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VACUUM JET AND SYSTEM OF OPERATING THE SAME.

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1,423,198. **Patented July 18, 1922.**

Fig. 1

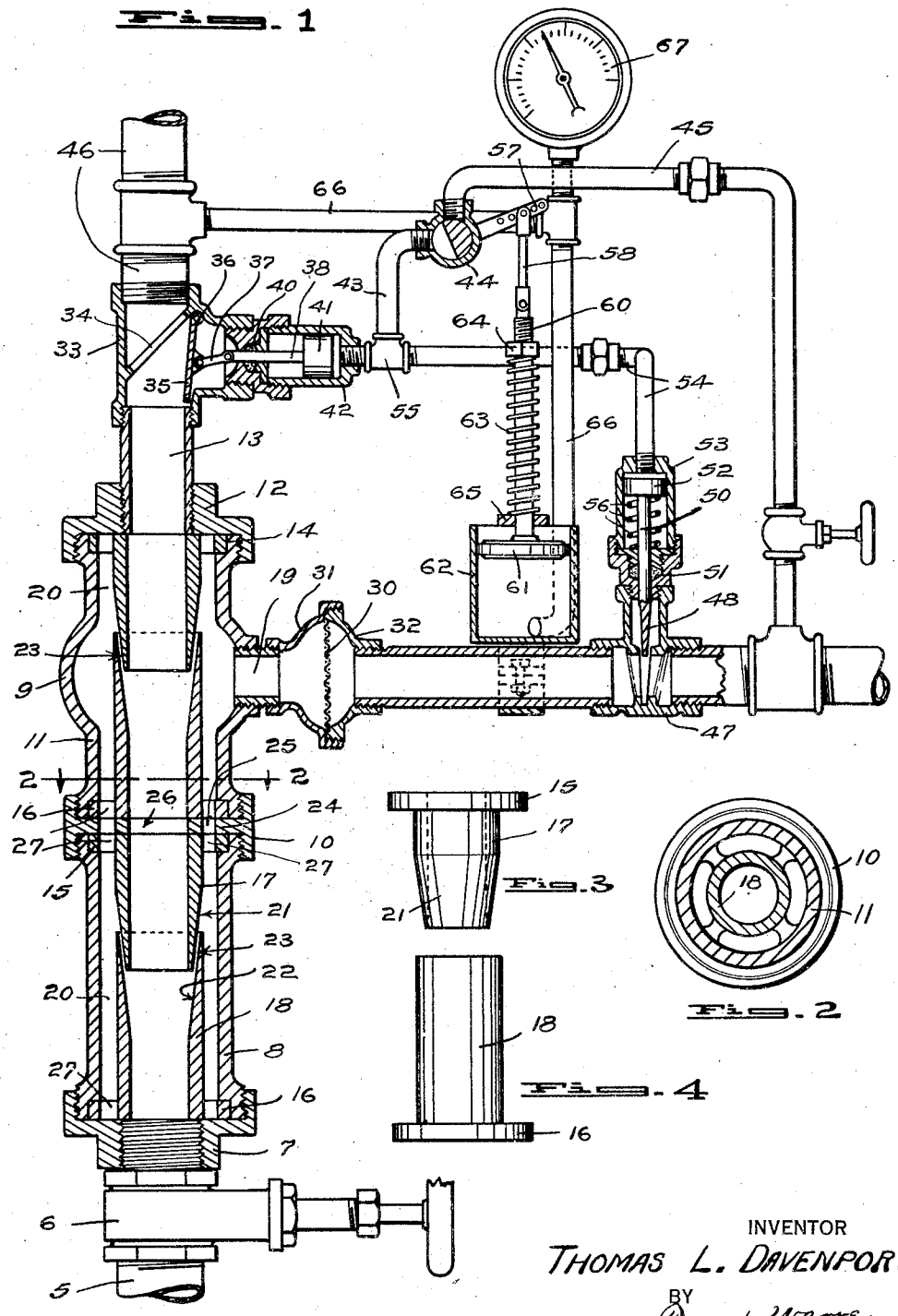


Fig. 3

Fig. 2

Fig. 4

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VACUUM JET AND SYSTEM OF OPERATING THE SAME.

1,423,198. Specification of Letters Patent. Patented July 18, 1922.

Application filed February 25, 1919, Serial No. 279,200. Renewed March 31, 1921. Serial No. 457,491.

To all whom it may concern:

Be it known that I, THOMAS L. DAVENPORT, citizen of the United States, residing at Everett, in the county of Snohomish and State of Washington, have invented a certain new and useful Improvement in Vacuum Jets and Systems of Operating the Same, of which the following is a specification.

My invention relates to improvements in vacuum jet pumping systems and is an improvement of the vacuum jet pumping system disclosed in my prior United States Letters Patents No. 1,152,302, issued to me August 31, 1915, and No. 1,180,017, issued April 18, 1916; and the object of my invention is to improve and simplify the construction and render more efficient the operation of a vacuum jet pumping apparatus.

A further object of my invention is to construct a vacuum jet that is formed of units or sections so that any desired number of the units may be used and to construct a jet wherein the various parts in the several units are of simple and uniform construction so that they are interchangeable.

A still further object of my invention is to provide novel and efficient controlling mechanism for use in combination with the vacuum jet that is adapted to operate automatically to shut off the flow of the fluid from which the power is derived when the degree of vacuum within the jet reaches a predetermined maximum.

My invention consists in the novel construction of a vacuum jet and in the adaptation and combination therewith of an automatic control for regulating the flow of fluid under pressure through said vacuum jet.

I accomplish these objects by devices illustrated in the accompanying drawings, wherein—

Figure 1 is a view in vertical cross-section of a vacuum pump and automatic control therefor certain parts being shown in elevation;

Fig. 2 is a view in cross-section on broken line 2, 2 of Fig. 1; and

Figs. 3 and 4 are views in elevation of two details embodied in the construction of the vacuum jet.

Referring to the drawings throughout which like reference numerals indicate like parts, the numeral 5 designates a conduit or pipe which may serve to conduct material to a suitable point of discharge. The pipe 5 is provided with a shutoff valve 6 and the top end thereof is externally threaded to screw within an internally threaded boss on a cap 7, which cap 7 is internally threaded to screw over the externally threaded lower end of a tubular member 8.

The upper end of the member 8 is externally threaded and is connected by an internally threaded coupling 10 with the externally threaded bottom end of another tubular member 11 that is provided on its top end with a cap 12 similar to the cap 7 that is connected with an inlet pipe 13.

The member 11 is enlarged as at 9 and is provided on one side of the enlarged portion with an internally threaded boss for the reception of an inlet pipe 19 through which fluid under pressure, as steam, may be admitted to the jet.

Both ends of each of the members 8 and 11 are internally counterbored as at 14 to provide seats for flanges 15 and 16 on the end of the tubular members 17 and 18, as shown in Figs. 3 and 4, that are adapted to be inserted within the members 8 and 11.

The tubular members 17 and 18 are of smaller diameter than the internal bore of the members 8 and 11 so that a passageway 20 is left therebetween.

The end of each tubular member 17 opposite the flange 15 is externally beveled or tapered as at 21 and the end of each tubular member 18 opposite the flange 16 is internally beveled or flared as at 22 so that when a section of the device is assembled the tapered end 21 of the member 17 will project within the flared end 22 of the member 16 as shown in Fig. 1 and a relatively narrow annular passageway 23 will be left therebetween.

The coupling 10 is provided with a transverse wall 24 that is slotted as at 25 and provided with a concentric opening 26 that registers with the openings in the tubular members 17 and 18, the flanges 15 and 16 are also slotted as at 27 to afford passageways that register with the slots 25 and permit fluid to pass from the jet 11 to the jet 8.

In assembling a pump consisting of two sections as shown in Fig. 1 one of the tubular members 18 is inserted into the botom end of each of the members 8 and 11 and one of the tubular members 17 is inserted into the top ends thereof and the two members 8 and

11 are secured together by screwing them into the coupling member 10 securely against the wall 24. The caps 7 and 12 are then screwed on to the outer ends of the jets 8 and 11 and the pipes 5 and 13 are screwed into the caps 7 and 12.

The flanges 15 and 16 are ground so that they will seat accurately in the counterbores 14 and when the caps 7 and 12 are screwed tightly in place and the members 8 and 11 are screwed tightly into the coupling 10 the several tubular members 17 and 18 will be held in accurate alignment with the tapered ends of the members 17 projecting into the flared ends of the members 18 and evenly spaced therefrom to form the annular passageways 23.

From the above description it will be seen that the several parts that go to make up this vacuum jet pumping apparatus are relatively simple and uniform construction and are interchangeable with respect to the different sections of the apparatus.

It will be seen that the several parts are so constructed that a continuous passageway of substantially constant cross-sectional area is formed within the members 17 and 18 while an annular pasageway of substantially constant area is formed around the outer walls of such members below the enlarged section 9 of the jet member 11.

Interposed within the supply pipe 19 is a strainer composed of a disk of perforated material or wire netting 30 that is clamped between two flanged members 31 and 32 of concavo-convex form which serves to prevent foreign matter from getting into the vacuum jets.

The foregoing description has been confined to the vacuum jet pumping apparatus and I will now proceed to describe the control mechanism that is associated therewith.

The upper end of the pipe 13 is connected with the bottom end of a T-shaped valve housing 33 that is internally provided with an angularly positioned valve seat 34 and with a flap valve 35 that is pivoted as at 36 and connected by a link 37 with the inner end of a piston rod 38 which passes through a stuffing box 40 and is secured to a piston 41 in a cylinder 42.

The end of the cylinder 42 is connected by a pipe 43 with a valve 44 which valve is in turn connected by a pipe 45 with the inlet pipe 19 so that when the valve 44 is open the pressure of the fluid that is passing through the inlet pipe 19 may enter the cylinder 42, move the piston 41 to the left from the position shown in Fig. 1 and close the flap valve 35.

The upper end of the valve casing 33 is connected with a pipe 46 which may in turn be connected with any suitable form of devices, not shown, through which a suction is to be produced.

The pipe 19 is provided with a valve housing 47 within which is slidably mounted a gate valve 48 that is rigidly connected with a piston rod 50 that passes upwardly through a packing gland 51 and is connected with a piston 52 in a cylinder 53.

The top end of the cylinder 53 is connected with a pipe 54 which in turn is connected by means of a T-fitting 55 with the pipe 43 so that when pressure is admitted to move the flap valve 35 the gate valve 48 will also be moved.

The gate valve 48 may be normally held in a raised position by a spring 56 on the piston rod 50.

The opening and closing of the valve 44 is effected by an arm 57 that is connected by a link 58 with the top end of a piston rod 60 whose bottom end is secured to a piston 61 that is disposed within a cylinder 62 that is open at one end.

The piston rod 60 has a compression spring 63 provided thereon which is interposed between an adjustable nut 64 on the top end of the rod 60 and a cross bar 65 on the top end of the cylinder 62.

The lower closed end of the cylinder 62 is connected with a pipe 66 that connects with the pipe 46 above the valve housing 33 and with a vacuum gage 67 that is adapted to register the degree of vacuum pressure within the pipe 66,

This device is adapted for any use to which a vacuum pump may be put and has been successively used for operating vacuum cleaners and also for pumping sand and gravel and for removing ashes from ash pits and like places.

In the operation of this device the pipe 46 is connected with the nozzles or outlets through which a suction is to be produced and fluid under pressure, as steam or compressed air, is admitted through the pipe 19 to the passageway 20 and is directed at a high velocity through the passageways 23 and downwardly through the tubular members 17 and 18 to the discharge pipe 5 thereby creating a suction through the pipe 46.

The suction produced by the two jets working in tandem has been found in practice to be substantially twice as great as the suction of one jet working alone.

If the vacuum in the pipe 46 reaches a predetermined maximum so that the pressure in the cylinder 62 drops sufficiently to permit the pressure of the air on the top of the piston 61 to move the piston 61 and piston rod 60 downwardly and open the valve slightly then the gate valve 48 will be moved downwardly to partially close the passageway through the pipe 19 and retard the inlet of steam until only enough to produce the desired vacuum is passing therethrough.

If the vacuum in the pipe becomes less the spring 63 will serve to open the gate

valve 48 and admit more steam to the vacuum jets.

It will thus be seen that the control mechanism serves to decrease the flow of the actuating medium when the desired vacuum is reached or exceeded and further serves to increase the flow of actuating medium when the vacuum is not as great as desired.

The control feature is especially advantageous and tends to conserve energy where several outlets are connected with the pipe 46 and each operated and shut off and turned on independently so that different numbers of these outlets may be actuated by the jet at different times.

Obviously changes in the form of construction of this device may be resorted to within the scope of the following claims.

What I claim is:

1. A vacuum jet of the class described, comprising an outer casing having a fluid inlet passageway and provided with a cylindrical passageway therethrough that is counterbored at each end to form a seat, a tubular member having an annular flange on one end adapted to fit within the seat in one end of said casing to center said tubular member within said casing the inner walls of the end of said tubular member opposite said flange being flared, another tubular member having an annular flange on one end adapted to fit within the seat in the opposite end of said casing said other tubular member having a tapered end adapted to project within the flared end of said first named tubular member so that a narrow annular space is left therebetween, caps on the ends of said outer casing and adapted to engage with and hold said tubular members and inlet and outlet pipes connected with said caps.

2. A vacuum jet pumping apparatus, comprising a plurality of vacuum jets adapted to be secured together in end to end relation each of said jets comprising an outer casing provided with a cylindrical passageway that is counterbored at each end to form a seat, a tubular member having a perforated flange on one end adapted to fit within the seat in one end of said casing said tubular member being of less diameter than the cylindrical passageway within said casing whereby an annular passageway is left therebetween when the tubular member is projected into the cylindrical passageway and said tubular member having its inner walls beveled to form a flaring end that is directed toward the intake end of said jet, another tubular member having a perforated flange on one end that is adapted to fit within the seat in the opposite end of said casing said last named tubular member being of substantially equal diameter to said first named tubular member and having its outer walls beveled to form a tapered lower end that is adapted to be projected into the flaring end of said first named tubular member in concentric relation thereto to leave a narrow annular passageway therebetween, a delivery conduit connected with the outlet end of said series of vacuum jets, an intake conduit connected with the inlet end of said series of vacuum jets and a pipe adapted to conduct fluid under pressure into the annular passageway between the walls of said tubular members and the walls of said vacuum jets.

3. A vacuum jet pumping system comprising a plurality of vacuum jets adapted to be secured together in end to end relation the main passageway through each of which is substantially cylindrical so that the combined passageway through all of said jets will be of substantially constant cross-sectional area, a delivery conduit connected with the outlet end of said series of vacuum jets, an intake conduit connected with the inlet end of said series of vacuum jets, a supply pipe adapted to conduct fluid under pressure into said jets, a gate valve interposed in said supply pipe, and automatic means associated with said gate valve and said intake conduit whereby the flow of fluid through said supply pipe shall be varied in response to variations in the reduced pressure of fluid within said intake conduit.

In witness whereof, I hereunto subscribe my name this 15th day of February, A. D. 1919.

THOMAS L. DAVENPORT.