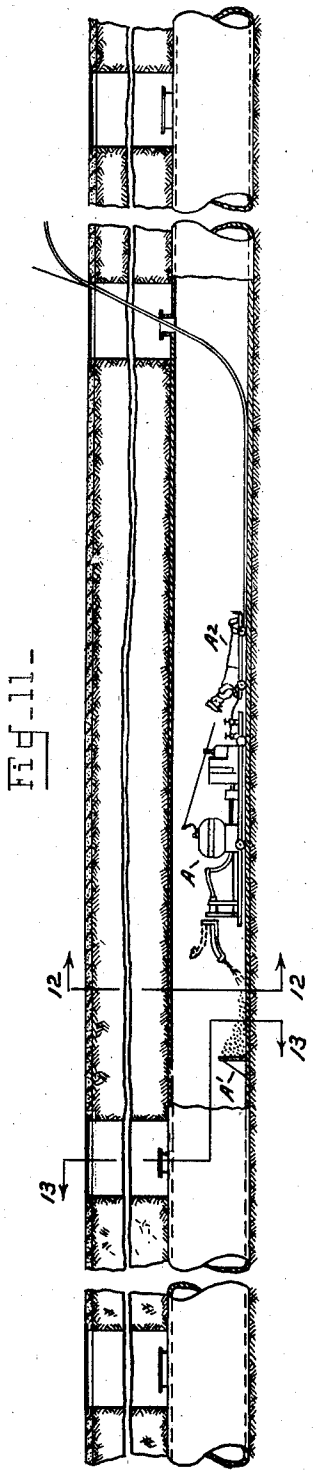



Fig. 11.

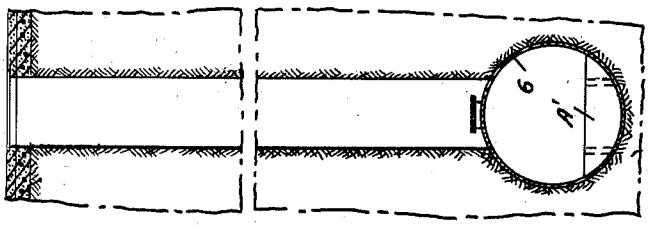



Fig. 13.

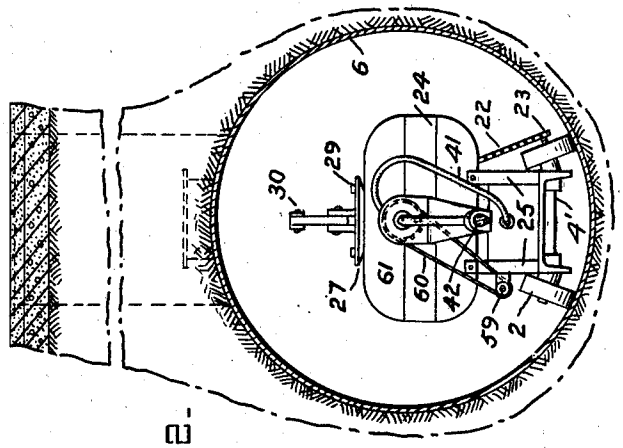



Fig. 12.

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# UNITED STATES PATENT OFFICE

2,285,157

## METHOD OF AND APPARATUS FOR CLEANING PIPES

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Application May 17, 1940, Serial No. 335,857

12 Claims. (Cl. 51—8)

This invention relates to a method of and apparatus or machine for automatically cleaning the interior of water or other pipes or similar surfaces.

One object of the invention is to provide a simple, reliable and efficient type of machine which may be operative within a tube or pipe to direct a blast of grit, shot or abrasive material against the interior of the pipe, whereby the latter may be quickly and efficiently cleaned.

A further object of the invention is to provide a machine or apparatus of this character which is motor propelled and provided with a rotatable nozzle, also motor propelled, for projecting a blast or stream of the abrasive material against the surface of the pipe.

A still further object of the invention is to provide a machine or apparatus of this character embodying a carriage, motor driven means for operating the carriage to propel it backward and forward, and motor driven means for operating the rotating blast nozzle, the motors and the driving means being separate from and independent of each other so that the speed of travel of the machine and its direction of movement and the operation of the blast nozzle may be independently controlled to give the best working results.

A still further object of the invention is to provide novel means for controlling the supply of air under pressure to a hopper containing the abrasive material and also supplying air under pressure to feed the material to and through the blast nozzle, combined with means whereby the pressures may be regulated to secure the best working results.

A still further object of the invention is to provide a machine or apparatus which is efficient in action, capable of being used in pipes or tubes of comparatively small diameter, and adapted to be manufactured, sold and operated at a comparatively low cost.

A still further object of the invention is to provide a novel method of conveying abrasive or like cleaning material through a pipe and blasting the interior surfaces of the pipe therewith and controlling the blasting action to vary the force or intensity of the treatment as occasion may require to secure an efficient cleansing action.

With these and other objects in view, the invention consists of the features of construction, combination and arrangement of parts, hereinafter more fully described and claimed, reference being had to the accompanying drawings, in which:

Fig. 1 is a top plan view of an apparatus of the character described embodying my invention.

Fig. 2 is a side elevation of the apparatus.

Figs. 3 and 4 are front and side views of parts of the structure showing elements of the gearing for propelling the apparatus.

Fig. 5 is a vertical transverse section on an enlarged scale through the apparatus taken on the line 5—5 of Fig. 2.

Fig. 6 is a similar section taken on the line 6—6 of Fig. 1.

Fig. 7 is an enlarged sectional plan view of a part of the apparatus showing particularly the gearing for propelling the apparatus and rotating the nozzle.

Fig. 8 is a plan view of a portion of the apparatus showing particularly the air supplying means.

Fig. 9 is an enlarged longitudinal sectional view through the nozzle.

Fig. 10 is a section on line 10—10 of Fig. 9.

Fig. 11 is a vertical longitudinal section through a portion of a pipe illustrating the mode of use of the apparatus therein.

Fig. 12 is a cross-section on line 12—12 of Fig. 11.

Fig. 13 is a cross-section on line 13—13 of Fig. 11.

Referring now more particularly to the drawings, A designates an apparatus embodying my invention, which comprises a base frame or carriage 1 mounted for travel on front and rear sets of supporting wheels 2, 2' and 3, 3', carried respectively by fixed axle spindles 4, 4' and 5, 5'. These wheels are arranged at a proper angle of inclination to support the machine for travel within the pipe 6 which is to be cleaned.

Mounted upon the frame are motors 7 and 8 arranged side by side at or near the rear end of the frame. The motors shown are of electrical type, but internal combustion or other motors may be employed. The motors are provided respectively with control devices 9 and 10 for governing the speed of operation of their shafts 11 and 12, and each motor may be provided with a control device 13 for governing its action to drive its shaft forwardly or rearwardly or to stop the motion of the shaft at will. The machine is adapted to be driven forwardly or rearwardly by means of suitable reduction gearing driven by the shaft 11 from the motor 7 to propel the machine at a desired slow speed.

This gearing comprises a spur pinion 14 on the shaft 11 which meshes with a gear 15 on a propeller shaft 16 on which is a worm 17 meshing with a worm gear 18 on a transmission shaft 19, which gear elements are supported in an upright frame or pedestal 20 mounted on the base frame or carriage. On the shaft 19 is a sprocket wheel or pinion 21 connected by a chain 22 with a sprocket wheel 23 fixed to one of the wheels 2, 2', as wheel 2' on the shaft 4', whereby the machine may be propelled backwardly or forwardly.

Supported on the machine in advance of the motors 7 and 8 is a hopper or receptacle 24 to contain the cleansing or coating material. This hopper is of pressure-sealed type and supported on frame members or pedestals 25 carried by the base frame or carriage 1. The hopper is provided at its top with a filling opening 26 through which the cleaning material may be introduced thereinto and which is adapted to be normally closed by a sealing cover 27 and valve 28. The cover 27 is detachably secured in position by bolts or other fastening members 29 and is provided with an opening therein adapted to be closed by the sealing valve 28, whereby any desired pressure may be maintained in the hopper and the pressure regulated or varied as occasion requires for a proper working operation. The valve 28 is coupled to a bell crank lever 30 connected with a rearwardly extending operating or control rod 31 having a handle 32 suitably arranged at the rear of the frame whereby the operator may open or close the valve as and when required. The hopper communicates at its bottom with a mixing or outlet chamber 33, communication between the two being provided by a restricted passage through which the material under pressure within the hopper may feed to the chamber for discharge. Hose pipes 34 and 35 communicate at their forward ends with the hopper 24 and the rear of the chamber 33 respectively for the supply of air under a desired working pressure thereto. These pipes communicate at their rear ends with the branches of a U-shaped coupling member or union 36 connecting the same with a main supply pipe or hose 37, whereby compressed air from a suitable source of supply may be furnished. A valve 38 arranged in the pipe 37 is provided for letting on, cutting off or regulating the supply of compressed air to the pipes 34 and 35 and valves 39 and 40 in the union branches are provided for similarly controlling the supply of the air to said pipes 34 and 35, whereby the amount of air supplied to each pipe 34 or 35 may be independently governed or the supply of air to either of said pipes cut off without cutting off the supply of air to the other pipe. The air supplied by the pipe 34 to the hopper 24 places the material therein under pressure for discharge to the chamber 33, the pressure in the hopper 24 being controlled by the regulation of supply through pipe 34 by proper manipulation of valve 39 when occasion requires, while the air supplied by pipe 35 to the chamber 33 operates to force the material from said chamber to a hose pipe 41 leading to a rotating distributor nozzle 42. The pipe 41 includes or is provided with an inlet nozzle 43 which communicates with the chamber 33 and is supported by the hopper frame or pedestal 25 so as to be fixed in position. From this nozzle 43 the distributor hose or pipe 41 extends in the form of a loop 44 to and communicates at its delivery end with the rear end of a hollow stationary shaft or nozzle carrier pipe 45, to the forward end of which the nozzle 42 is attached. The pipe 45 is fixedly supported on a standard or pedestal 46 extending upwardly from the base frame or carriage at the front of the machine and has journaled thereon a collar or head 47 to which is fastened one end of a bracket plate 48 having a suitable bearing 49 at its free end in which the outer end of the nozzle 42 is confined. The bracket 48 extends on a desired arc of curvature and the nozzle 42, which may be of flexible construction or have its body portion formed of hose piping, is correspondingly curved, allowing it to flex in accordance with the travel of the bracket 48, the curvature of the bracket and nozzle being such as to provide for the proper discharge of the cleaning material against the walls of the pipe as the nozzle is rotated.

The shaft 12 of the motor 8 carries a spur pinion 50 which meshes with a spur gear 51 on a nozzle drive shaft 52 which in turn carries a pinion 53 meshing with a spur gear 54 on a counter-shaft 55 whereby said counter-shaft is driven through the reduction gearing thus provided at a lower speed than the motor shaft 12. The counter-shaft 55 is connected by a transmission shaft 56 with a driven shaft 57, arranged out of alinement with the shaft 55 but parallel therewith, the shaft 57 being universally jointed, as at 58, at its opposite ends with the shafts 55 and 56. The shaft 57 is journaled in bearings on the pedestals 25 and 46 and carries a sprocket wheel 59 connected by a chain 60 with a sprocket wheel 61 on the collar or head 47 of the nozzle whereby motion will be transmitted from shaft 57 to the nozzle carrier shaft and nozzle to rotate said nozzle in a path generally at right angles to the line of travel of the vehicle and in a circular path to cause the cleaning material to be directed therefrom against the inner surface of the pipe 6 to be cleaned, whereby an effective cleaning action will be obtained.

From the foregoing description, it will be understood that the machine is designed to travel, as shown in Figs. 11 and 12, through the water conducting, sewer or other pipe 6 to be cleaned. The cleaning material, which may be shot, sand, or any kind of abrasive material or mixture of abrasive materials, is stored under pressure in the hopper 24, from which it feeds to the mixing chamber 33, from which it is forced by pressure supplied through the pipe 35 to the pipe 41 which conducts it to the nozzle 42. The material in the hopper 24 may be kept under any desired or suitable forcing pressure, and discharged from the chamber 33 under pressure from pipe 35 conforming to that in the hopper, so that a pressure balance for a proper feeding of the material will be maintained. As the material discharges from the nozzle 42, whose delivery end is rotated in close contact with the pipe, the force with which it is discharged causes a rapid and clear removal of all foul or foreign substances from the interior surface of the pipe 6. In practice, the position of the nozzle as it revolves with respect to the interior surface of the pipe 6, may be regulated, as by the use of a properly curved nozzle, or by the use of cams or other devices which will automatically adjust the nozzle or may be controlled by the operator to adjust the nozzle to move at a determined distance from the surface of the pipe 6, so that a pipe of any diameter or cross-sectional shape may be efficiently cleaned. As the machine travels through the pipe its rapidity of travel, as well

as the rapidity of rotation of the nozzle, may be governed by properly controlling the working actions of the motors, and the cleaning action may be further regulated and controlled by regulating the amount and pressure of the fluid supplied to the hopper and material distributing chamber. By disposing a partial bulkhead or partition A' in the pipe 6 at a suitable distance, from time to time, ahead of the machine as its travels, the abrasive or cleansing material which is discharged may be kept confined and as the machine approaches the bulkhead it may be stopped and the abrasive material shoveled back into the hopper to be used again. In a normal operation in pipes of a diameter of twenty inches or more, that is, sufficiently large to accommodate workmen, workmen who travel with the machine inside the pipe regulate the speed and flow of the abrasive material or mixture and refill the hopper from time to time as it becomes empty. If desired, a light trailer A2 may be attached to the rear of the carriage or frame 1 to serve as a support on which the operator may ride as the machine travels through the pipe. In practice, two men may be employed within the pipe to operate the machine; an operator who regulates the speed and flow of the abrasive materials and a loader who refills the hopper from time to time as it becomes necessary, the operator being transported on the referred to trailer, while the loader works in front of the machine. As stated, the cleansing material employed may be sand, shot of suitable size, or any other suitable kind of abrasive material or a mixture of such materials, and the machine may be built of such size as to operate in pipes of both large and small diameters within a given range per size of machine. Machines of different sizes for use within pipes of given ranges of diameters may be manufactured and sold so that water, sewer or other pipes of any diameter in use may be cleansed by means of this machine. In the event that the pipe to be cleaned is too small for the entrance and travel therein of the complete machine, provision may be made for mounting the rotating nozzle alone for travel in the pipe and motion may be transmitted to the machine and the material supplied to the nozzle through power and material supply conductors leading from the outside of the pipe. As is well known, the cleaning of the interior of various kinds of pipe lines has been ordinarily done by means of abrasive materials applied through manually manipulated blast pipes. This mode of operation has always involved a large expense. The coating of interiors of pipe lines, tunnels or canals with cement, protective materials, enamels or other linings has likewise involved manual operation at high expense. By the use of my machine a stream of abrasive material under air pressure may be supplied to the interior of pipe lines automatically through simple operations easily controlled and whereby the amount of time and cost for labor and materials will be considerably reduced below that involved in hand operations of the character referred to. It is to be understood, of course, that the machine may also be used for coating the interior of pipes with protective materials of the character specified by simply substituting for the hopper 24 a chamber or reservoir to contain the cement, paint, enamel or other protective material to be dispensed, which may be discharged by air pressure in the manner herein set forth or by equivalent pumping means through the discharge nozzle to coat the interior of the pipe. In the use of shot or like material as an abrasive material, the discharged material may, as stated, be kept confined by the use of a partial bulkhead disposed at a suitable distance, from time to time, ahead of the machine as it travels, so that the discharged material may be accumulated and fed for reuse back into the hopper, thus allowing an apparatus of this character to be operated with great economy.

From the foregoing description, taken in connection with the drawings, the construction, mode of operation and advantages of my improved automatic pipe cleaning or coating machine will be readily understood without a further and extended description and it will be seen that the invention provides a machine of this character which is comparatively simple of construction and which may be conveniently operated at low cost. While the structural organization disclosed is preferred, it will, of course, be understood that changes in the form, construction, arrangement and proportions of the parts may be resorted to, within the scope of the appended claims, without departing from the spirit or sacrificing any of the advantages of the invention.

What I claim is:

1. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, a rotary blast nozzle mounted on the carriage, means including a conductor connecting the hopper with the nozzle for feeding the material under pressure from the hopper to the nozzle and discharging the same from the latter, and motor driven means mounted on the carriage separate from and independent of the conductor for rotating the blast nozzle.

2. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, said hopper having a filling inlet, a discharge outlet and a removal closure for the inlet having a vent port therein, a manually operable valve controlling said port, a rotary blast nozzle mounted on the carriage, means for supplying air under pressure to the hopper to place the material therein under pressure, a feed conductor leading from the outlet of the hopper to the blast nozzle, means for supplying air under pressure to the conductor to force the material from the hopper to the nozzle and discharge the material through the nozzle, and motor driven means on the carriage separate from and independent of said conductor for rotating the blast nozzle.

3. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, said hopper having a filling inlet, a discharge outlet, a sealing closure for the filling inlet, means for supplying air under pressure to the hopper, means for supplying air under pressure to the discharge outlet, a rotary blast nozzle mounted on the carriage, a conductor connecting said nozzle with the hopper outlet, means whereby the air pressure in the hopper may be regulated with respect to the air pressure supplied at the discharge outlet, and motor driven means on the carriage separate from and independent of the conductor for rotating the blast nozzzle.

4. An apparatus of the character described

comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, a rotary blast nozzle mounted on the carriage, means including a conductor connecting the hopper with the blast nozzle for feeding the material under pressure from the hopper to the nozzle and discharging the same from the latter, a pair of motors on the carriage, gearing driven by one of the motors for propelling the carriage, and gearing mounted independent of said conductor and driven by the other motor for rotating the blast nozzle.

5. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, a rotary blast nozzle mounted on the carriage, means for supplying air under discharging pressure to the hopper to place the material therein under pressure, a feed conductor leading from the outlet of the hopper to the blast nozzle, means for supplying air under pressure to the conductor to force the material as it issues from the outlet of the hopper to the nozzle and discharge the material through the nozzle, a pair of motors on the carriage, gearing driven by one of the motors for propelling the carriage, and gearing mounted independent of said feed conductor and driven by the other motor for rotating the blast nozzle.

6. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, said hopper having a filling inlet, a discharge outlet, a feed conductor leading from said outlet, a sealing closure for the filling inlet, means for supplying air under pressure to the hopper to place the material therein under discharging pressure, means for supplying air under pressure to the discharge outlet to force the material as it issues from the outlet through the feed conductor, a rotary blast nozzle mounted on the carriage and communicating with said feed conductor, a manually operable valve controlling the pressure whereby the air pressure in the hopper may be regulated with respect to the air pressure supplied at the discharge outlet, a pair of motors on the carriage, gearing driven by one of the motors for propelling the carriage, and gearing mounted independently of the feed conductor and driven by the other motor for rotating the blast nozzle.

7. An apparatus of the character described comprising a traveling carriage, motor driven means for propelling the carriage, a hopper on the carriage for containing material to be discharged therefrom, a rotary blast nozzle mounted on the carriage, means including a conductor connecting the hopper with the blast nozzle for feeding the material under pressure from the hopper to the nozzle and discharging the same from the latter, and means mounted independent of the conductor and independent of the carriage propelling means for rotating the blast nozzle.

8. In an apparatus of the character described, a traveling carriage, a hopper on the carriage, a hollow fixed shaft supported on the carriage, a flexible discharge nozzle having an inlet end connected to and communicating with said shaft, a bearing member rotatable about said shaft, a bracket arm connecting said bearing member with the discharge end of the nozzle, a material feed conductor leading from the hopper to the hollow shaft, and gearing connected to said bearing member for rotating the same and effecting the transmission of rotary motion through the bracket arm to the discharge end of the discharge nozzle.

9. In an apparatus of the character described, a traveling carriage, a hopper on the carriage, a fixed hollow shaft mounted on the carriage and communicating with the hopper, a supporting collar or head journaled thereto, a bracket carried by said collar or head, a discharge nozzle connected at its inlet end to and communicating with the shaft and connected at its outlet end to and supported by the collar or head to rotate therewith, and gearing connected to said collar for rotating the same and the discharge nozzle.

10. In an apparatus of the character described, a traveling carriage, a hopper on the carriage, a fixed hollow shaft mounted on the carriage in advance of the hopper, a discharge nozzle communicating with and rotatable about said shaft, a material feed conductor leading from the hopper to the hollow shaft for the supply of material from the hopper to the hollow shaft and thence to the nozzle in rear of the hopper, a motor on the carriage, a nozzle driving shaft on the carriage extending partly beneath the hopper and partly in advance of the hopper, gearing between said shaft and the nozzle, a transmission shaft on the carriage in rear of the hopper, gearing between the motor and the transmission shaft, and a shaft arranged at an angle to the nozzle driving and transmission shaft and universally jointed thereto.

11. A method of cleaning the interior surfaces of pipes comprising: providing a rapidly moving stream of air and directing said stream of air in a blast against said surfaces at an angle to cause said air to flow along said pipe in a direction away from the point at which said blast was produced; causing said blasting operation to progress in the aforesaid direction along said pipe; feeding shot or the like into said air stream closely adjacent to the aforesaid point; disposing a barrier in the pipe at a point in advance of the blasting operation being conducted so as to bank the shot being fed into said air stream after blasting contact with the pipe surfaces, and collecting the banked spent shot.

12. In an apparatus of the character described, a traveling carriage, a hopper on the carriage, a stationary hollow shaft on the carriage, a material feed conductor leading from the hopper to the hollow shaft, a bearing member mounted to rotate about the hollow shaft, a material discharge nozzle in communication with the hollow shaft and supported for rotation by and with said bearing member, and motor driven gearing separate from and independent of said conductor for rotating said bearing member and nozzle.

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