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EDUCTOR

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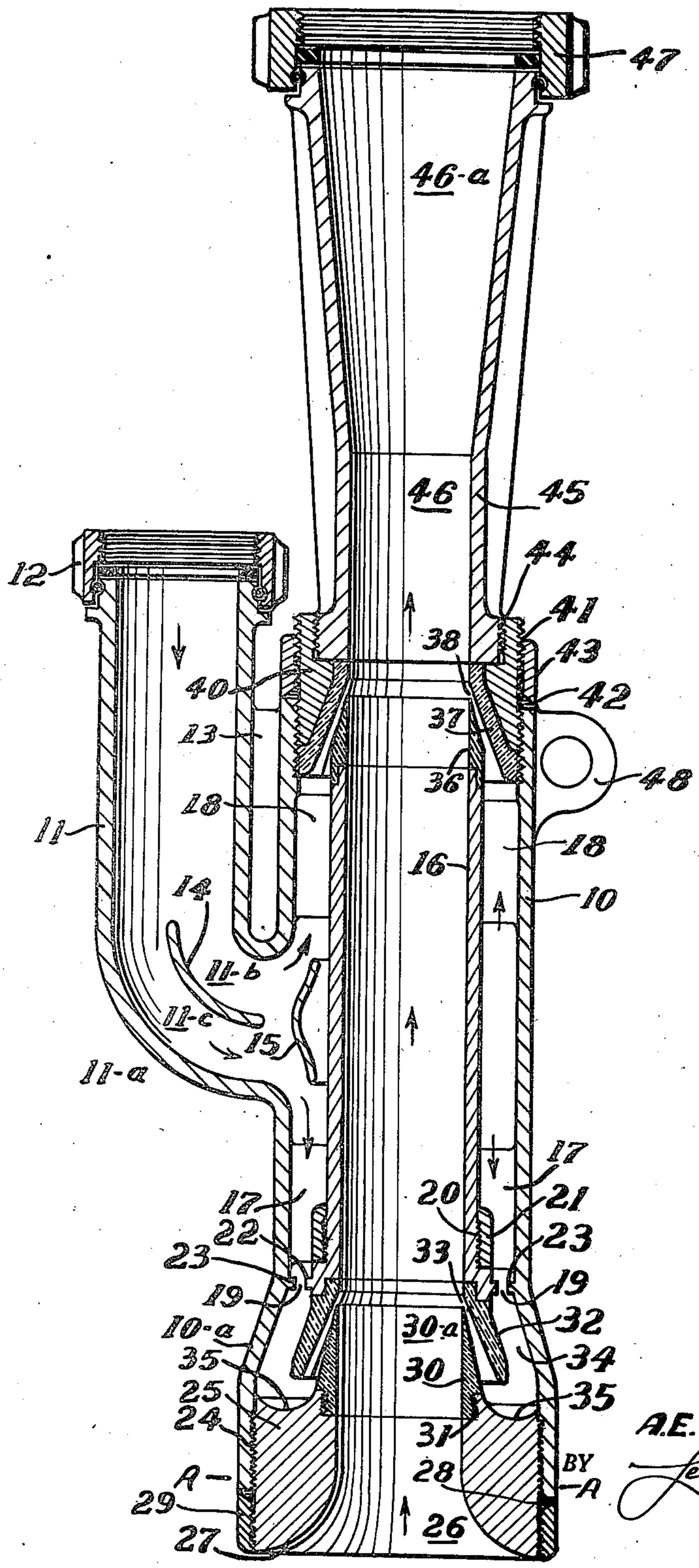

INVENTOR.
A.E. REINHARDT
BY Leonard L. Kalish
Attorney

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EDUCTOR

Albrecht E. Reinhardt, Flourtown, Pa., assignor to Derbyshire Machine & Tool Company, Philadelphia, Pa., a copartnership

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This invention relates to eductors or jet pumps. Such pumps are commonly used aboard naval and other ships when compartments are flooded and must be unwatered and at the same time must be cleared of the debris commonly found in flooded ship compartments, such as rags, cotton waste, clothing, sticks, fibreboard, newspaper, glass wool, etc.

The general objects of the invention are to provide a fixed or portable eductor which is operated by water pressure and which is capable of pumping liquids containing all manner of debris, without clogging. A further object is to reduce the shock loss arising when a single jet strikes a static body of water by employing two or more jets spaced along the axis of the pump and properly disposed for maximum efficiency. The preferred embodiment of the invention is characterized by a straight passage of substantially uniform cross section except at the lower or intake end, where it is well rounded to prevent catching of debris, and near the upper or discharge end, where its cross section increases. Another object is to form the surfaces which create the jets from highly erosion-resistant material, and arranged so that these surfaces may be renewed by easily-accomplished substitutions of parts. A further object is to provide nozzle or jet openings which may be changed to suit various operating conditions, e. g., water pressure, discharge head and suction flow. A still further object is to provide means to insure a uniform peripheral jet, thereby enhancing the efficiency of the eductor. Other objects will be understood by referring to the accompanying drawing showing in a single figure a preferred embodiment of the invention.

Referring particularly to the drawing, the eductor consists of a generally elongated, cylindrical body 10 having an integral conduit 11 for the pressure water, which may enter through a hose or pipe (not shown) connected by hose coupling 12 or a standard pipe connection (not shown) to the inlet of conduit 11. The body 10 and conduit 11 may be a unitary metal casting with a web 13 joining them to enhance the strength of the casting. A vane 14 is within the conduit and is curved through an arc of about 90° to conform to the curvature of the bend 11a of the conduit where the latter joins and discharges into the body 10, the arrangement being such that the passageway through conduit 11 is divided by vane 14 into two parts 11b, 11c. At the point where the discharge into body 10 takes place, which is approximately midway between

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the ends of the body, the vane 14 terminates, so that its inner end is spaced from a crowned flow-dividing member 15 located directly opposite the discharge end of the conduit. Member 15 is preferably an integral part of the body 10. The vane 14 co-operates with member 15 to divide the water flowing into body 10 into two streams, one stream being directed toward the discharge end of the eductor, the other stream being directed toward the intake end thereof. Coaxial with body 10 and on the inside is a tube 16. Tube 16 is a straight tube of circular section and its outer walls are in direct contact with a series of guide vanes 17 and 18 arranged radially and integral with the body 10. There may be three or more vanes 17 and the same number of vanes 18, with each vane 17 in the same radial plane with a vane 18. It has been found that these guide vanes 17, 18 are essential to insure uniform peripheral jets projected in opposite directions along the interior of body 10. The tube 16 provides a throat section through which the matter to be lifted freely moves.

The jet which is projected toward the intake end of body 10 is throttled by an orifice 19. Tube 16 is in contact with the inner edges of guide vanes 17 and is secured by screw threads 20 to an annular collar 21 integral with the guide vanes 17 and located near the throttling orifice 19. Preferably the orifice 19 is annular and formed by a flange 22 integral with tube 16 and extending outwardly therefrom at the lower or intake end, being spaced from another annular flange 23 on the interior wall of body 10 to provide a constricted passageway or throttling orifice for the jet of water.

At its lower or intake end, the body 10 is enlarged or bell-shaped as indicated at 10a, and within this enlarged end an inlet member 25 is secured as by screw threads 24. The inlet member 25 may be a metal casting and it is annular to provide a central passageway or inlet 26 with rounded walls 27 at the entrance to prevent catching of cloth and other articles and to guide the water and its contents into the mouth of the eductor. A sealing ring 28, which may be of various compositions, having a wedge-shaped cross section, surrounds the inlet member 25 and abuts the end of body 10, being compressed by a packing and locking ring 29, which is threaded on the inlet member 25, to provide a seal between the inlet member and the enlarged end 10a of the body. The inlet member 25 also carries an annular frusto-conical nozzle member 30 whose central opening 30a is of the same size

as the inlet 26. This nozzle member may be made of a special erosion-resisting material such as Bakelite, and may be press-fitted in a groove at the upper end of the inlet member, or as shown may be removably mounted on the inlet member by screw threads 31. A complementary frusto-conical nozzle member 32 is press-fitted or screwed on the adjacent end of tube 16 and is of such dimensions as to receive nozzle member 30 and thus provide a narrow jet opening 33 which is of least width adjacent the free end of nozzle member 30. In other words, the outer wall of nozzle member 30 converges toward the inner wall of nozzle member 32, as is known in the art of jet pumps. The periphery nozzle 30, 32 may be replaced by a succession of four or more individual nozzles (not shown) equally spaced circumferentially. Passageway 34 leads to a deflecting surface 35 formed on the upper end of inlet member 25 and adapted to reverse the flow of the water jet from passageway 34 and project it into the space between the nozzle members 30, 32.

The illustrative jet pump or eductor is a two-stage pump, the first stage being the suction caused by the jet opening 33 and the water under very high pressure issuing therefrom into tube 16. This suction draws water and any of its contents from the flooded compartment through openings 26 and 30a and the bore of the tube. A second stage of greater thrust is provided at the upper end of the tube, where a nozzle member 36 is secured by press-fitting or screw threads, and is surrounded by a nozzle member 37. All the nozzle members are preferably of the same material. A jet opening 38 is provided by the converging walls of nozzle members 36, 37. The effect of the throttling orifice 19 is to diminish the pressure in the chamber 34. A volume greater than one-half of the total flow through conduit 11 passes through the second stage of the pump, so that the impelling effect or lift of the jet at the upper end of tube 16 is greater than the jet at the lower end of said tube. A collar 40, which is annular, fits around the outside of nozzle member 37 and is screw-threaded as at 41 for engagement with the upper end of body 10, thereby holding nozzle member 37 in position. A sealing ring 42, like sealing ring 28, abuts the end of body 10 and is compressed by a packing and locking ring 43 screwed on threads 41 of the collar 40, so as to form a seal around the jet nozzle.

Secured by screw threads 44 to the inside of collar 40 and in axial alignment with the tube 16 is a diffuser 45 which is essentially a conduit whose bore 46 for a portion of its length is of the same size as the bore of tube 16 but for the remainder of its length uniformly increases, as indicated at 46a. At its upper end diffuser 45 carries a hose coupling 47 or standard pipe connection (not shown and unnecessary to describe), which permits connecting a hose line or pipe to the pump to conduct away the water and debris. A perforated ear 48 is integral with body 10 and projects radially from the cylindrical wall of the body to provide convenient means by which the eductor may be hooked onto a hoist cable or the like for lowering into a compartment and afterwards for raising it without subjecting the couplings and connections to undue stresses. Actually there are preferably two such ears on diametrically opposite sides of the body 10, both in a plane at right angles to the ear 48 shown in the drawing, but for convenience of illustration only a single ear is shown, and in the wrong position.

The efficient conversion of the kinetic energy of liquid flowing through the throat section (i. e., tube 16) into static pressure requires a properly proportioned diffuser 45. Insofar as the internal diameter of the discharge conduit or hose (which is coupled to the discharge end of the diffuser) determines the maximum diameter of the diffuser at the discharge end, and the length and angle of divergence of part 46a of the diffuser have certain critical values for best efficiency, it is apparent that the diameter of said throat section has a maximum value which is a function of the geometry of the diffuser as well as of the operating conditions. Accordingly the internal diameter of the discharge conduit has a very definite influence on the diameter of said throat section. For optimum performance the area of said throat section should be approximately 0.35 times the area at the discharge end of the diffuser. The jet nozzles should be spaced apart a distance equal to approximately 4 to 5 times the diameter of said throat section, and the lower nozzle should discharge into the throat as near the plane A—A as possible. The upper nozzle should discharge into the diffuser at a point spaced from the lower end of part 46a a distance about equal to the diameter of the throat section.

In actual use in the field, the described eductor will efficiently clean out flooded compartments, etc., including any muck and debris therein, without ever clogging anything which enters the inlet end being passed on through. Even coarse or large articles such as overalls will be handled without clogging. The jet nozzles are easily removed when worn by erosion and new parts are readily substituted.

Obviously the present invention is not limited to the preferred embodiment thereof herein described and shown.

Having described one embodiment of my invention, what I claim as new and desire to protect by Letters Patent is:

1. An eductor comprising an elongated hollow body having an inlet at its lower end, a tube co-axially held within the body to provide an annular passageway for fluid under pressure, a pair of jet nozzles secured at opposite ends of the annular passageway, said jet nozzles co-operating to lift water and debris entrained therein through said inlet and tube, a conduit secured to said hollow body and extending generally parallel thereto and having means at its upper end for attachment of a hose or the like, said conduit being bent at its lower end to discharge into the annular passageway in a direction at right angles to the common axis of the body and tube, a guide vane within the bent portion of the conduit and dividing the fluid flowing through the conduit into two streams, and a crowned flow-dividing member secured to the body within said annular passageway in the direct path of the fluid discharged from the conduit and co-operating with the guide vane to divide the fluid into two streams moving in opposite directions through said passageway to said jet nozzles.

2. An eductor consisting of an elongated hollow body, a straight tube secured co-axially of and within the body and providing therewith an annular passageway for fluid under pressure, conduit means secured to the body and discharging into the annular passageway at a point about midway between the ends of the tube, means secured to the body to divide the flow from the discharge end of the conduit means into two

parts one of which moves toward the upper end of the annular passageway while the other moves toward the lower end, a jet nozzle at the upper end of the annular passageway and another jet nozzle at the lower end, sets of guide vanes extending between the body and tube in said annular passageway and interposed between the two jet nozzles and the discharge end of said conduit and arranged to insure a uniform peripheral jet from each nozzle, an inlet member secured to the lower end of the body and having a central opening which is aligned with the tube, said inlet member also having a rounded surface on its upper end to reverse flow of fluid and direct it into the lower jet nozzle, the outer part of the lower jet nozzle being secured to the lower end of the tube and the inner part of the lower jet nozzle being secured to the upper end of the inlet member and surrounding the central opening therein and being surrounded by said rounded surface.

3. An eductor consisting of a hollow elongated body, a straight hollow tube co-axial with the body, means to hold the tube rigidly within the body so as to provide an annular passageway for fluid, conduit means connected to the body and discharging into said annular passageway midway of its ends, a guide vane in said conduit means near its discharge end and adapted to divide the fluid into two streams, flow-dividing means within the annular passageway and adapted to turn the two streams discharged by the conduit toward opposite ends of the annular passageway, a throttling orifice provided near the

lower end of the annular passageway, means below the throttling orifice to reverse the flow of fluid, a jet nozzle so disposed as to receive all the fluid whose flow is thus reversed and discharge it into the lower end of the tube, an inlet member secured to the lower end of the body and having a central opening aligned with the tube opening, said jet nozzle being mounted partly on the inlet member and partly on the tube, another jet nozzle in the upper part of the body and carried partly by the body and partly by the tube, the jet nozzles being at the ends of the annular passageway and together discharging all fluid flowing through the annular passageway, a diffuser secured to the upper end of the body and receiving the discharge jet of the upper jet nozzle, and guide vanes in the annular passageway and so constructed and arranged as to insure a uniform peripheral jet at each jet nozzle.

ALBRECHT E. REINHARDT.

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