

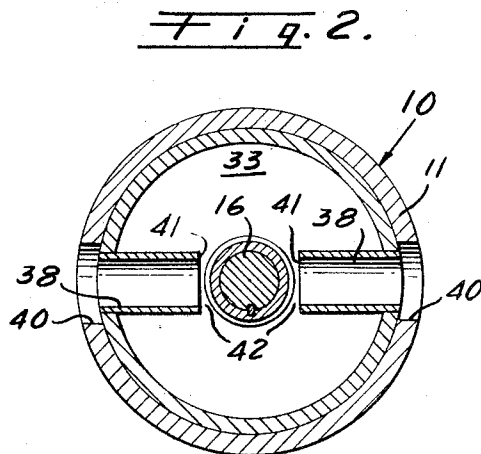
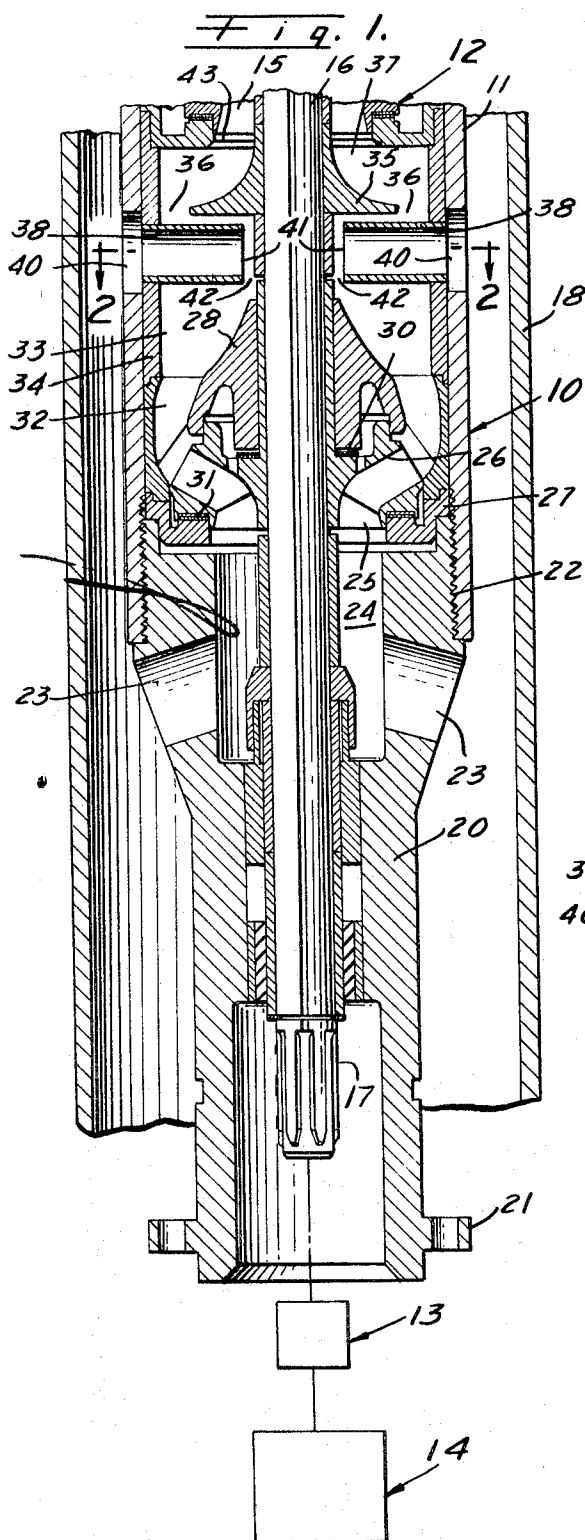
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CENTRIFUGAL GAS SEPARATOR

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CENTRIFUGAL GAS SEPARATOR

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Continuation of application Ser. No. 258,080, Feb. 12, 1963. This application Oct. 18, 1965, Ser. No. 505,061
3 Claims. (Cl. 55—199)

This application is a continuation of application 258,080 filed February 12, 1963, and assigned to the assignee of the present application and now abandoned.

This invention relates, in general, to gas separators, and in particular, to a new and improved gas separator for installation with a submersible pump for oil and water wells.

In a submersible pump it is common practice to provide an electric motor for driving a pump with a seal and gas separator interposed therebetween, all of which are provided with a common shaft driven by the motor with the pump located at the upper end with the connecting drive shaft extending through the seal section and gas separator.

Sometimes the seal and motor may be of one unit and sometimes the pump and gas separator may be of one unit, and other times each is a separable unit suspended from the pump with the interconnecting drive shaft extending therethrough.

In oil and water wells, in which the submersible pump is submerged, free and/or entrained gas with the fluid being pumped is produced and the gas interferes with the pumping ability of the pump to produce the expected volume. In most cases, this interference of the gas reduces the volumetric and mechanical efficiency of the pump.

Accordingly, it is a general object of this invention to provide a new and improved gas separator for a submersible pump which reduces the gas-liquid ratio of the fluid to be pumped so as to increase the efficiency of the submersible pump.

Still another object of this invention is to provide a gas separator for a submersible pump which is relatively short in length and relatively inexpensive to manufacture as compared to existing gas separators.

A more specific object of this invention is to provide a gas separator for a submersible pump which comprises an impeller which will subject fluid entering the separator to centrifugal force and cause the gas and liquid to separate before entering the submersible pump inlet.

Other objects and advantages of this invention will become more apparent to those skilled in the art from a reading of the invention hereinafter described and disclosed in the accompanying drawings forming a part hereof wherein:

FIGURE 1 is a side elevational view, in section, illustrating the gas separator of the present invention and submerged in a well casing;

FIGURE 2 is a transverse sectional view taken along line 2—2 of FIGURE 1 and looking in the direction of the arrows.

Referring now to the drawings, the gas separator, constructed in accordance with the teaching of this invention, is designated in its entirety as 10 and shown in a pump and gas separator housing 11 so as to form an integral part with a multi-stage submersible pump, shown only partially, but indicated in its entirety as 12. A submersible type seal 13 and a submersible type motor 14 are shown schematically. The pump impellers 15 are driven by the motor 14 through a coaxial shaft 16 extending through the gas separator and seal 13. Suitable splines 17 are provided in the shaft for appropriate connections with the respective segments of the shaft from the pump to the motor. All of the above units are shown located within a casing 18 of a gas or oil well.

The gas separator 10 is adapted to be spaced from the well casing 18. Housing 11 is suitably closed at its bottom end by a base member 20, which in turn, is provided at its lower end with a flange 21 for connecting the housing 11 to a flange on the seal 13 in a conventional manner. The upper end of the base member 20 is provided with suitable threads 22 for appropriate connection to the housing 11. Thus, installed, the pump and gas separator combination have suspended therefrom the seal and motor in a conventional manner.

The base member 20 is provided with a fluid inlet 23, which connects with an internal bore 24 and which, in turn communicates inlet 23 with an eye or inlet 25 of a gas separator impeller 26 rotatably driven by the shaft 16. Impeller 26 is interposed between a stationary bottom diffuser 27 and a stationary gas separator diffuser 28 with a pair of thrust bearings 30 and 31 permitting rotation of the impeller 26 between the two stationary diffusers. The gas separator diffuser 28 is provided with an outlet 32 which directs the fluid entering the eye or inlet 25 and subjected to centrifugal force by the impeller into a separation chamber 33 formed in part, in the embodiment disclosed, by a compression tube 34 and a diffuser 28. At the upper end of the separation chamber 33 there is provided a slinger 35 which extends from the shaft 16 radially outwardly toward the housing 11 but leaves a space 36 forming the outlet from the gas separator to permit the gas-free fluid to enter an upper or pump inlet chamber 37. Immediately below, but spaced slightly from the slinger 35, are bleed-off tubes 38 (two shown), which extend from immediately adjacent the shaft 16 outwardly to the housing 11 and communicate with apertures 40 in the housing. Bleed-off tubes 38 have inlets 41 slightly spaced from the shaft 16 so as to provide gaps 42 located adjacent the shaft.

Thus, as described, fluid and gas impelled by the gas separator impeller 26 enters the separator chamber 33. The gas-free or relatively gas-free liquid being heavier and subjected to the centrifugal force by the impeller, tends to cling to the outside wall or compression tube 34 and travel upward past the bleed-off tubes 38 through the space or outlet 36 and into the upper pump inlet chamber 37. Gas, being lighter, is separated by action of the centrifugal force and flows and accumulates near or at the gaps 42 and being of higher pressure than outside the housing 11, is vented out the bleed-off tubes 38 and apertures 40 to return to the well fluid. Any liquid which travels with the gas out the bleed-off tube will be recycled again through the impeller 26, or flow upwardly between the casing and the housing because of its high gas-to-liquid ratio. The fluid in the pump inlet chamber 37, while being relatively gas-free, then enters the pump inlet 43 to be pumped by the submersible pump in a conventional manner.

While there is shown and described a centrifugal gas separator type impeller 26, any impeller such as a mixed flow impeller which will subject the liquid therein to centrifugal force may be used, and while there is shown only two bleed-off tubes 38, more than two such tubes may be used.

And while this invention has been disclosed in connection with a unitary gas separator and pump combination, this invention may be utilized as a separate gas separator and pump, and further, while this invention has been disclosed in connection with a separate seal 13 and a separate motor 14 (which seal and motor are previously of the type disclosed and claimed in the copending patent applications of Joseph T. Carle entitled, "Submersible Seal," Serial No. 88,096 and "Submersible Pump Motor," Serial No. 88,223 both of which were filed on February 9, 1961), this invention may be utilized with any sep-

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arate seal and motor or with a motor having its seal formed integrally therewith.

I claim:

1. A gas separator for a submersible well pump comprising: a housing including a separator inlet adapted for communication with a well fluid and a separator outlet adapted for communication with an inlet of a submersible pump, a rotatable impeller adjacent said separator inlet adapted to transfer well fluid from said inlet to said outlet, said impeller including means for imparting a centrifugal force to the well fluid during transfer thereof whereby gases entrained in the well fluid are separated therefrom, a compression tube of generally cylindrical cross section within said housing defining an elongated separation chamber having an inlet adjacent said impeller to receive well fluid and separated gases for flow generally longitudinally through said chamber, a rotatable slinger disposed interiorly of said compression tube in spaced relation to said chamber inlet, said slinger having a diameter smaller than the diameter of said compression tube and forming with said compression tube a generally annular outlet in communication with said separator outlet for delivery of well fluid thereto, and at least one conduit extending through said compression tube intermediate said chamber inlet and said annular outlet and adjacent said slinger, said conduit including an open end communicating externally of said housing and an open end disposed within said chamber generally radially inwardly of said compression tube to allow escape of separated gases from said chamber.

2. A gas separator for a submersible well pump comprising: a housing including a separator inlet adapted for communication with a well fluid and a separator outlet adapted for communication with an inlet of a submersible pump, a rotatable impeller adjacent said separator inlet adapted to transfer well fluid from said inlet to said outlet, said impeller including means for imparting a centrifugal force to the well fluid during transfer thereof whereby gases entrained in the well fluid are separated therefrom, a compression tube of generally cylindrical cross section within said housing defining an elongated separation chamber having an inlet adjacent said impeller to receive well fluid and separated gases for flow generally longitudinally through said chamber, a rotatable slinger disposed interiorly of said compression tube in spaced relation to said chamber inlet, said slinger having a diameter smaller than the diameter of said compression tube and forming with said compression tube a generally annular outlet in communication with said separator outlet for delivery of well fluid thereto, a shaft extending through said housing and said compression tube generally longitudinally of said compression tube and generally centrally disposed with respect thereto, said shaft being connected to both said impeller and said slinger and adapted to effect rotation thereof, and at least one conduit extending through said compression tube intermediate said chamber inlet and said annular outlet and adjacent said slinger, said conduit including an open end

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communicating externally of said housing and an open end disposed within said chamber generally radially inwardly of said compression tube and adjacent said rotatable shaft to allow escape of gases from said chamber.

3. A gas separator for a submersible well pump comprising: a housing including a separator inlet adapted for communication with a well fluid and a separator outlet adapted for communication with an inlet of a submersible pump, a rotatable impeller adjacent said separator inlet adapted to transfer well fluid from said inlet to said outlet, said impeller including means for imparting a centrifugal force to the well fluid during transfer thereof whereby gases entrained in the well fluid are separated therefrom, a compression tube of generally cylindrical cross section within said housing defining an elongated separation chamber having an inlet adjacent said impeller to receive well fluid and separated gases for flow generally longitudinally through said chamber in two generally distinct paths with the well fluid flowing generally radially outwardly of the separated gases and adjacent said compression tube and an outlet in communication with said separator outlet for delivery of well fluid thereto, a rotatable slinger disposed interiorly of said compression tube in spaced relation to said chamber inlet, said slinger having a diameter smaller than the diameter of said compression tube and forming with said compression tube a generally annular outlet in communication with said separator outlet for delivery of well fluid thereto, a shaft extending through said housing and said compression tube generally longitudinally of said compression tube and generally centrally disposed with respect thereto, said shaft being connected to both said impeller and said slinger and adapted to effect rotation thereof, and at least one conduit extending through said compression tube intermediate said chamber inlet and said annular outlet and adjacent said slinger, said conduit including an open end communicating externally of said housing and an open end disposed within said chamber generally radially inwardly of said compression tube and adjacent said rotatable shaft to allow escape of gases from said chamber.

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