Sept. 23, 1958 F. A. CARPENTER 2,853,014

BOOSTER ATTACHMENT FOR CENTRIFUGAL PUMPS

Filed Feb. 28, 1956 2 Sheets-Sheet 1

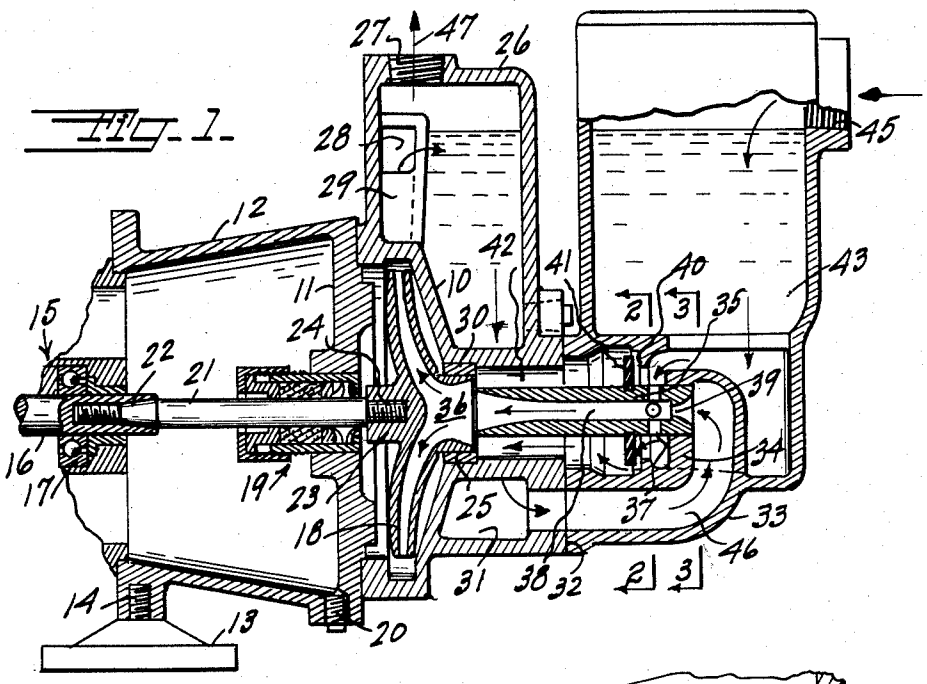

Fig. 1.

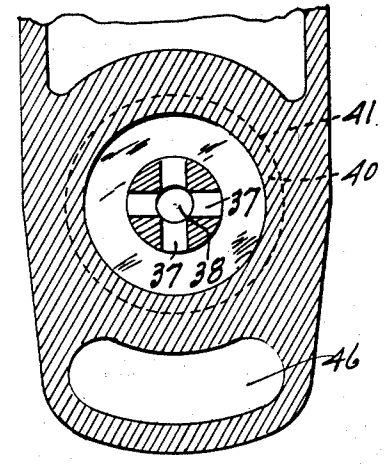

Fig. 2.

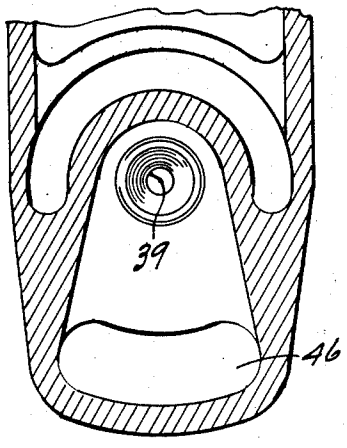

Fig. 3.

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BOOSTER ATTACHMENT FOR CENTRIFUGAL PUMPS

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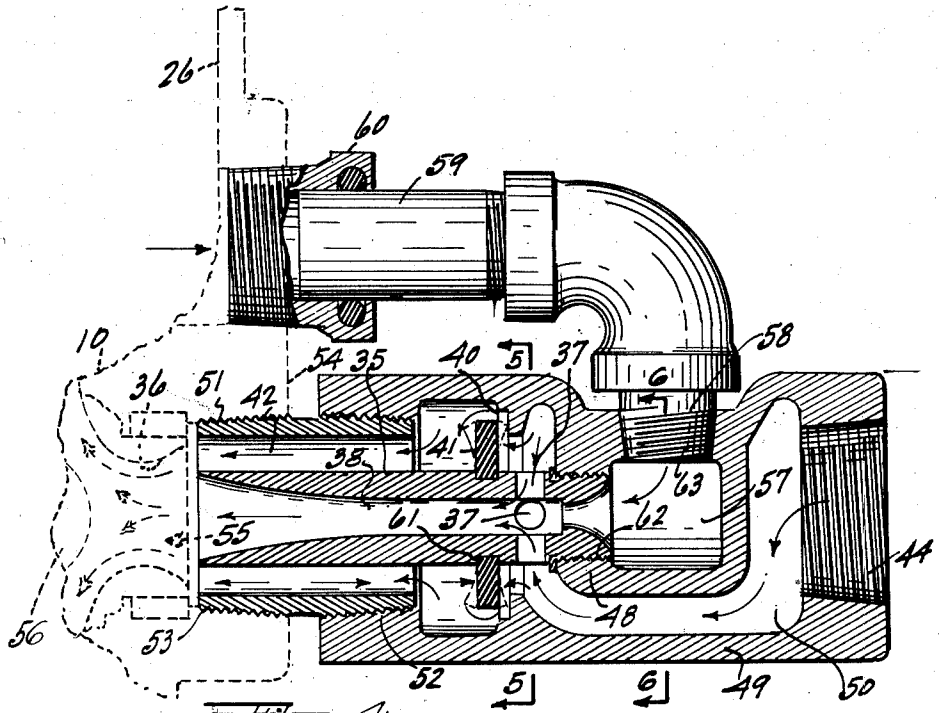

Fig. 4.

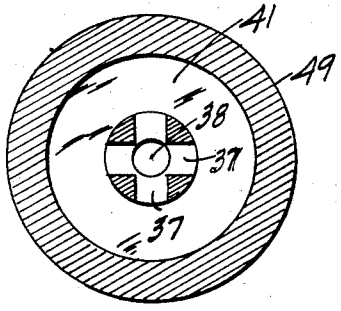

Fig. 5.

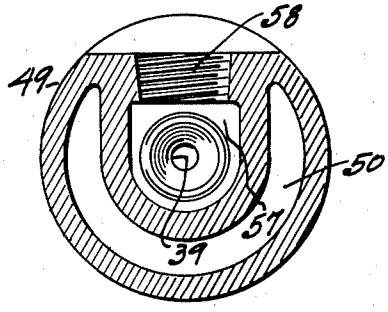

Fig. 6.

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BOOSTER ATTACHMENT FOR CENTRIFUGAL PUMPS

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6 Claims. (Cl. 103—5)

This invention relates to improvements in centrifugal pumps and provides a pump which, when operating against a normal head will operate at full capacity as a plain centrifugal pump, but with an increased head is automatically converted into a centrifugal pump with a booster jet, increasing the head available to more than twice that of the normal head.

A small centrifugal pump will deliver an abundance of water at normal pressures of 20 to 25 pounds gauge per square inch even against a heavy suction lift but do not have sufficient pressure range to build up noticeably beyond this pressure and will not build up to a desired cut-off pressure of 40 pounds gauge per square inch which is normally expected of domestic water systems, and are therefore short range pumps.

It is common practice toward overcoming this deficiency to connect a jet to the pump, which on the average will double the pressure range of the centrifugal pump, however, the capacity of the pump is thereby greatly diminished, particularly under heavy suction because all of the water must pass through the restricted throat of the venturi, the capacity thus being limited to the volume capable of passing through this restricted passage under the specific degree of vacuum developed by the pump.

My invention overcomes the faults mentioned by providing an annular passage about the venturi, suitably controlled by a flexible valve, to permit bypass of water to the impeller intake while the pump is operating against a specific head, or a pressure of up to about 25 pounds gauge per square inch, and closing through reverse pressure as the pressure builds up above that value through conversion to a jet boosted pump for building the pressure to 40 to 50 pounds gauge per square inch or more.

My invention can be incorporated in any centrifugal pump during manufacture, or can be added to existing centrifugal pumps in the form of an attachment which is easily connected and which is simple and relatively small and light in weight.

The objects and advantages of the invention are as follows:

First, to provide a centrifugal pump with an automatically controlled jet booster for increasing the pressure range of the pump.

Second, to provide a centrifugal pump which will operate as a normal centrifugal pump until the head attains a predetermined value and automatically change over to a jet boosted pump for increasing the working head to a second predetermined higher value when said predetermined value is exceeded, thereby maintaining the full capacity of the centrifugal pump until said second predetermined value is attained.

Third, to provide a centrifugal pump with a jet discharging directly into the intake of the pump impeller and fed from the discharge of the pump and having a valve controlled bypass to said intake with the valve controlled through direct and reverse pressures in the bypass as the discharge head progresses to and above a predetermined value.

Fourth, to provide a jet attachment for a centrifugal pump and having an intake, and having connections attachable to the intake and discharge of the pump for boosting the pressure range of the pump.

Fifth, to provide an attachment as outlined with a valve controlled by-pass from the said intake to the intake of the pump with the valve controlled by the developed head for operation as a conventional centrifugal pump when the head is below a predetermined value and for operation as a jet boosted centrifugal pump when the said predetermined value is exceeded, for increasing the pressure range of the pump beyond its normal range.

Sixth, to provide a jet attachment for centrifugal pumps which attachment is simple in construction, relatively light in weight, easily connected to the pump, and economical to manufacture.

In describing the invention reference will be had to the accompanying drawings, in which:

Fig. 1 is a longitudinal section through a centrifugal pump with my invention applied thereto.

Fig. 2 is a section taken on line 2—2 of Fig. 1.

Fig. 3 is a section taken on line 3—3 of Fig. 1.

Fig. 4 is a longitudinal sectional elevation through a modification showing the jet attachment.

Fig. 5 is a section taken on line 5—5 of Fig. 4,

Fig. 6 is a section taken on line 6—6 of Fig. 4.

As illustrated in Fig. 1, the invention may be incorporated as a unit with the pump casing or with the head, depending on the construction of the centrifugal pump, and can also be manufactured as an attachment for existing centrifugal pumps, and may include a priming chamber for suction columns having no foot valve as shown in Fig. 1, or the priming chamber may be omitted as in Fig. 4 for those having a foot valve.

Referring to Fig. 1, the pump casing includes the impeller housing **10** and cover plate **11** which is formed integral with a support housing **12** which is provided with a detachable base **13** which as illustrated is secured to the support housing by a stud or bolt **14**, one end of this housing forming the cover plate, with driving means **15** secured to the other end, the driving means having a shaft **16** mounted in suitable bearings **17** for perfect alignment with the axis of the impeller **18**. Suitable packing means **19** is mounted axially in the cover plate to prevent leakage from the impeller housing, and a drain passage provided with a plug is provided at the lower end of the support housing as indicated at **20**.

A shaft **21** has one end fixed in the drive shaft **16** as indicated at **22**, with the other end fixed in the hub **23** of the impeller **18** as indicated at **24**.

The impeller housing **10** has a bearing **30** for the intake impeller hub **25**, and has an integral discharge chamber **26** which has the discharge connection **27** at its upper end with the discharge from the impeller issuing from the passage **28** in the end of the volute **29**, this discharge chamber extending downwardly about the hub of the jet unit and therebelow as shown at **31**, the jet unit being made in two parts which are suitably secured together at **32**. The hub extension **33** terminates in a transverse wall **34** in which the venturi **35** is fixed coaxial with the intake **36** of the pump, the outside diameter of the venturi being less than the inside diameter of the pump intake to provide a passage thereabout.

This venturi is provided with diametric passages **37** which connect with the axial passage **38** just ahead of the restriction or nozzle **39** and clear of the inside of the transverse wall, and immediately ahead of these passages, a valve seat **40** is provided for the flexible valve **41** which is slightly spaced from the valve seat, the valve therefore being normally open.

An annular passage 42 is provided about the venturi and is in communication with the priming chamber 43 where no foot valve is provided, or directly with the intake connection 44 as shown in Fig. 4 when there is a foot valve to maintain priming of the pump.

In operation, the suction line is connected to the intake connection 45 on the priming chamber or the connection 44 of Fig. 4. The priming chamber is filled with water as indicated. The pressure line is connected to the discharge connection 27.

The driving means is set in operation, pumping the water through the passage 28 and discharging into the discharge chamber 26 which has communication with the intake 39 of the venturi through the passage 46, the discharge to the supply line being through the connection 27 as indicated by the arrow 47. Practically the full supply of water passes through the diametric passages 37 and axial passage 38, and through the annular passage 42 past the valve 41 which is flexed toward the intake of the pump, with only a relatively very small amount passing through the restricted passage 39 of the venturi.

This condition exists until the back pressure from increased head is sufficient to overcome the suction pressure in the annular passage 42 to deflect the valve to its seat, at which time the annular passage is closed, the water under pressure in the discharge chamber acts through the throat 39 of the venturi, drawing the water through the diametric passages into the axial passage in the venturi and discharging the water under force into the intake of the pump, following which, the pump will continue to deliver water under increased pressure until that pressure has increased to double or more that of the existent pressure when the valve closed to its seat.

The valve will remain open until the pressure has attained a value of 20 to 25 pounds gauge per square inch and will then be closed by the back pressure, the final pressure ranging from 50 to 65 pounds gauge per square inch. As the pressure is reduced to a value below the 20 to 25 pounds gauge per square inch, the valve will again open for the increased capacity to the midpoint range.

The booster attachment illustrated in Fig. 4 accomplishes the same results, but is provided for attachment to existent pumps, and includes venturi 35 which has one end mounted in the wall 48 with the other end arranged for axial alignment with the intake 36 of the pump, and includes the valve seat 40 and flexible valve 41, as also the annular passage 42 about the venturi, the diametric passages 37 and axial passage 38 in the venturi, and all of which is contained in the housing 49 in which the chamber 50 is formed for communication between the intake connection 44 and the diametric passages 37.

The discharge end of this housing is provided with a pipe coupling 51 with the annular passage 42 formed between the inner wall of this coupling and the outer wall of the venturi, and this coupling is illustrated as threaded into the end of the housing at 52 though it can be formed integral with the end of the housing, the projecting portion 53 being externally threaded to screw into the intake hub of the pump 54 for discharge directly into the intake 55 of the impeller 56.

A chamber 57 is formed coaxially with the intake end of the venturi, and has communication with the discharge of the pump through the connection 58, and the sealed slip joint connection 59 and 60.

The plain centrifugal pump is provided with the internally threaded hub of the pump 54 for connection of the intake or suction pipe, therefore it is merely necessary to screw the coupling 51 after removal of the suction pipe, into this hub, screw the suction pipe into the connection 44, and connect the coupling 59 through the member 60 to the discharge end of the volute of the pump, or to the discharge chamber illustrated in Fig. 1. It is also apparent that the priming chamber as illustrated in Fig. 1

can also be formed integrally with this attachment when no foot valve is provided on the suction line.

This attachment operates identically with that illustrated in Fig. 1. The jet coincidently serves as a recirculation means to create a self-priming feature, the jet being fed from the bottom of the discharge chamber as also from the bottom of the priming chamber with the air discharging through the top of these chambers.

The invention is of the simplest possible construction in view of the integral nozzle and venturi, and the valve which is formed of resilient material and simply stretched over the nozzle and slipped back until it snaps into the groove 61. In view of the resiliency of the valve, it cannot become encrusted or clogged and even the valve seat need not be machined if the casting is smoothly made. Thus the casting merely requires tapping at 62 for the venturi, at 63 for the feedback to the venturi, and at 44 for the intake connection, and, either the threading at 52 or forming this connection integrally and threading the projecting portion 53, slipping the valve onto the venturi and screwing the venturi into the wall 48, the other connections 58, 59, 60 being made at the time of installation.

I claim:

1. A booster attachment for a centrifugal pump, said pump having a pump intake and a pump discharge comprising, a housing having a suction passage formed therethrough and having means for coupling a suction line at one end and having coupling means for the intake of the centrifugal pump at the other end, a pressure chamber formed intermediate the length of the housing and having walls and a connection for connecting to the discharge of the centrifugal pump, a venturi having a nozzle mounted in one wall of said pressure chamber with the venturi projecting axially in said passage substantially to the end of said coupling means, passages formed through the wall of said venturi in slightly spaced relation externally of said wall and in communication with said suction passage, and a valve and a seat therefor in advance of said passages, said valve being mounted on said venturi and being normally open for passage of water through the annular passage about the venturi when the pressure in the pressure chamber is below a predetermined value and closing for passage of all water through the venturi when the pressure in the pressure chamber has exceeded said predetermined value.

2. A structure as defined in claim 1, said venturi comprising a tubular member having a nozzle formed in one end and externally threaded for securing in said wall, and having a bore formed in the other end and extending to said nozzle and being increasingly tapered to a maximum diameter for the tubular member from the nozzle to the other end, and having an annular groove formed intermediate its length and externally thereof, with said passages formed through the wall of the venturi being located intermediate the space between the ejection end of the nozzle and said groove, and said valve comprising a disc of resilient material having a bore fitting in said annular groove.

3. A booster attachment for a centrifugal pump having a pump intake, a pressure chamber, and a pump discharge in communication with said pressure chamber, comprising a booster housing having a booster intake at one end and means for connecting a suction line thereto and having a booster discharge at the other end and means for connecting said booster discharge to said pump intake, a venturi mounted in said housing coaxially with said booster discharge, a nozzle for said venturi, said nozzle having a nozzle intake and means for connecting said nozzle intake in communication with said pressure chamber, said venturi having walls and having a plurality of radial passages formed through said walls immediately forward of the discharge end of said nozzle, an annular passage provided about said venturi and providing direct communication between said booster intake and said

radial passages, and a normally open flexible disc valve mounted peripherally on said venturi and a seat therefor and located in said annular passage forwardly of said radial passages in the direction of said other end for controlling passage of water through the annular passage to said pump intake when the discharge pressure of the water is below a predetermined value for simultaneous delivery through said annular passage and said radial passages, and for closing said annular passage through back pressure when the predetermined pressure is exceeded for restricting delivery through said radial passages, respectively for maximum delivery of water until said predetermined pressure is attained, and thereafter for increasing the pressure range beyond that of the normal capacity of the pump.

4. A booster attachment for a centrifugal pump having a pump intake and a pump discharge, a booster housing having a booster intake at one end and a booster discharge at the other end and including means for connecting a suction line to said booster intake and means for connecting said booster discharge to the pump intake, a venturi including a nozzle, said venturi having its discharge end terminating adjacent said other end, said booster housing having an intake chamber in direct communication with said booster intake, a pressure chamber in direct communication with said nozzle and including a communicating connection for the pump discharge, a well separating said intake chamber from said pressure chamber and having the nozzle end of said venturi fixed therein, an annular chamber provided about said venturi and extending from said wall to said other end and having a valve seat formed intermediate its length, and a normally open resilient disc type valve anchored in an annular groove formed in the periphery of said venturi and cooperative with said valve seat, and a plurality of radial passages formed through the wall of said venturi and located between said wall and said valve seat areas, said valve remaining open until the discharge pressure exceeds that of the suction pressure by a predetermined value for maximum capacity of the pump, and closing through reverse pressure when said predetermined value is exceeded, for delivery by said venturi solely through said radial passages for doubling the pressure range of the pump.

5. A jet attachment for a centrifugal pump having a pump intake and a pump discharge, comprising a booster housing having a suction line connection at one end and

a pump intake connection at the other end and a communicating passage between said ends, a pressure chamber formed in said housing and having a wall, a venturi having a nozzle at one end and having its nozzle end mounted in said wall with its other end in delivery relation to the pump intake connection, a valve seat in said communicating passage and surrounding said venturi and a valve cooperative with said valve seat and mounted on said venturi, said venturi having a wall with radial passages formed therethrough in the area between said wall for the pressure chamber and said valve, said valve being normally open for direct passage of water through said communicating passage when the pressure of the pump is below a predetermined value for maximum capacity, and being closed by reverse pressure when the discharge pressure exceeds said predetermined pressure value for converting the centrifugal pump into a jet boosted centrifugal pump for increasing the discharge pressure of the pump over its normal limit.

6. A booster housing having a suction passage formed therethrough and having a suction connection at one end and a connection for the intake of a centrifugal pump at the other end, a pressure chamber formed in said housing and having a wall and having a connection for the discharge of the centrifugal pump, a venturi having a nozzle at one end and mounted in said wall and extending axially in the suction passage and having a plurality of radial passages formed through the wall of the venturi adjacent to the discharge end of said nozzle, a valve seat and a valve therefor located ahead of said radial passages for controlling passage of water through said suction passage, said valve being normally open for passage of water coincidently through the suction passage and the venturi, and closed through back pressure of predetermined value for limiting passage of water solely through said radial passages for boosting the pressure of the centrifugal pump beyond its normal limit.

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