The present invention is directed to a device for cleaning pipe lines.

It is well known to the art that pipe lines, particularly those utilized for transporting oil and gas at great distances across country, often contain obstructions. If the line is assembled by welding, steel pipes or projections may extend into the pipe at the welds. Moreover, in welded pipe lines as well as in pipe lines assembled with screw joints, there may be burrs and obstructions, such as timbers or dead animals. After oil pipe lines are put into use, a layer of paraffin is gradually deposited on the interior of the pipe and this accumulation causes a restriction of the flow through the line to such an extent as to require periodic cleaning.

The present invention is directed to a device for removing paraffin from the interior of pipe lines. The device is also particularly useful for removing obstructions in recently constructed pipe lines such as welding irregularities, pipe imperfections, scale, small animals or timbers.

An object of the present invention is to produce a device for cleaning pipe lines having a cutter head and a body, the cutter head being rotated with respect to the body by the force of fluid flowing through the pipe line.

Another object of the present invention is to produce a device for cleaning pipe lines in which the cutting elements are operated by the fluid flowing through the pipe line with means for rotating the cutting elements at a relatively high speed when the device is meeting with little resistance and at a lower speed when the device meets with a greater resistance.

More specifically it is an object of the present invention to devise a means for cleaning pipe lines in which vanes are arranged to be rotated by the flow of fluid through the line and are connected through a gear train to a cutting head so that the rate of rotation of the cutting head with respect to the vanes is altered in response to the resistance encountered by the cutting head.

Other objects and advantages of the present invention may be seen from a reading of the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 is an elevation, partly in cross section, of an embodiment of the present invention; and

Fig. 2 is a fragmentary view showing the gear train which connects the shaft carrying the cutter head of the device with the shaft carrying the vanes of the device.

Referring to the drawing in detail, numeral 11 designates a cutaway section of a pipe line having arranged therein a paraffin cutter constructed in accordance with the present invention. A body 12 has attached thereto a plurality of guide wheels 13 by means of spring mountings 14. The guide wheels are preferably provided with sharp edges so that when the mounting means forces them against the interior of the pipe line they will prevent rotation of body 12.

Body 12 is of a general cylindrical shape and has secured to its upstream end a flexible annulus 15 which seals the space between the pipe line and the wall of the body to divert all of the fluid stream through the body 12. The body 12 is provided with spiders 16 and 17 having secured thereto bearings 18 and 19, respectively, to accommodate shaft 20. Vanes 21 are secured to shaft 20 so that the flow of fluid through the interior of body 12 will act on the vanes and cause it and the shaft to rotate. The forward end of body 12 is provided with ports 19 to serve as exits for the fluid flowing therethrough.

A cutter head assembly is arranged ahead of body 12. The cutter head is connected to shaft 20 through a train of gears so that the power received from the fluid stream by vane 21 is transmitted to the cutter head. Before describing in detail the cutter head and the gear train transmitting power to it from the vanes, it may be stated broadly that the vanes and the cutter head are mounted on separate shafts and that a jack shaft receives power from the shaft carrying the vanes and transmits it to the shaft carrying the cutter head. Both the shaft carrying the cutter head and the jack shaft are slidably arranged and are provided with biasing means.

The shaft carrying the cutter head and the jack shaft are provided with pairs of co-operating gears, and similarly the jack shaft and the shaft carrying the vanes are provided with pairs of co-operating gears. When the cutter head is encountering little resistance, a pair of gears carried by the cutter head shaft and the jack shaft are in mesh. When the resistance encountered by the cutter head increases, the first pair of gears carried by the jack shaft and cutter head shaft respectively are disengaged and a second pair are engaged. This assembly allows three different ratios between the shaft carrying the vanes and the shaft carrying the cutter head.
In the drawing the shaft carrying the cutter head is designated by numeral 23. The cutter head is arranged so that if it meets an obstruction incapable of being cut away, the moving blades may be collapsed to allow the cutter head to pass around it. A member 24 provided with laterally extending lugs or projections is attached to the forward end of shaft 23. A conical shaped cutter 22 is secured to the front end of member 24. Member 25 is slidably mounted on shaft 23 with spring 26 between body 12 and member 25 blasting member 29 forwardly. A plurality of cutters 27 are each rotatively mounted on separate frames 28. The forward end of each frame 28 is pivoted to member 24, while the rear end is secured to slidable member 25 by means of a toggle 26.

The gear train connecting cutter-head-carrying shaft 23 and vane-carrying shaft 20 is shown in detail in Fig. 2. It will be understood that the gears shown in this figure are hidden by body 12 in Fig. 1. It will be further understood that the gear train shown in Fig. 2 is somewhat more extended than is desirable in a working device, the gear train being distorted in this figure for the purpose of more clearly illustrating the proportions between the several members thereof.

Shaft 23 is supported by bearing 30 as it passes through the forward end of body 12. The rear portion of shaft 23 is provided with second bearing 31 also secured to body 12. A bearing 32 is affixed to the rear end of shaft 23 for supporting one end of spring 33, arranged between the rear end of the shaft and a portion of body 12. It will be evident that shaft 23 is free to move in a longitudinal direction, but that it is biased in a forward direction by spring 33.

Vane-carrying shaft 20 is arranged with its longitudinal axis lying on the same line as the axis of shaft 23. The rear end of this shaft is supported by bearing 34, carried by spider 16. Another bearing, 35, provides support to the shaft as it goes through spider 17, and a third bearing, 36, supports the forward end of this shaft. Shaft 37, has its longitudinal axis parallel to the axes of shafts 23 and 20 and is supported by bearings 39, 40 and 41. Another bearing 42 is attached to the rear end of the jack shaft for providing a relatively friction-free contact between spring 43, arranged between the rear end of jack shaft 31, and a portion of the body 12. The means for mounting shaft 37 allows it to be moved along its longitudinal axis, but biases the shaft in a forward direction.

Power is transmitted between shaft 23 and shaft 37 by pairs of gears 44, 45 and 46, 47. These gears are provided with leather or rubber faces 44, 45, 46, and 47 respectively. The gears are shown in the drawing with the pair of gears 44, 45 in mesh. Upon movement of shaft 23 in a rearwardly directed motion, such as caused by the cutter head meeting an obstruction, the pair of gears 44, 45 are disengaged and the pair of gears 46, 47 become engaged. As the pair of gears 44, 45 are disengaged, faces 44, 45, 46, and 47 serve as clutches to continue the respective rotary motion of shafts 23 and 37, until the second pair of gears 46, 47 mesh. Mounted to the rear of gear 41 is an annulus 48, with which face 47 comes in contact upon additional rearward movement of shaft 23 and forces shaft 37 to move with shaft 23 if such additional movement takes place.

Shaft 20 and jack shaft 37 are provided with co-operating pairs of gears 49, 50 and 51, 52 respectively. These gears are provided with leather or rubber faces 49, 50, 51, and 52 respectively. In the drawing gears 49 and 50 are shown in mesh. This pair of gears will be in mesh when power is being transmitted between cutter head shaft 23 and jack shaft 37 by pair of gears 44, 45 or pair of gears 46, 47 so long as face 46 does not make friction contact with face 50. When face 46 is forced against annulus 48, both shaft 23 and shaft 37 move rearwardly together, disengaging pair of gears 49, 50 and engaging pair of gears 50, 51, faces 49, 50, 51 and 52 serving as clutches as gears 49, 50 are disengaged and gears 51, 52 are engaged.

In the operation of the device of the present invention, power is provided by the rotation of vanes 21 mounted on shaft 20. The power is transmitted from shaft 28 through jack shaft 37 and from jack shaft 37 to cutter-head-carrying shaft 23. When shaft 23 is in its forward position it is turned at a relatively high speed. As indicated on the drawing, pairs of gears 49, 50 and 44, 45 are all approximately the same size, making the rotation of shaft 23 comparable to that of shaft 28. Upon the movement rearwardly of shaft 23, the power is transmitted from jack shaft 37 through gears 47 and 46 to shaft 23. As indicated on the drawing, gear 47 is considerably smaller than gear 46, causing the speed of rotation of shaft 23 to be reduced and causing more torque to be transmitted to shaft 23. Additional rearward movement of shaft 23 carries with it jack shaft 37, which in turn disengages pair of gears 49, 50 and engages pair of gears 50, 51. Gear 51 is considerably smaller than gear 52, which diminishes the speed of rotation of jack shaft 37, but increases the torque transmitted thereto, which in turn increases the torque exerted by shaft 23.

It will accordingly be seen that shaft 23 may be turned at three different speeds with respect to shaft 37, these speeds being changed so that relative longitudinal movement between shaft 23 toward shaft 20, such as produced by the pressure of pipe line fluid, against the rear end of body 12 while the cutter head is held against longitudinal movement by an obstruction causes the shifting of the gears to increase the torque exerted by shaft 23. When the device is cutting paraffin the force exerted against the cutter head is relatively small, and this in turn allows the cutter head to assume its most forward position so that the speed of rotation of shaft 23 is great, but the shaft exerts little torque. When an obstruction is encountered such as caused by a timber in a pipe line or a welding icicle, the cutter head is held against longitudinal movement and fluid pressure on the rear of the cutter will shift the gear train first to a second position, diminishing the relative speed of shaft 23 and increasing its torque. Additional fluid pressure on the rear of the device will shift the gear train to a third position, still further decreasing the rotative speed of shaft 23 and increasing its torque. This arrangement allows the device to remove gas, oil, emulsions, etc., from the pipe line at a rapid rate and efficiently remove objects such as paraffin or well casings or metal obstructions as they may be encountered in the pipe line.

From the above description it will be apparent that we have devised a simple, effective device for removing obstructions from pipe lines. The arrangement of a reduction gear between the driv-
ing means and the cutting head allows the liquid flowing through the pipe line to move at a faster rate than the device so that the cuttings may be removed from the pipe as small particles and will be carried off by the pipe line liquid. This overcomes a tendency for materials to be accumulated immediately ahead of the device and will allow more satisfactory operation. Moreover, the cutter head is capable of removing hard obstructions, such as welding icicles and scale, from the pipe so that after the device has been passed through a pipe line, the interior of the pipe is free from paraffin-accumulating obstructions and has a polished surface which offers a low resistance to fluid flow.

While we have disclosed a specific embodiment of the present invention, it will be apparent that various changes may be made in the size, shape and proportion of the individual parts of the device without departing from our invention. It is intended to embrace such changes by the hereto appended claims.

We claim:

1. In a pipe cleaning device a body defining a conduit adapted for longitudinal movement through a pipe, a vane mounted on said body arranged in such position as to be rotated by the flow of fluid through the conduit, a scraper element rotatably carried by said body adapted for rotation in the pipe and so positioned as to clean the wall thereof, a variable speed gear mechanism arranged to connect the vane to the scraper element and having means operable under variations in the load applied to the scraper element to vary the ratio at which the vane is geared to said scraper element in such manner as to raise the torque applied to said scraper element when said load increases.

2. A device in accordance with claim 1 in which the scraper element is mounted on a shaft and includes a plurality of mounting members, means arranged pivoting the forward end of each mounting member to the forward end of said shaft, a biasing means forcing the rear end of each of said mounting members laterally outwardly, and a cutter mounted for rotation on each of said mounting members.

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