Jan. 7, 1969 N. BERRY 3,420,181

PUMPING SYSTEM

Filed Dec. 12, 1966

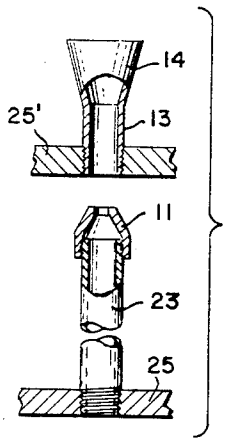


FIG__2

FIG__1

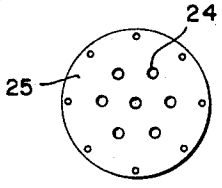


FIG__3

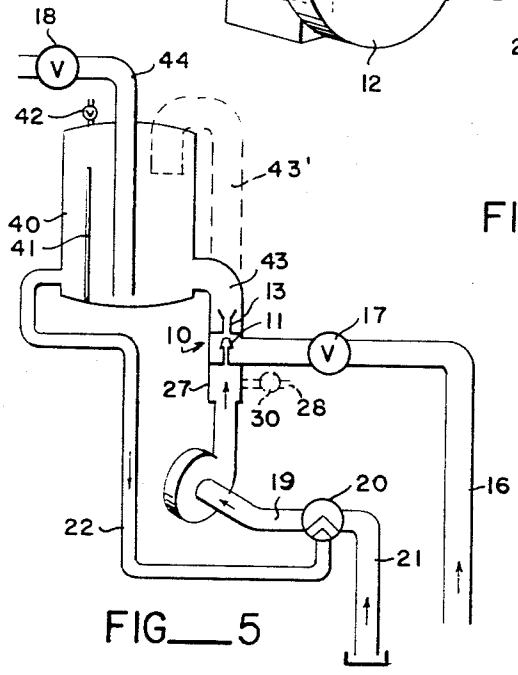


FIG__5

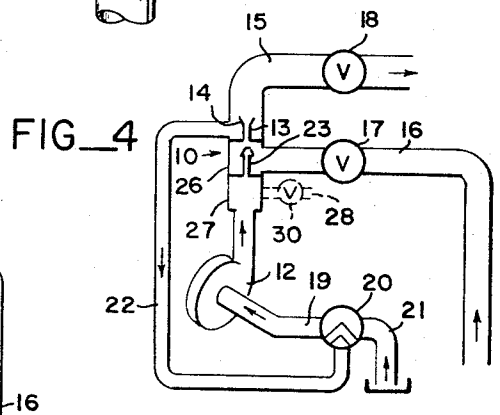


FIG__4

NORMAN BERRY
INVENTOR.

BY Seed & Berry

ATTORNEYS

United States Patent Office 3,420,181
Patented Jan. 7, 1969

3,420,181

PUMPING SYSTEM

Norman Berry, 57 Lombard St., Glebe, New South Wales, Australia

Filed Dec. 12, 1966, Ser. No. 600,806
U.S. Cl. 103—5 8 Claims
Int. Cl. F04b 23/14; F04f 5/48

ABSTRACT OF THE DISCLOSURE

A pumping system utilizing an eductor having its nozzle connected to the discharge side of a pump, a by-pass from the delivery side of the eductor to the suction side of the pump, and valves arranged to selectively connect the suction side of the pump with the by-pass or with a suction pipe and to selectively deliver the output of the pump to the nozzle or as a backwash for the eductor or to discharge before reaching the eductor.

This invention relates to an improved pumping system of the type utilizing an eductor, commonly called a jet pump or injector, to move materials without need of circulation thereof through a conventional pumping unit serving as the energy source. Such a system has been recognized as of particular value in dredging operations in which the dredging materials would damage a centrifugal pump or other pumping unit if passed therethrough.

The invention aims to provide an improved such system which can be conveniently utilized merely by selected opening and closing of valves for many functions including dredging, continuous dewatering, dry and wet material handling, vacuum pumping, air compression, hydraulic cutting, and gas or vapor pumping.

Another object is to provide an improved efficient eductor unit which is of simple and economical construction, which can be readily repaired, replaced, or modified as to characteristics.

Other more particular objects and advantages of the invention will, with the foregoing, appear and be understood in the course of the following description and claims, the invention consisting in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawings:

FIG. 1 is a perspective view of a typical piping layout incorporating the pumping system of the present invention;

FIG. 2 is a fragmentary exploded elevational view to an enlarged scale and partly in vertical section illustrating one of the nozzle-venturi sets in the eductor component of the system;

FIG. 3 is a plan view of one of the flange plates used in the eductor;

FIG. 4 is a schematic of the pumping system illustrated in FIG. 1; and

FIG. 5 is a schematic of a modified pumping system.

Directing attention to the schematic of FIG. 4, the present invention utilizes an eductor **10** having one or more nozzles **11** supplied with pressure fluid from a centrifugal pump **12**. Each nozzle jets into a respective venturi tube **13** which expands at its free end as a diffuser **14** and discharges into a delivery line **15**. The suction line **16** for the eductor **10** and the delivery line **15** are provided with respective shut-off valves **17-18**, while the suction line **19** for the centrifugal pump **12** has a two-way valve **20**. This two-way valve provides a selective suction through external line **21** or from a by-pass line **22** feeding from the delivery side of the eductor.

As shown in FIG. 2, the eductor **10** has its nozzles **11**

mounted on extension pipes **23** which are threaded into through-openings **24** in a circular flange plate **25**. A second like flange plate, denoted **25'**, carries the venturi tubes **13**. These flange plates **25–25'** are bolted at the ends of the legs of a flanged pipe T **26** which houses the nozzles **11** and provides a suction chamber surrounding the extension pipes **23** and connecting by the arm of the T with an elbow **16'**. The latter connects via the valve **17** with suction **16** which continues downwardly to the selected suction level.

The venturi tubes **13** project upwardly into a flanged pipe **15** connecting by an elbow **15'** with the shut-off valve **18** from which the delivery line continues to the desired discharge point. It is preferred that the by-pass line **22** connect to the pipe **15** at a level below the free ends of the venturi tubes **13** as indicated in the drawing to prevent air from entering the pump **12** when the by-pass suction line **22** is in use as will be explained hereinafter.

Continuing to the manner of operation, for dredging the pump suction line **21** is placed in clear water and the eductor suction line **16** into the sand, gravel, sludge, etc. to be dredged. A foot valve is not used on the eductor suction, but a strainer with maximum openings smaller than the inside of the venturi tubes **13** is desirable to prevent blockage in the eductor by any of the dredged material. On the other hand, it is preferred to equip the pump suction pipe **21** with a foot valve.

When the pump **12** is being supplied through the suction line **21** it must be placed in a reasonable suction position for suction lift even though the eductor **10** has a much greater suction lift which compensates for the weight of any solids lifted. However, if the dredged material is fine sludge or sand of a consistency normally not harmful to the pump **12** increased dredging output for a given power input to the pump can be achieved by turning the valve **20** to close off the suction line **21** and open the by-pass **22** to the suction side of the pump. This connects the suction and delivery lines **18** and **15** so that the suction side of pump **12** is at the same pressure as the delivery side of the eductor **10**. The pump will then be circulating on itself via the by-pass **22**, thereby giving an action analogous to a stage pump. With the by-pass in use the suction side of the pump is in effect submerged, and hence any air or vapours cannot reach the suction side to vapor lock the pump. The pump remains permanently self-primed and cannot be injured through lack of supply to the eductor suction line **16**. Accordingly, the system is valuable for continuous de-watering operations conducted in pipe line trenches and excavations.

As shown schematically in FIG. 5, if it is desired to be able to use the by-pass **22** during the dredging of materials which may be harmful to the pump **12**, a modified arrangement is used wherein a tank **40**, subdivided by a baffle **41**, is inserted on the discharge side of the eductor **10**. In this case the pipe **15** is replaced by an elbow **43** leading into the base of the tank at one side of the baffle **41**, and the by-pass **22** is connected at the base of the tank at the other side of the baffle. In the alternative, as illustrated by the broken lines in FIG. 5, discharge from the eductor to the tank **40** may be conducted by a pipe **43'** which leads into the top of the tank and is directed downwardly below the upper level of the baffle **41** so that materials discharging from the pipe **43'** will be delivered on the opposite side of the baffle from the by-pass **22**. Discharge from the tank **40** is performed by a delivery pipe **44** extending from the foot of the tank on the same side of the baffle as the eductor discharge line **43** or **43'**, and out through the top. A relief valve **42** is provided for the tank. With this modified installation, the discharge from the eductor expands in the tank **40** and allows for settling of the solids while the mouth of the by-pass **22**

is shielded by the baffle 41 from these solids. The settled solids then pass out through the delivery pipe 44. At the same time the liquid requirements for the pump 12 circulate in the tank over the top of the baffle 41 and will contain only light materials in suspension which are not harmful to the pump.

If separation of solids and delivery of solids-free water is desired at the same time, a second valved discharge line (not shown) can be provided from the tank 40, but located on the same side of the baffle as the by-pass 22. Then the valves in the discharge lines can be adjusted for the proper combined flow rates. In this manner part of the water drawn through the eductor suction line 16 can be recovered and returned to service if required at the dredging site or elsewhere.

Should the eductor suction become plugged, the valve 18 in the delivery line can be closed, and with the pump suction line 21 open to the pump 12, water can then be pumped through the nozzles 11 and discharged through the eductor suction line 16 in the counter-flow to the normal suction flow in the latter to clear the line 16.

There is also provided in the pipe section 27 between the nozzles 23 and the discharge side of the pump 12 an auxiliary discharge line 28 normally closed by a valve 30. With this valve opened and valves 17–18 closed, water can be delivered at high pressure directly by the pump to the line 28 for use, for example, by a hydraulic jet (water cutter) to free or break up material to be dredged. Alternatively, valve 30 may be a two-way valve located in pipe section 27 at the intersection of pipe 28 therewith.

The invention is further of value as a vacuum pump or compressor in the material handling of grain, paper, pulp, wood chips, coal, etc. For example, such materials can be loaded into a closed hopper by connecting the eductor suction line 16 with the hopper to create a partial vacuum therein, or the hopper can be pressurized to empty it. In the latter instance the delivery pipe 18 is connected to the hopper, the eductor suction 16 is opened to the atmosphere, and liquid is circulated by the pump 12 in a closed circuit through the by-pass 22. Another use of the invention is to mix dry materials with a selected liquid at the eductor 10, the liquid supply being connected with the pump suction 21 and the dry materials with the eductor suction 16.

The number of nozzle-venturi sets can be varied according to the types of operation to be conducted and the capacity of pump 12 available. Generally speaking a group of small nozzle-venturi sets is preferable in terms of efficiency to a single larger nozzle-venturi unit. However, since the inside diameter of the venturi tubes 13 limits the size of solid materials that can be handled by the eductor 10, it may be necessary to compromise theoretical efficiency in order to handle larger size materials. It is preferred to use loose-flange joints at the connections of the discharge pipe 15 with pipes 15′ and 22, at the connection of elbow 16′ with section 26; and at one of the ends of section 27, so that the flange plates 25–25′ and the related nozzle and venturi tube assemblies can be easily removed for repair or replacement, or to change nozzle-venturi sizes for change of materials to be dredged or otherwise handled. In this regard, the eductor characteristics can be readily modified for a given set of flange plates 25–25′, merely by the removal of a selected number of the tubes 23, 13 and plugging of the respective holes 24 by screw plugs.

A centrifugal pump 12 has been shown for purposes of example, but the present invention is not limited to the use of this type of pump. The showing 31 of a pump drive is intended to indicate that any suitable power source may be provided for the pump 12.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A pumping system comprising, a pumping unit having its discharge side connected with the nozzle component of a nozzle-venturi eductor means, a discharge pipe from the eductor means, respective suction pipes to the eductor means and the pumping unit, a by-pass from the delivery side of said eductor means to the suction side of the pumping unit, a delivery pipe between the discharge side of the pumping unit and said eductor means, first valve means for selectively connecting the suction side of the pumping unit with said by-pass or with said suction pipe for the pumping unit, second valve means for selectively delivering the output of said pumping unit through said eductor means or out through said delivery pipe, and third valve means for selectively back-washing said suction pipe of the eductor means from the delivery of the pumping unit.

2. A pumping system according to claim 1 in which said first valve means comprises a two-way valve located at the intersection of said by-pass and suction pipe for the pumping unit.

3. A pumping system according to claim 1 in which said second valve means comprises respective shut-off valves in said discharge pipe, in said suction pipe to the eductor means, and in said delivery pipe.

4. A pumping system according to claim 1 in which said third valve means comprises a shut-off valve in said discharge pipe.

5. A pumping system according to claim 1 in which said eductor means comprises an intermediate pipe section connected between said pumping unit and said discharge pipe, and having inlet and outlet flange plates mounted across its ends and having said suction pipe for the eductor means connected thereto between said plates, nozzles mounted in said inlet plate and projecting toward said outlet plate, and venturi tubes mounted in said outlet plate and projecting into said discharge pipe in alinement with respective of said nozzles.

6. A pumping system according to claim 5 in which said nozzles are carried on the ends of the extensions which are screwed into said inlet plate, said venturi tubes being screwed into said outlet plate.

7. A pumping system according to claim 5 in which said by-pass connects to said discharge pipe between the free ends of said venturi tubes and said outlet plate.

8. A pumping system according to claim 1 in which a tank is mounted between said eductor means and said discharge pipe and has a vertical baffle therein, said eductor means discharging on one side of said baffle and said discharge pipe taking suction from the same side adjacent the bottom of the tank, and said by-pass taking suction from the other side of said baffle.

References Cited

UNITED STATES PATENTS

452,308	5/1891	Lee	103—260
988,225	3/1911	Sweeny et al.	103—258
2,080,624	5/1937	McMahon	103—260
2,652,181	9/1953	Rupp	103—258 X
2,654,434	10/1953	Culleton	103—5
2,674,189	4/1954	Lung	103—5
2,682,225	6/1954	Coberly	103—5
3,013,665	12/1961	Schmidt et al.	103—5
3,212,450	10/1965	Castellot	103—260

DONLEY J. STOCKING, *Primary Examiner.*

WARREN J. KRAUSS, *Assistant Examiner.*

U.S. Cl. X.R.

103—271