Oct. 29, 1957 T. B. LITTLE 2,811,393

APPARATUS FOR TRANSPORTING MATERIALS IN A LIQUID CARRIER

Filed Sept. 17, 1954 2 Sheets-Sheet 1

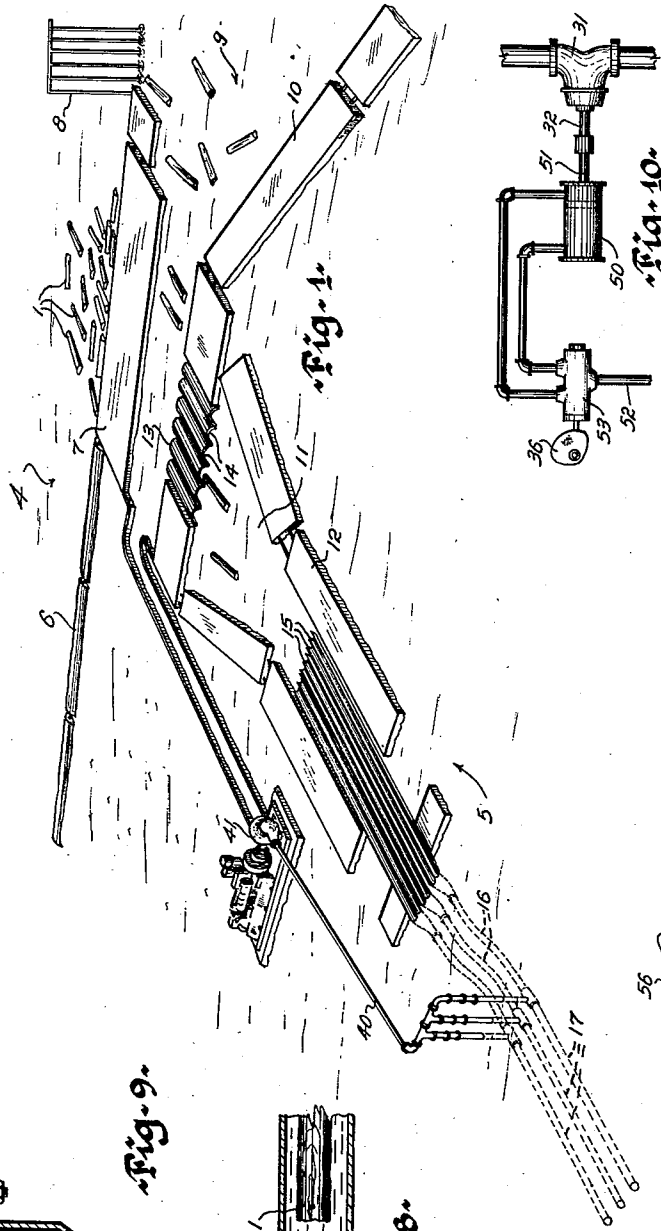

Fig. 1.

Fig. 10.

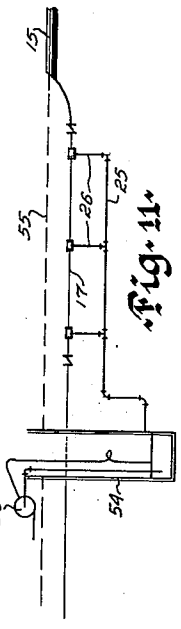

Fig. 11.

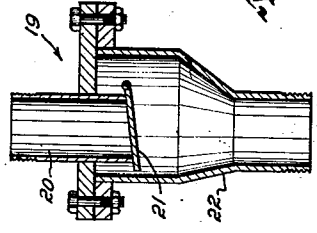

Fig. 9.

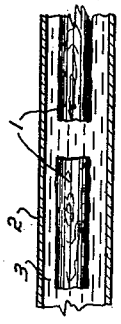

Fig. 8.

INVENTOR.
Thomas B. Little
BY
Alex. E. MacRae
Attorney.

Oct. 29, 1957 T. B. LITTLE 2,811,393

APPARATUS FOR TRANSPORTING MATERIALS IN A LIQUID CARRIER

Filed Sept. 17, 1954 2 Sheets-Sheet 2

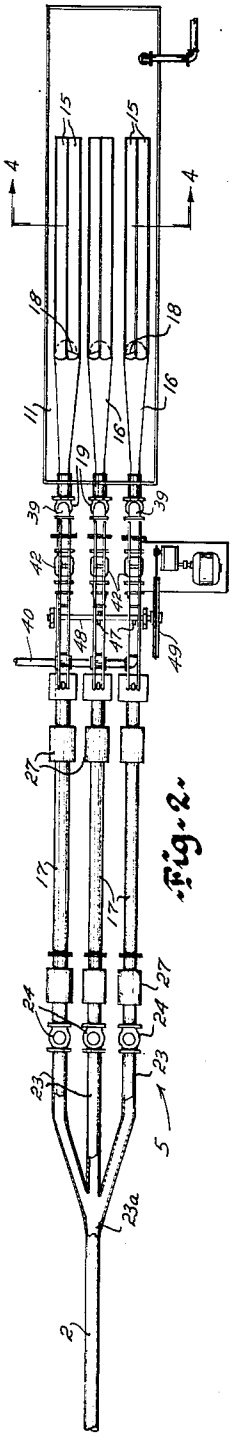

Fig. 2.

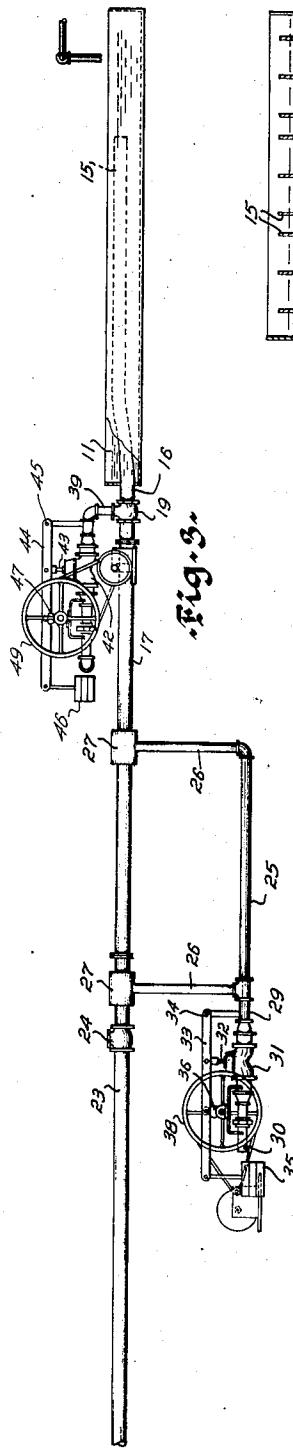

Fig. 3.

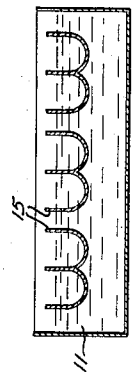

Fig. 4.

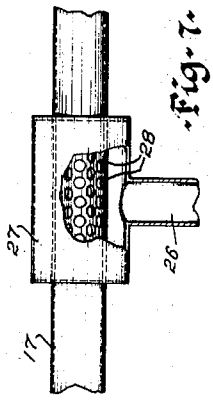

Fig. 7.

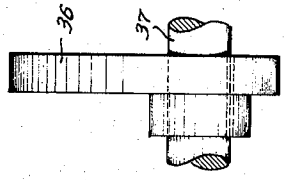

Fig. 6.

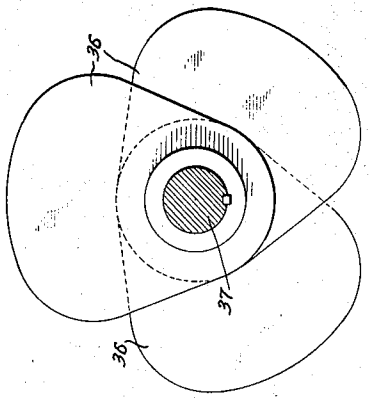

Fig. 5.

INVENTOR.
Thomas B. Little
BY Alex. E. MacRae
Attorney.

United States Patent Office

2,811,393

Patented Oct. 29, 1957

2,811,393

APPARATUS FOR TRANSPORTING MATERIALS IN A LIQUID CARRIER

Thomas B. Little, Quebec City, Quebec, Canada, assignor to Northeastern Paper Products Limited, Quebec City, Quebec, Canada

Application September 17, 1954, Serial No. 456,645

4 Claims. (Cl. 302—14)

This invention relates to an apparatus for transporting in a liquid carrier materials, such as pulpwood, logs and the like.

One of the major considerations in the use of wood, and especially pulp wood, is the mode of transport of the timber after felling from the stand to the place of collection or use. The use of flume transportation is well known, but since such transportation is only usable for downgrade conditions, auxiliary expensive and time-consuming transportation means, as by trucking, snow-mobile, rafting, towing, boat or cable, must be provided.

It is an object of the present invention to provide a simplified method and apparatus for transporting material in pieces of substantial size in a closed line from one point to another regardless of differences in the elevation of such points or intermediate points.

The invention contemplates the transportation of material in a closed line containing such material and otherwise completely filled with a moving liquid, such as water, in which the material is suspended and which constitutes the carrying medium, the liquid moving at such velocity that the material remains substantially completely submerged therein at all times. In a specific sense, the flow characteristics of the carrying liquid may be designated as having a Reynolds number greater than approximately 10,000.

The invention is particularly adapted for the transport of relatively large pieces or bundles of material not substantially smaller than one foot in length and one inch in diameter and may be employed for transporting pieces or bundles of material as large as sixteen feet or greater in length and fourteen inches or greater in diameter.

The invention will now be more particularly described with reference to the accompanying drawings, in which:

Figure 1 is a perspective diagrammatic view of a system in accordance with the invention, certain parts being omitted for clarity of illustration,

Figure 2 is an enlarged detail plan view of an apparatus for feeding the material into a pipeline,

Figure 3 is a side elevation of the apparatus shown in Figure 2,

Figure 4 is a cross sectional elevation on line 4—4 of Figure 1,

Figure 5 is a cross sectional elevation of an actuating cam device included in the apparatus,

Figure 6 is a side elevation of one of the cams shown in Figure 5,

Figure 7 is an enlarged side elevation, partly in section, of a suction producing means included in the apparatus,

Figure 8 is an enlarged sectional elevations of the pipeline showing the material therein,

Figure 9 is an enlarged sectional elevation of a valve member employed in the apparatus,

Figure 10 is a side elevation of a modified valve operating means, and

Figure 11 is a diagrammatic elevation of a modified suction producing arrangement.

The invention will be described with reference to the

transportation of pulpwood in water as the carrying medium. In accordance with the invention, pieces of logs or pulpwood 1 are arranged to be transported through a pipeline 2 in water 3 filling the pipeline and travelling at a velocity of, say, five feet per second. Conventional pump means (not shown) are provided for pumping water through the pipeline 2 at desired velocity. It has been found that such transportation of pieces or logs of the size order hereinbefore mentioned is efficiently possible only by disposing such pieces in a single, longitudinally aligned row in the pipeline, since the pieces should be desirably maintained in substantially spaced relation to the interior surface of the pipeline and lateral jamming of two or more pieces between the walls of the pipeline must be avoided. Thus, the selected diameter of the pipeline has particular relation to the minimum and maximum diameters of the pieces of pulpwood to be transported therein. Therefore, each piece must have a diameter greater than one-half the diameter of the pipe and one and a half to two inches less than the interior diameter of the pipe. In general, the diameters encountered in any stock of pulpwood pieces will vary from 3 inches to 14 inches. It is apparent then that one pipeline will not handle all the pieces. Thus, for a range of diameters of 3 to 14 inches, three separate pipelines will be required to transport all the pieces. The diameters of such three pipelines could be as follows:

6 inch—for pieces 3 to 4½ inches diameter
10 inch—for pieces 5 to 8½ inches diameter
16 inch—for pieces 9 to 14 inches diameter

Any standard type of metal or like pipe may be employed to form the pipeline, such pipe being selected with particular relation to the water pressures which will be encountered for any particular location. The preferred pipe to be selected is the lightest grade which will handle the water pressure involved since the pieces of pulpwood tend to travel close to the center of the pipe and thus have no abrasive effect on the inside of the pipe. The pipeline may curve as required but any such curves should have a large enough radius to allow clearance between the pieces of pulpwood and the pipe at all times. For instance, a six inch pipe should have a radius no smaller than 40 feet for transportation of a five inch log, four feet in length. Joints in the pipeline should have a smooth uninterrupted surface on the pipeline interior with no projecting edges to obstruct the logs.

While it is mentioned above that three sizes of pipelines, namely 6, 10 and 16 inch will normally handle the average assortment of pulpwood sizes which are encountered, there is no reason why larger diameter pipelines could not be employed for larger diameter wood or bundles of wood with equal success.

One of the phenomena of importance in the present invention is the condition of turbulence in the pipe conveying the logs and water. This condition is best described by the use of the dimensionless grouping of characteristics known as the Reynolds number, viz:

$$\mathrm{Re}=\frac{Vdp}{u}$$

where

V=velocity of fluid in pipe
d=pipe diameter
p=density of liquid
u=viscosity

For laminar flow, Re 2,000, the logs tend to move along the side of the pipe. For efficient transport of the logs to occur, it is desirable that the Re (calculated on the

sections of the pipe filled with water) be greater than 10,000.

At high Reynolds numbers, greater than 35,000 the log travels very slightly slower than the water and there are thus, regions of extreme turbulence (Re approximately 100,000) on either side of the log. As the turbulence will vary on either side of the log, then the pressure varying on either side of the log will cause it to oscillate slightly but to remain substantially in the center of the pipe. Thus, at sufficiently high Re, danger of collision between log and wall of pipe, and of two logs jamming, is very greatly diminished.

It will be apparent that, since a substantial velocity must be imparted to the carrying liquid 3 in the pipeline, means must provided to feed the logs into the moving liquid in the pipeline without substantial disturbance of its velocity. One suitable form of feeding means will now be described, although other suitable forms of injecting means may be employed.

The pieces 1 of pulpwood are shown as floating in a body of water 4. The feeding apparatus of the present invention is generally indicated at 5 and is floatingly disposed in the body of water 4 but separated from the main portion thereof by means of a sorting boom 6.

An operators' platform 7 is disposed in the sorting boom 6 and pieces 1 are fed by operators through a suitable log gauge 8 also disposed in the boom 6 to an area 9 of the water body confined by boom 10 on the apparatus side of boom 6. The purpose of the gauge 8 is to reject any oversize or undersize pieces.

The selected logs or pieces 1 are fed into a second confined area or reservoir 11 of water enclosed by a small boom or like 12 through a gauge 13. The gauge 13 comprises a plurality of laterally disposed pipes 14. The purpose of gauge 13 is to reject any logs having projecting portions such as knots or branches which would prevent transportation by the particular size of pipeline 2 to which the feeding apparatus 5 is connected. It will be understood that other pipelines may be provided for other size ranges of logs, each such pipeline being provided with a feeding apparatus 5.

Leading from the area 11 are a plurality (three as shown) of pairs of floating loading troughs 15, each of which is arranged to floatingly receive a single row of longitudinally aligned pulpwood pieces. Each pair of troughs terminates in a downwardly extending pipe or chute 16 which is connected to a fixed vessel or pipe section 17. Since the troughs 15 must float and the pipe sections 17 are fixed, the pipe 16 preferably has some degree of flexibility and may be formed of flexible plastic or like composition. such as polyethylene. It will be apparent that each pair of troughs and its pipe 16 may be integrally formed.

Each pair of troughs is provided with a swingable gate 18 at the entrance to pipe 16 whereby one or other of the troughs may be placed in communication with pipe 16 while closing communication of the other trough with pipe 16.

Each pipe section 17 is connected to pipe 16 by means of a check valve 19. Each check valve 19 is of conventional form and permits flow through the pipe 17 in one direction only, i. e., from pipe 16. Figure 9 illustrates a suitable form of check valve 19 which includes a fitting 20 for connection to pipe 16, a normally closed hinged gate 21 on the end of fitting 20, and a fitting 22 fixed to fitting 20 for connection to pipe section 17. The fitting 22 is of enlarged diameter surrounding the gate 21 to permit free opening of the gate and unrestricted passage of the water and pulpwood pieces through the valve. The other end of each pipe section 17 is connected to a pipe section 23 through a check valve 24 similar to check valve 19 and permitting flow only in one direction, i. e., from section 17 to section 23. Pipe sections 23 merge into a single pipe section 23*a* which is connected to the main pipeline 2.

Means for subjecting each of pipe sections 17 to suction comprises a suction pipe 25 for each section 17 and having a plurality of branches 26 each communicating with section 17 through a cylinder 27 surrounding section 17, the enclosed portion of section 17 being perforated as indicated at 28.

Means for imparting suction to pipe sections 17 in continuously successive order comprises a pipe 29 connected to each suction pipe 25 and having an outlet 30 discharging to atmosphere. A diaphragm or like valve 31 of conventional design is mounted in each pipe 29, and as a reciprocable actuating stem 32. Each stem 32 is connected to a lever arm 33 pivotally mounted at 34 and normally held in valve closing position by a weight 35. Each lever arm 33 is swingable upwardly to open its respective valve by means of a cam 36. Cams 36 are mounted on a shaft 37 driven by suitable means 38. It will be observed that the three cams 36 are spaced 120° apart on shaft 37 to provide successive opening of the valves 31.

It will be apparent that, when suction is imparted to each pipe section 17, a flow of water will be induced therein from reservoir 11, respective trough 15, and past respective check valve 19, which will be opened by the flow, such flow carrying with it the row of pulpwood pieces in the trough. Such row of pulpwood pieces will then come to rest in pipe section 17 between check valves 19 and 24.

Means are provided for successively ejecting the row of pulpwood pieces in each of pipe sections 17 immediately after they are disposed therein. Such means comprises a pipe 39 connected to the top of each check valve 19 at one end and at its other end to a common header pipe 40. Pipe 40 is arranged to be fed with water from a pump 41. Each pipe 39 is provided with a conventional type of diaphragm or like valve 42, similar to valve 31, and having a reciprocable actuating stem 43. Means for successively opening valves 42, similar to that previously described with reference to valves 31, are provided and include, for each valve, an operating lever 44, pivoted at 45 and weighted at 46, a cam 47, camshaft 48, and camshaft rotating means 49. On opening of each valve 42, the resultant flow of water under pressure will close check valve 19 and apply pressure to the water and logs in the respective section 17 to open check valve 24 and eject the water and logs therein into the main pipeline 2. It will be apparent that the water pressure in pipe section 17 and main pipeline 2 should be approximately equal to provide smooth, uniform flow of the logs and water into the main pipeline.

The driving means 38 for valves 31 and the driving means 49 for valves 42 are so synchronized that, as soon as a valve 31 is closed, the corresponding valve 42 is opened to project the pieces of pulpwood in the respective pipe section 17.

The operation of the feeding mechanism described will be apparent from the foregoing description. With provision of three feeding pipe sections 17 and two loading troughs for each pipe section 17, a substantially continuous flow of logs and water will be fed into the pipeline 2.

Various changes may be made in the mechanical arrangements described. Thus, instead of lever means for actuating the diaphragm valves 31 and 42, hydraulic cylinder means may be employed, such as shown in Figure 10. In the latter figure, a hydraulic cylinder 50 has the piston rod 51 of its piston connected to the valve stem 32 of valve 31. Hydraulic fluid from line 52 is directed to either side of the piston in cylinder 50 through a three or four way valve 53 actuated by a cam 36, as before.

A suitable means of discharging the suction pipe sections 17 is diagrammatically illustrated in Figure 11. As shown, a tank 54 is partially submerged in the body of water and the pipe sections 17 discharge therein substantially below the water level 55. A pump 56 maintains the

water level in the tank 54 below the discharge outlet of the pipe sections 17.

It will be apparent that the pieces of pulpwood may, if desired, be formed into bundles of suitable size for transport through the pipeline.

Furthermore, barking means may be incorporated in one or more of the last few sections of the pipeline by providing inwardly directed projections on the pipe for engagement with the logs to loosen or remove the bark thereon.

The speed with which the logs may be driven through the pipeline may vary considerably. A water speed of five feet per second is effective where the line is of great length, say considerably more than 2,000 feet. On shorter lines, the speed may be increased. It is proposed that approximately 40 or more pieces of pulpwood per minute may be driven through the pipeline.

It will be apparent that the cost of transporting pulpwood in the manner defined will be much less than, for instance, transport by trucking. It is estimated that the cost of pipeline transportation, as described, as compared with trucking, would be reduced by approximately two-thirds.

The term "pieces" as used in the claims is intended to include single separate logs or the like and preformed bundles of such logs and the like.

I claim:

1. Apparatus for transporting pieces of material comprising a pipeline arranged to receive said pieces in a liquid carrying medium, and means for feeding said pieces to said pipeline comprising a plurality of troughs arranged to contain liquid carrying medium and to floatingly receive said pieces in longitudinally aligned order, a plurality of closed pipe sections each having a valved inlet leading from at least one of said troughs and a valved outlet leading to said pipeline, means for withdrawing liquid carrying medium from said pipe sections and means for admitting liquid carrying medium under pressure to said pipe sections.

2. Apparatus for transporting pieces of material comprising a pipeline aranged to receive said pieces in a liquid carrying medium, and means for feeding said pieces to said pipeline comprising a plurality of troughs arranged to contain liquid carrying medium and to floatingly receive said pieces in longitudinally aligned order, a plurality of closed pipe sections each having an inlet leading from at least one of said troughs and an outlet leading to said pipeline, a valve controlling each of said inlet and said outlet, means for successively withdrawing liquid carrying medium from said pipe sections to successively open said inlet valves and cause movement of said pieces and liquid carrying medium from one of said troughs into one of said pipe sections in successive order, and means for successively admitting liquid carrying medium under pressure to said pipe sections to open said outlet valves and cause movement of said pieces and liquid carrying medium from one of said pipe sections to said pipeline in successive order.

3. Apparatus for transporting pulpwood logs comprising a pipeline arranged to be completely filled with water under pressure as a liquid carrying medium and to receive said logs in submerged condition in said water, and means for feeding said logs into said pipeline comprising a plurality of loading troughs having water therein and each arranged to receive said sorted logs in longitudinally aligned relation, a plurality of closed pipe sections each having a valved inlet leading from at least one of said troughs and a valved outlet leading to said pipeline, means for imparting suction successively to said pipe sections to open in succession said valved inlets and cause a row of said logs from one of said troughs to enter each of said pipe sections, and means for successively admitting water to said pipe sections to successively close each of said valved inlets and open each of said valved outlets to cause successive discharge from said pipe sections of said rows of logs to said pipeline.

4. Apparatus for transporting pieces of material comprising a pipeline arranged to receive said pieces in a liquid carrying medium, and means for feeding said pieces to said pipeline comprising at least one trough arranged to contain liquid carrying medium and to floatingly receive said pieces in longitudinally aligned order, a closed pipe section having a valved inlet leading from said trough and a valved outlet leading to said pipeline, means for withdrawing liquid carrying medium from said pipe section, and means for admitting liquid carrying medium under pressure to said pipe section.

References Cited in the file of this patent

UNITED STATES PATENTS

599,658	Lempert	Feb. 22, 1898
1,999,430	Townsend	Apr. 30, 1935
2,672,371	Jones	Mar. 16, 1954
2,672,372	Jones	Mar. 16, 1954