Aug. 24, 1948. D. K. STEPHENS 2,447,966

EXPANDABLE FLUID ACTUATED PIPE CLEANING APPARATUS.

Filed Jan. 23, 1947 3 Sheets-Sheet 1

Fig. 1.

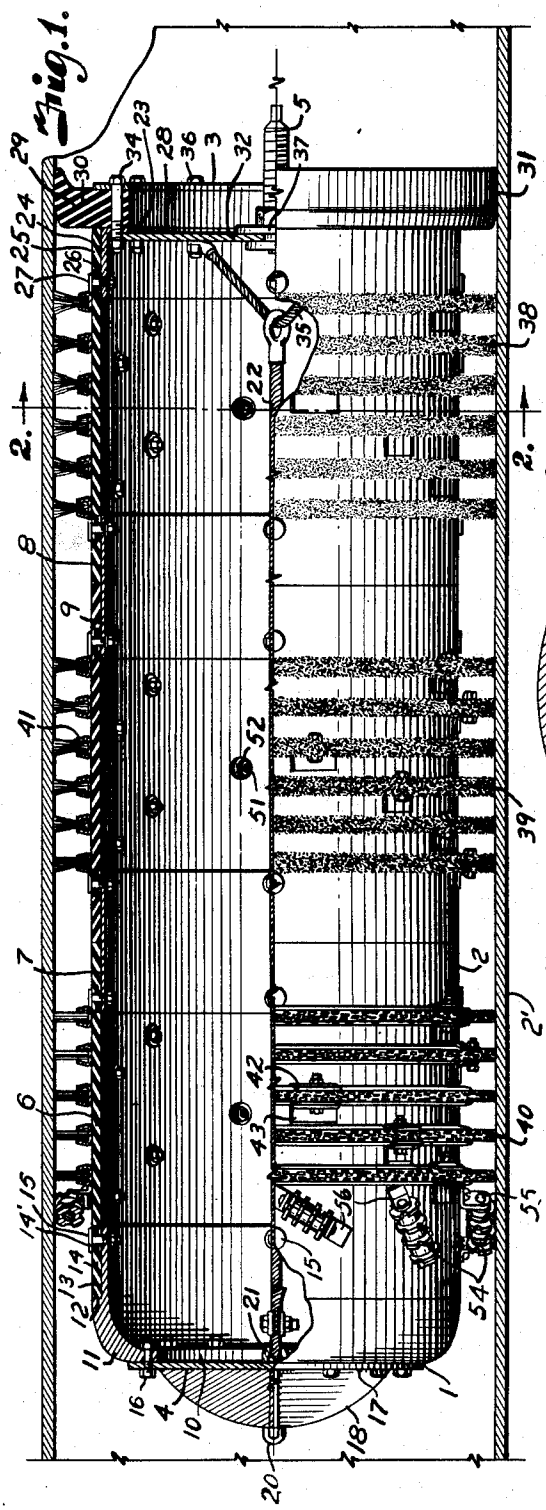
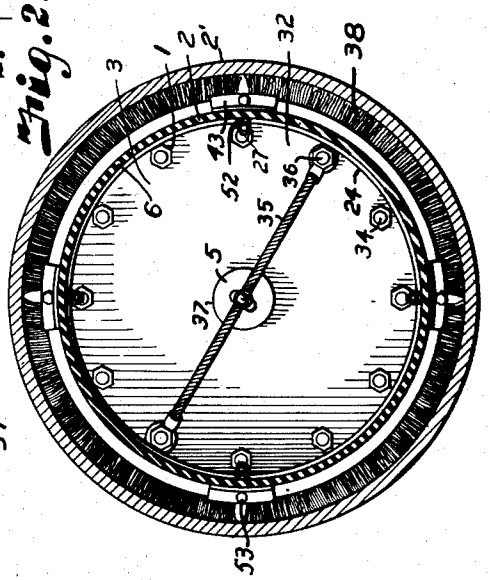


Fig. 2.



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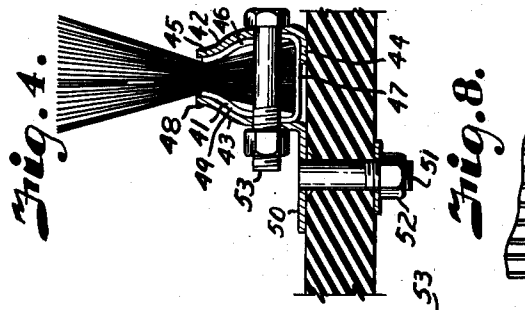


Fig. 4.

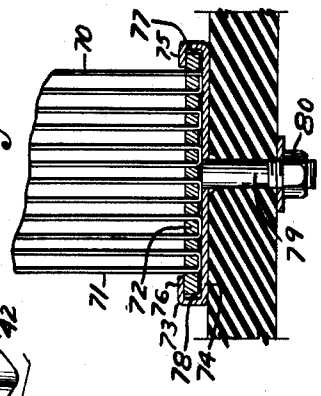


Fig. 8.

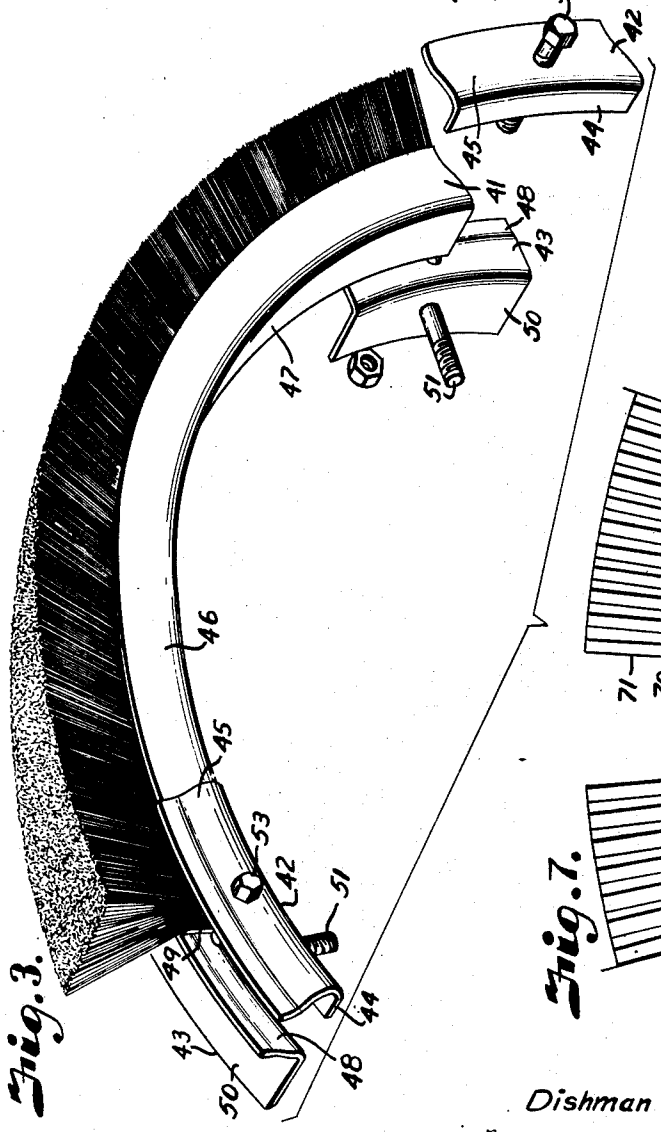


Fig. 3.

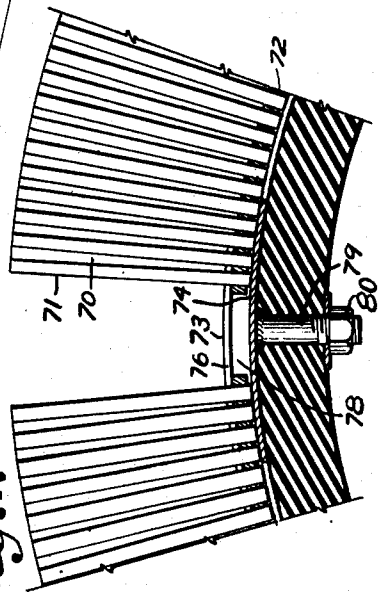


Fig. 7.

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EXPANDABLE FLUID ACTUATED PIPE CLEANING APPARATUS

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Fig. 5.

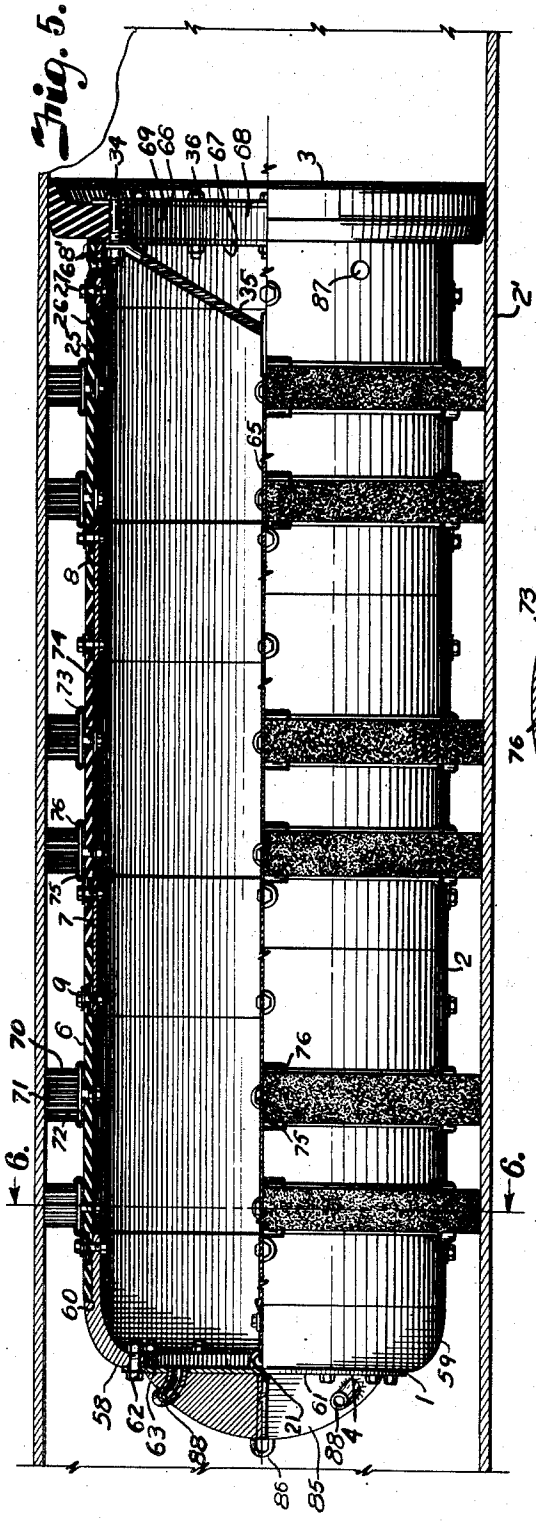
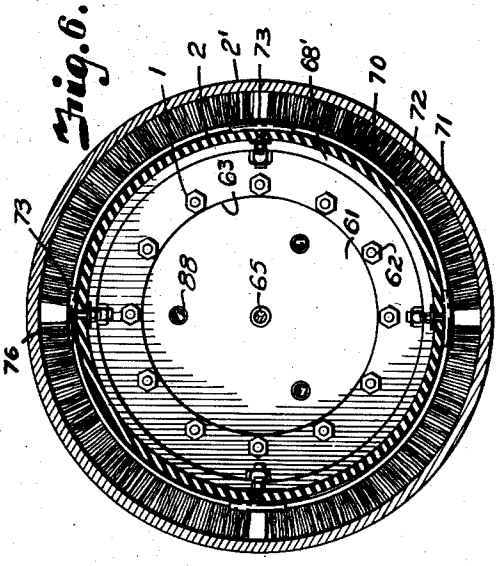


Fig. 6.



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UNITED STATES PATENT OFFICE

2,447,966

EXPANDIBLE FLUID ACTUATED PIPE-CLEANING APPARATUS

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10 Claims. (Cl. 15—104.06)

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This invention relates to expandable fluid actuated pipe cleaning apparatus commonly known as a "go-devil" used in cleaning pipe lines employed for transmitting fluid such as natural gas.

The principal objects of the present invention are to provide a device for freeing the interior walls of pipe lines of mill scale, dust, sand, products of corrosion and other extraneous material; to provide a device of this character having expandable side walls; to provide a pipe cleaning apparatus exerting uniform pressure around the interior of the pipe; to provide a device having a longitudinal body provided with a plurality of cutters and/or brushes around its exterior surface to contact the walls of the pipe line being cleaned; to provide bristles or brushes of different degrees of stiffness so as to secure a wiping and polishing action as well as scouring or scraping; to provide a device of this character adapted to be propelled by motive fluid through the pipe line, such as gas; to provide a device of this character having an inflatable body member; to provide means for inflating the body member and propelling it through the pipe line; to provide means in the respective ends of the device for allowing the gas or other fluid to flow therethrough; to provide means longitudinally of the device for maintaining the ends in relative spaced relation to the inflatable body member; and to provide improved elements and arrangements of elements in an apparatus of this character.

In accomplishing these and other objects of the invention, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side view of my improved go-devil shown partly in elevation and partly in section to better illustrate the invention.

Fig. 2 is a transverse cross sectional view taken on a line 2—2, Fig. 1.

Fig. 3 is an elevational view of a section of the bristles and the means for connecting the sections together.

Fig. 4 is a cross sectional view of the bristles illustrating the connection thereof to the inflatable body member.

Fig. 5 is a side view of a modified form of the invention shown partly in elevation and partly in section to better illustrate the invention.

Fig. 6 is a transverse cross section taken on a line 6—6, Fig. 5.

Fig. 7 is an elevational view illustrating the bristles shown in the modified form of invention of Figs. 5 and 6.

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Fig. 8 is an end view of the section of bristles illustrated in the modified form of invention.

Referring more in detail to the drawings:

1 designates a go-devil embodying the features of my invention consisting of a body member 2 preferably of elongated shape adapted to be inserted on the inside of a pipe line 2' and be propelled therethrough by gas or other motive fluid. As illustrated in Fig. 1, the device consists of closed rear and front ends 3 and 4 respectively, and 5 designates a valve in the rear end through which gas or other fluid may be admitted to the interior of the body member 2 for inflating the same, a separate inflatable bag may be used in the body member if desired.

The elongated body member is preferably made of a plurality of sections of rubber as indicated at 6 having a fabric reinforcing material and the sections joined together by metal rings 7 and 8 to which the rubber sections of the body are connected by bolts or the like 9.

The end 4 comprises a closure member 10 having rounded corners 11 with an offset portion 12 providing a flange 13 to which the end rubber section 14 is attached by a metal ring member 14' by a bolt or the like 15. Secured to the end plate 10 by bolts or the like 16 is a plate 17 to which are secured fins or the like 18. A loop 20 is secured to said fins for a purpose later described. A loop 21 is secured to the inside of the plate 17 and adapted to receive a cable or the like 22 extending longitudinally of the body member 2 and attached to the end 3 of the go-devil to hold the ends to the body member to hold the body member in shape and prevent excessive elongation of the body.

The end 3 comprises an inner plate 23 having an inturned flange 24 adapted to be secured to the end rubber section 25 by a metal ring member 26 by bolts or the like 27. A plate 28 is spaced from the plate 23 and secured between the plate is a squeegee 29 preferably composed of rubber or like material having a portion 30 extending beyond the body member 2 and the outer end turned laterally forming a surface for engaging the inside of the pipe 2' as indicated at 31 (Fig. 1). A plate 32 is provided to engage the inner plate 23 and the plate and squeegee are all held in place by a bolt or the like 34. The cable 22 is secured to a short cable 35 and the respective ends of the cable 35 are secured to the end 3 by bolts or the like 36 which also aid in holding the plates 23 and 28 and rubber member 29 together. The plate 32 has an opening adapted to receive the valve 5 and the valve is provided with the

usual connection 37 on the inner plate 32, or with a separate inflatable bag if desired.

Surrounding the body member 2 is a series of brushes 38, 39 and 40. I have here illustrated six rows of brushes in each series although any number may be used without departing from the spirit of my invention. The series 38 is of finer bristle than series 39 and 40, and series 39 is also finer than series 40. The bristles of all series may be made of wire, hair, or other suitable material, and series 40 is substantially stiff to remove scale and other matter from the inside of the pipe and the softer series 38 and 39 will polish and clean the surface as the go-devil is propelled through the pipe, the squeegee 29 engaging the pipe to finally clean it, propel removed scale and like material ahead of the go-devil and prevent the material from passing the end of the go-devil as it passes therethrough.

The series of bristles comprise annular rows around the body member and each row is comprised of sections as best illustrated in Fig. 2. The rows are composed of a plurality of bristles held by a substantially U-shaped flange member 41, the open end of which is compressed to engage the bristles therebetween and hold them in place. The sections 41 for holding the bristles are fastened together around the circumference of the body member 2 by clamping members or plates 42 and 43. The clamping member 42 has a bottom portion 44 and a side portion 45 formed to conform to the side 46 of the member 41 and the bottom 44 under the bottom face 47 of the member 41. The plate 43 has a side 48 also bent to conform to the side 49 of the member 41 and has an outwardly turned flange 50 carrying a stud bolt 51 which is welded or otherwise suitably secured thereto which extends through an opening in the side of the body member and is fastened thereto by a nut 52 to hold the rows of bristles around the circumference of the body member 2. The clamping members 42 and 43 are provided with openings substantially midway of the side portions 45 and 48 adapted to receive a bolt or the like 53 which extends between the sections 41 of the rows of bristles. The member 41 is loosely engaged by the clamping members 42 and 43 so that it may move with respect to the clamping members to provide for expansion and contraction of the bristles as the go-devil moves through the pipe line. The bolt 9 of the metal rings 7 and 8 extends through the flange 50 on the outer rows of the respective series of the rows of bristles and also extends through the metal flange 13 of the end 4 and flange 24 of the end plate 23 of the go-devil. The sections and clamping plates are staggered around the body member 2 as illustrated in Fig. 1, and while I have illustrated four sections, any number may be used.

Mounted on the rubber section 6 adjacent the flange 13 are a plurality of cutter member 54 rotatably carried on shafts 55 supported on brackets 56. The cutters are located adjacent the flange 13 where the outward movement due to inflation of the body member is limited and excessive pressure between the cutters and pipe is prevented. However, the cutter contact will remove scale or the like that might resist action of the brushes. The cutters are preferably mounted in angular relation to the direction of movement of the cleaning device through the pipe and the engagement of said cutters with the pipe tends to effect rotation of the cleaning device during its travel through said pipe.

Operation of the go-devil constructed and assembled as described is as follows:

The forward end 4 is inserted in the pipe line 2' and the body 2 inflated with gas or other fluid. Gas or other motive fluid may be applied behind the go-devil against the end 3, propelling the go-devil through the pipe. The cutters 54 will loosen scale and the like and the first series of bristles 40 near the forward end being stiff, will remove the heavier scale and other foreign matter from the inside of the pipe and the series of bristles 39 and 38, respectively, graduated to softer fiber, will polish and clean the walls of the pipe as the loosened material is propelled through the pipe. The squeegee 29 will carry what material is loosened forwardly thereof and prevent the same from going behind the go-devil in the pipe, thus carrying the dirt ahead of the squeegee. The cable 22 will hold the ends and tend to lend stability to the structure. Inflating of the bag or body 2 will cause the rubber portion 6 to be inflated to cover uneven places in the pipe line and at all times to provide uniform engagement of the bristles with the inside walls of the pipe. The loop 20 in the end 4 may be utilized for handling the go-devil and when advisable, may form a hook for pulling the go-devil through the pipe.

The form of invention illustrated in Figs. 5, 6, 7 and 8 comprises a body member substantially the same as the body member shown in Figs. 1 to 4 inclusive, and like numbers have been applied to the body member, ends and sections of rubber comprising the body portion as well as the metal plate joints shown in the preferred form of the invention.

The end 4 of this form of the invention comprises a member 58 having rounded corners 59 and offset flanges 60 to which the rubber sections are attached as in the preferred form of the invention. A plate 61 is attached to the member 58 by bolts 62 and covers a concentric opening 63 in the end member 58. The plate 61 is provided with a loop 21 to which a cable 65 is attached and extends through the body member and has its opposite end attached to the end 3 as in the preferred form of the invention.

The end 3 comprises an outer plate 66 and an inner plate 67 adapted to receive therebetween the rubber squeegee 68 having outturned flanges as in the preferred form of the invention for engaging the inside of the pipe 2'. The plate 67 has an inturned flange 68' to which is attached the end section of the rubber body, also as in the preferred form of the invention. The end plates 66 and 67 and the rubber squeegee are provided with an opening 69 of substantially greater size than the opening 63 in the front end 4 of the go-devil.

A series of annular brushes or bristles 70 is secured to the body member around the outer circumference thereof spaced apart as best illustrated in Fig. 5. The brushes shown in this form of invention are all of substantially the same stiffness.

The rows of bristles around the circumference of the body member 2 are comprised of sections here illustrated as four, and the bristles are preferably made of wire or similar stiff material as indicated at 71 (Fig. 7) and are inset into a base 72 preferably of metal or similar material. The base 72 is provided with openings and the wires run through said openings providing a U-shaped member hooked through the openings in the base member 72 as best illustrated in Fig. 8. The sections are spaced apart around the periphery of

the body member and held in place by clamping members 73 having a substantially flat back portion 74 engaging against the rubber of the body and the respective sides thereof are turned outwardly and inwardly forming hooks 75 and 76 providing grooves 77 and 78 to loosely engage the respective sides of the base sections 72 where they are joined together as best illustrated in Fig. 6. The clamping members are provided with openings to receive stud bolts or the like 79 which may be welded or otherwise suitably secured in said openings. The stud bolts extend through openings in the rubber body member and are provided with nuts 80 to retain the respective rows of bristles spaced on the body member as illustrated in Fig. 5. The base members 72 of the respective sections of the rows of bristles are thus free to move with respect to the clamping members 73 to allow for expansion and contraction of the sections of the bristles as the go-devil is propelled through the pipe line.

The forward end 4 of the go-devil in the form of invention shown in Fig. 5 is provided with a plurality of fins 85 to which is secured a loop 86 providing a grab rod or hook for handling the go-devil as in the preferred form of the invention.

It may be desirable to allow some of the propelling fluid to pass through the cleaning device, thereby reducing the differential pressure between the inside and outside of the body and the pressure of the bristles against the pipe wall. The fluid passing through the body is utilized to rotate the cleaning device and to blow scale, dirt and the like from the bristles providing maximum cleaning efficiency thereof. A plurality of openings or nozzles 87 are provided in the flange 68' adjacent the end 3 of the device and extend through the portion of the rubber section 25 overlying said flange, said nozzles being arranged at an angle to the radius whereby the force of the fluids issuing therefrom tends to rotate the cleaning device. Cooperating with the nozzles 87 in effecting rotation of the device and reducing the differential pressure are nozzles 88 mounted in the plate 63 and having communication with the interior of the body through the opening 83 of the member 58. The nozzles are preferably spaced from the axis of the device and turned outwardly at substantially the same angle as the nozzle 87 whereby passage of fluid therethrough effects rotation of the device.

In operation of the go-devil shown in the modified form of the invention, the forward end 3 is inserted in the pipe line and gas, air or other motive fluid is applied behind the go-devil, forcing the go-devil through the pipe. Motive fluid entering the openings 69 of the end 3 which are larger than the combined openings in the nozzles 87 and 88 will cause an accumulation of gas in the body member and a smaller amount escaping out of the nozzles to the forward end of the go-devil will cause pressure against such forward end to aid in propelling the go-devil through the pipe line and the pressure building up in the body will cause expansion of the rubber body member so that the bristles will uniformly contact the inside of the pipe at all times, the bristles will uniformly contact the inside of the pipe at all times, the bristles thus loosening and carrying the scale, dirt and other material along with the go-devil and the squeegee contacting the pipe to prevent the dirt from going backward so that it will be carried ahead of the go-devil.

It will be noted that there is very little difference in the two forms of the invention, i. e., in the openings in the end plate of the modified form and in the number of rows of brushes or bristles around the circumference of the body 2. It will be obvious that the brushes 38, 39, 40 and 70 are to be utilized as required on any section 6 of the flexible body member shown in either Fig. 1 or Fig. 5 of the drawing; in other words, either form of bristles may be used in either form of the invention.

While I have described my invention as being adapted specifically for the cleaning of pipe lines, it will be obvious that it may be used for other purposes without departing from the spirit of my invention.

It will also be obvious from the foregoing that I have provided improved details of a flexible structure capable of passing by chill rings, or the like in pipes and operating around curves for uniformly cleaning the inside of pipe lines and for other purposes which is simple, economical and efficient in operation.

What I claim and desire to secure by Letters Patent is:

1. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, a flexible expandable hollow body member, a series of rows of brushes around the outer circumference of said body member, means engaging the body member between selected rows of brushes and adapted to limit the expandable areas of said body member to the portions adjacent the brushes, and means for effecting differential pressure between the inside and outside of the body member for expanding same for effecting uniform circumferential cleaning contact between the brushes and the interior of the pipe.

2. In a pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned, an elongated flexible expandable hollow body, means on said body adjacent the rear end thereof and engaging the pipe for maintaining differential pressure between the respective ends of said apparatus, means for maintaining fluid pressure in the hollow body greater than the pressure at the forward end of said apparatus for effecting circumferential expansion of said body, annular rows of brushes secured around the outer circumference of said body and spaced longitudinally thereof, means between selected brushes and adapted to retain portions of the body against circumferential expansion and restricting the expansion of the intermediate portions on which the brushes are secured, and means for maintaining the axial length of the apparatus.

3. In a pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned, an elongated tubular body consisting of a plurality of flexible expandable tubular sections coaxially arranged, spaced non-expandable rings telescoped in adjacent portions of the tubular sections and having sealing engagement therewith, means securing the sections to the rings whereby expansion of the sections is confined to the portions thereof between said rings, non-expandable end members secured to the ends of said tubular body, means connecting the end members for maintaining the relative spacing therebetween, a resilient member mounted on the rear end member and having a flange adapted to be expanded into substantially sealing engagement with the pipe by the motive fluid for maintaining differential pressure between the respective ends of said apparatus, said differential pressure effecting expansion of the tubular sections between the rings, and circumferential rows of arcuate brushes

on the tubular sections between said rings adapted for uniform circumferential engagement with the interior of the pipe for cleaning same.

4. In a pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned, an elongated tubular body consisting of a plurality of flexible expandable tubular sections coaxially arranged, spaced non-expandable rings telescoped in adjacent portions of the tubular sections and having sealing engagement therewith, means securing the sections to the rings whereby expansion of the sections is confined to the portions thereof between said rings, non-expandable end members secured to the ends of said tubular body, means connecting the end members for maintaining the relative spacing therebetween, a resilient member mounted on the rear end member and having a flange adapted to be expanded into substantially sealing engagement with the pipe by the motive fluid for maintaining differential pressure between the respective ends of said apparatus, said differential pressure effecting expansion of the tubular sections between the rings, circumferential rows of arcuate brushes on the tubular sections between said rings adapted for uniform circumferential engagement with the interior of the threaded pipe for cleaning same, said rows of brushes being composed of arcuate sections, and means on said body member and having sliding engagement with the brush sections for mounting said sections and permitting limited circumferential movement thereof in response to expansion of said body member.

5. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, a flexible expandable hollow tubular body member, means closing the ends of said body member, a series of rows of brushes around the outer circumference of said body member, means engaging the body member between selected rows of brushes and adapted to limit the expandable areas of said body member to the portions adjacent the brushes, the rear end closing means having openings therein whereby motive fluid entering said body will expand same for effecting uniform circumferential cleaning contact between the brushes and the interior of the pipe, means on the rear end of the body member adapted to be expanded by motive fluid into substantially sealing engagement with the interior of the pipe whereby the motive fluid will propel the apparatus through the pipe, and means for effecting escape through the pipe ahead of the apparatus of a portion of the motive fluid entering the body member.

6. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, a flexible expandable hollow tubular body member, means closing the ends of said body member, a series of rows of brushes around the outer circumference of said body member, means engaging the body member between selected rows of brushes and adapted to limit the expandable areas of said body member to the portions adjacent the brushes, the rear end closing means having openings therein whereby motive fluid entering said body will expand same for effecting uniform circumferential cleaning contact between the brushes and the interior of the pipe, resilient means on the rear end of the body member adapted to be expanded by motive fluid into substantially sealing engagement with the interior of the pipe whereby the motive fluid will propel the apparatus through the pipe, said body member having openings between the resilient means and the brushes for directing motive fluid through said brushes for cleaning same, said openings being of less combined area than the openings in the rear end of the closing means, whereby a differential pressure between the inside and outside of the body member is effected for controlling the circumferential expansion of said body member, said rows of brushes being composed of arcuate sections, means on said body member having sliding engagement with the brush sections for mounting said sections and permitting limited relative circumferential movement thereof in response to expansion of said body member, and means connecting the end members for maintaining the axial length of the body member.

7. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, an elongated flexible expandable hollow body member having its respective ends closed to provide an airtight structure, a series of rows of brushes around the outer circumference of said body, means between selected rows of brushes and adapted to limit the expandable areas of said body member to the portions adjacent the brushes, a squeegee on the rear end of said body member, and means for inflating said body member for effecting uniform circumferential cleaning contact between the brushes and the interior of the pipe.

8. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, an elongated flexible expandable hollow body member having its respective ends closed to provide an airtight structure, a series of rows of brushes around the outer circumference of said body of different stiffness, a squeegee on the rear end of said body member, means for inflating said body member for effecting uniform circumferential cleaning contact between the brushes and the interior of the pipe, means between selected rows of brushes and circumferentially of the body member and adapted to restrain adjacent portions of said body member from circumferential expansion, and means connected to the respective ends of the body member for maintaining the axial length of said body.

9. A pipe cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, an elongated flexible expandable hollow body member having its respective ends closed to provide an airtight structure, a series of rows of brushes around the outer circumference of said body of different stiffness, a squeegee on the rear end of said body member, means for inflating said body member, rings arranged circumferentially of said body member and secured thereto between selected rows of brushes and adapted to restrict the expansion of said body member to the portions adjacent the brushes, means connected to the respective ends of the body member for maintaining the axial length of said body, said rows of brushes being composed of arcuate sections, and means on said body member and having sliding engagement with the brush sections for mounting said sections and adapted for limited, relative circumferential movement thereof in response to expansion of said body member.

10. A pipe line cleaning apparatus adapted to be moved by motive fluid through a pipe to be cleaned comprising, a flexible expandable hollow body member, a series of rows of pipe cleaning devices mounted around the circumference of said body member, non-expandable sleeves engaging

the body member between selected rows of cleaning devices and adapted to limit the expandable areas of the portions adjacent the rows of cleaning devices, means for effecting differential pressure between the inside and outside of the body member for expanding same and for effecting uniform circumferential cleaning contact between the cleaning devices and the interior of a pipe, and means for effecting rotation of the body member during passage through a pipe.

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