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DUPLEX HIGH PRESSURE ROTARY PUMP

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2 Sheets-Sheet 1

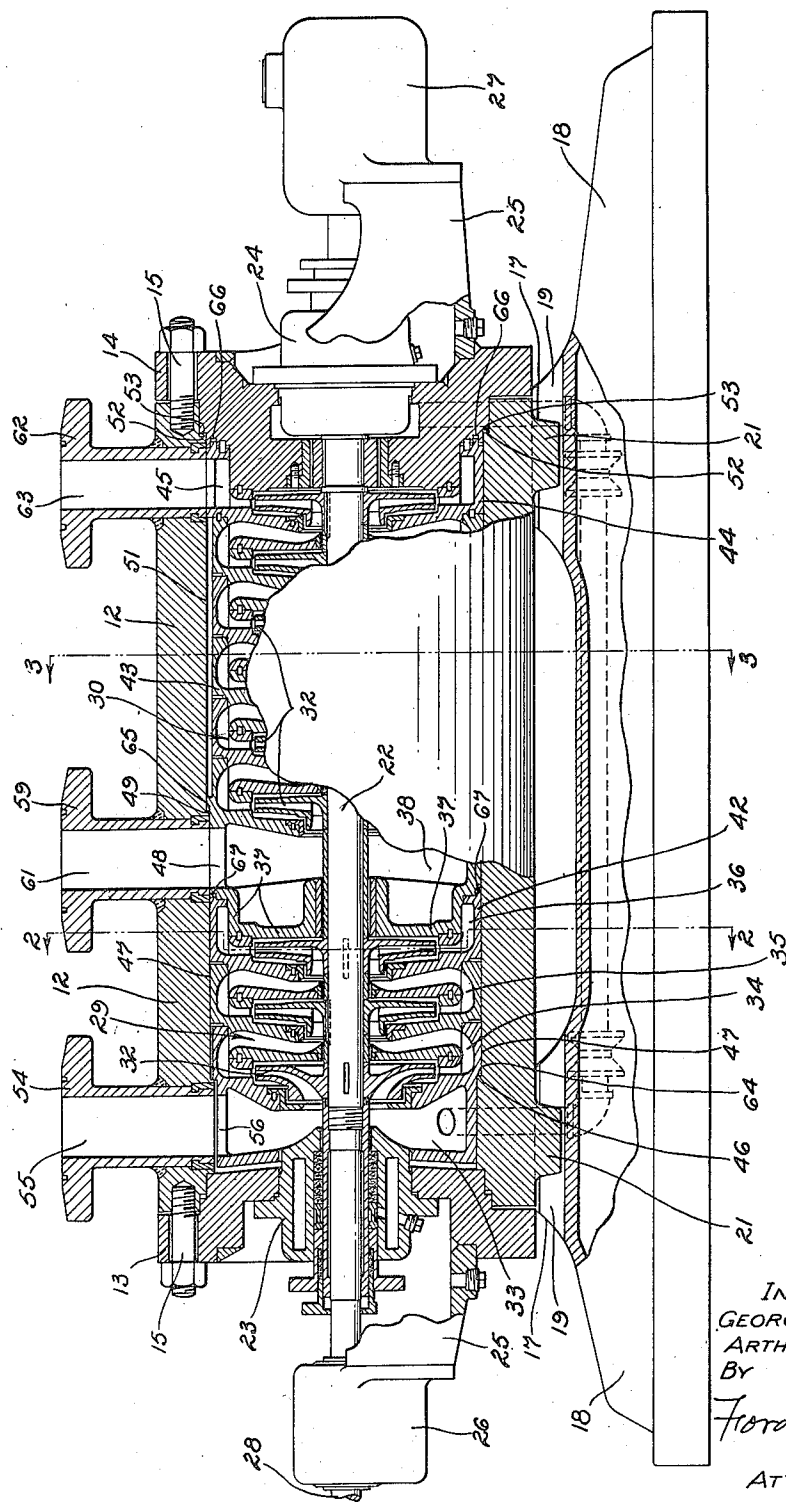


Fig. 1.

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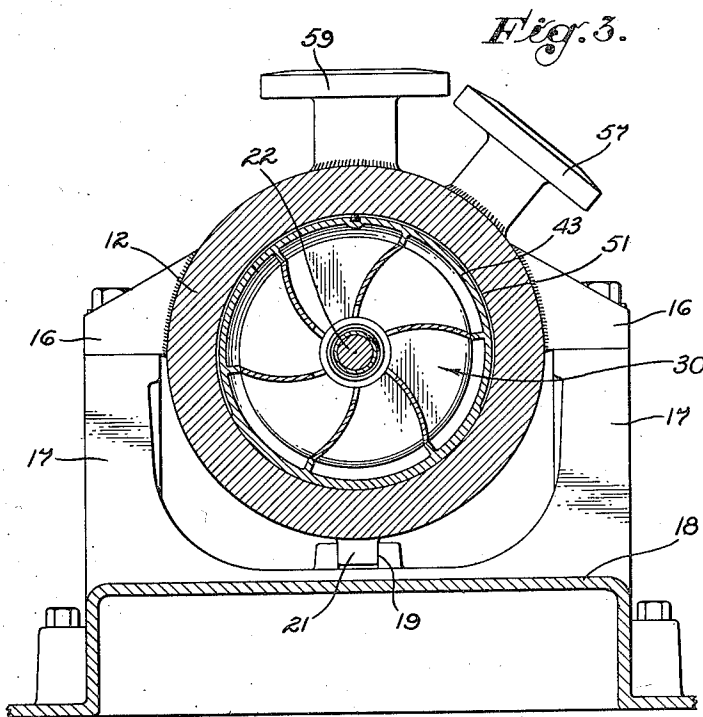
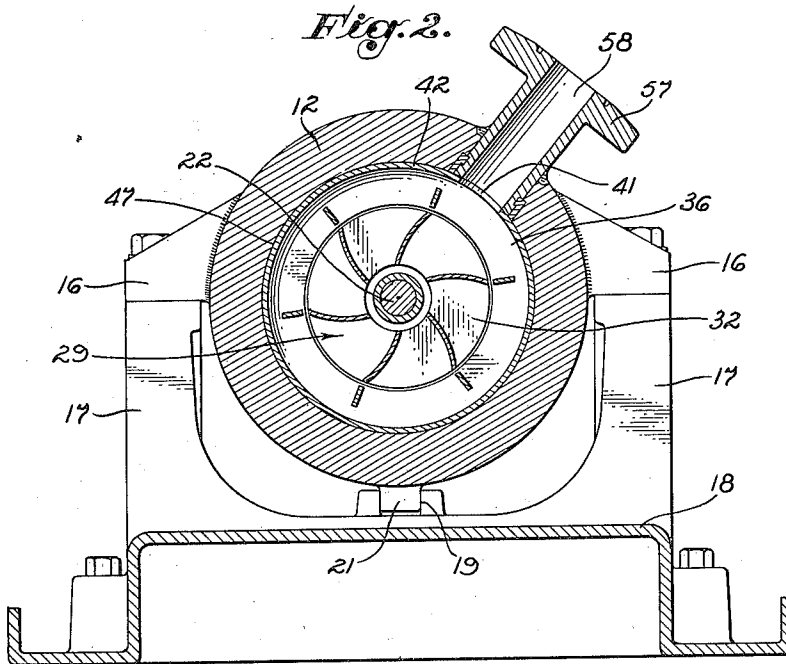
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DUPLEX HIGH PRESSURE ROTARY PUMP

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5 Claims. (Cl. 103—108)

Our invention relates to a rotary pump especially adapted for the pumping of liquids at high pressures and temperatures, for example, hot oils in oil refineries.

5 Pumps of this character are operated under conditions which are extremely severe, and a very high degree of dependability is demanded of them. They must be capable of continuous operation throughout a period of refining, for the reason that should the flow of oil through the stills be stopped by pump failure, serious accidents and great losses are likely to occur. In a process of distillation, the crude oil is received from a supply and is then pumped through a preliminary heater under medium pressure, from which the oil is then pumped under high pressure through the superheated tubes of a cracking still. These two pumping stages ordinarily require two separate pumps, with the result that 10 two sets of packing are required for the two pump units employed. An object of our present invention is to provide a duplex pump contained in one massive forged cylindrical shell, such pump having an oil inlet at the front end thereof connected to a source of supply, and a high pressure oil discharge at the rearward end thereof adapted to be connected to the cracking still. Intermediate the ends of the pump structure, ports are provided so that oil at intermediate pressure may be taken from the pump and conducted through an oil heater at medium pressure and then returned to the pump which raises the pressure to maximum before it is conducted through the final discharge port of the pump and delivered to the 35 high pressure cracking still.

It is accordingly an object of the invention to provide a pump of the above character having a massive tubular or cylindrical shell containing therein a pair of insert pump structures in end-to-end relation, inlet means connected to the intake of the first of the insert pump structures through which oil may be received from a suitable source, an outlet connected to the discharge of the second of the insert pump structures whereby 45 the oil may be delivered under high pressure, and means intermediate the before-named inlet and outlet members cooperating to form an oil passage exterior of the shell of the pump, this external oil passage connecting the discharge of the first insert pump structure with the intake of the second insert pump structure, both the insert pump structures being therefore supported within one massive shell and being operated by a single drive shaft which extends into the shell 50 through heads which close the ends of the shell,

It is a further object of the invention to provide in a pump of the above character a simple and positive means for preventing reverse flow of fluid around the exterior of the insert pump structure and within the enclosing shell, between 5 the discharge and intake of each insert pump structure.

It is an object of the invention to provide in a pump of the above character a cylindrical shell having primary and secondary, rearwardly faced 10 annular sealing shoulders formed therein against which cooperating annular shoulders on the insert pump structures are forced as the result of the assembly of the component parts of the pump structure and which are given additional sealing 15 pressure by the pressure of fluid within the pump when it is in operation.

Further objects and advantages of the invention will be made evident throughout the following part of the specification. 20

Referring to the drawings, which are for illustrative purposes only,

Fig. 1 is a partly sectioned side view of a preferred form of our invention.

Fig. 2 is a cross section taken as indicated by 25 the line 2—2 of Fig. 1.

Fig. 3 is a cross section taken as indicated by the line 3—3 of Fig. 1.

In the form of the invention shown in the drawings, we provide a tubular housing consisting of a massive forged steel cylinder 12 having means for closing the ends thereof, such means being preferably in the form of separate massive forged steel heads 13 and 14 secured in the forward and rearward ends of the shell 12 by means 35 of screws 15. The shell 12 has four brackets 16 projecting therefrom which are supported on posts 17 which extend upwardly from a base 18. The base 18 has a pair of channels 19 formed near the ends thereof and being upwardly faced 40 so as to receive guide lugs 21 which project downwardly from the shell 12. A shaft 22 extends axially through the shell 12 and projects through packing devices 23 and 24 respectively secured in the heads 13 and 14. By means of brackets 25 45 which project outwardly from the heads 13 and 14, outboard bearings 26 and 27 are held in position to receive the ends of the shaft 22 which project from the packing devices 23 and 24. The bearing 26 is a simple radial bearing, and the 50 bearing 27 is a combined radial and thrust bearing. The shaft 22 has a projection 28 extending from the bearing 26 to which a drive means such as an electric motor may be connected.

Within the shell and between the heads 13 and 55

14 are a primary insert pump structure 29 and a secondary insert pump structure 30, which are placed in end-to-end relation and have impellers 32 keyed on the shaft 22 so as to be driven thereby. The primary insert pump structure 29 includes an annular intake member 33 and pump bowls 34, 35, and 36, in which the three impellers 32 of the primary insert pump structure 29 operate. The last bowl 36 of the insert pump structure 29 partly encloses the end wall 37 of the intake member 38 of the secondary insert pump structure 30. The final bowl 36 constitutes the discharge member of the primary insert pump structure 29 and has an opening 41 in the outer wall 42 thereof.

The secondary insert pump structure 30 has a plurality of intermediate bowls 43 held together in end-to-end relation and a final bowl member 44 which forms the discharge member of the secondary insert pump structure 30 and has an outlet opening 45 therein.

The shell 12 has a rearwardly faced annular shoulder 46 near the forward or leftward end thereof, and has a primary bore 47 extending rearwardly from the primary shoulder 46 to a vertical plane disposed a short distance rearwardly of the inlet opening 48 of the secondary intake member 38. At the rightward or rearward end of the primary bore 47 there is a secondary, rightwardly faced annular shoulder 49 formed within the shell 12, and extending rearwardly from the shoulder 49 is a secondary bore 51 of larger diameter than the primary bore 47, which secondary bore 51 extends to a plane beyond the outlet opening 45 of the discharge member 44 and ends at a shoulder 52 against which an annular gasket 53 is clamped when the head 14 is bolted in place, as shown.

There is an inlet member 54 communicating with the primary intake member 33, this primary inlet member 54 being preferably mounted in the forward end of the shell 12 and providing a radial opening 55 communicating with an opening 56 in the circumferential wall of the intake member 33. A primary outlet member 57 is mounted in the shell 12 at such distance from the front end of the shell that its opening or passage 58 will communicate with the opening 41 of the discharge member 36. A secondary inlet member 59 is mounted in the wall of the shell 12 at such distance rightwardly of the plane defined by the primary outlet member 57 that its radial passage 61 will communicate with the opening 48 of the secondary intake member 38. The outlet member 57 and the inlet member 59 are placed in offset relation, the member 57 being shown in Figs. 2 and 3 on an axis which slopes relative to vertical so that it will have clearance relative to the member 59 which is vertically disposed. Rearwardly of the secondary inlet member 59 a secondary outlet member 62 is provided which has an opening or passage 63 communicating with the outlet opening of the secondary discharge member 44. The inlet member 54 is adapted to be connected to a source of oil which may be at a relatively low pressure, for example, 100 pounds per square inch. The primary insert pump structure 29 operates to raise the pressure of the oil to an intermediate pressure, for example, 600 pounds per square inch, which oil is delivered through the primary outlet member 57 which may be connected by means of piping, not shown, with an oil heater, or other oil treatment device if desired. From the oil heater the oil is returned

to the pumping device through piping which connects with the secondary inlet member 59 so that the oil passes into the secondary intake 38 at a slightly reduced pressure, for example, 500 pounds per square inch, due to the frictional loss in head due to the passage of the oil through the heater. The secondary insert pump structure 30 raises the pressure of the heated oil to a high value, for example, 1500 to 2000 pounds per square inch, and delivers the same through the secondary discharge member 44 and the secondary outlet member 62 to piping leading to a cracking still.

Means are provided for forming an annular seal around the primary insert pump structure 29 between the intake and the discharge thereof, and further means are provided for forming an annular seal around the secondary insert pump structure 30 between its intake and discharge. These respective sealing means are formed by shoulders on the primary and secondary insert pump structures. The first of these shoulders 64 is formed in leftwardly facing position on the primary insert pump structure 29 and engages the primary shoulder 46 of the shell 12, and the second of these shoulders 65 is formed on the secondary insert pump structure 30 in leftwardly facing position so as to engage the secondary shoulder 49 of the shell 12. The bowls 34, 35, and 36 of the primary insert pump structure 29 are of a size to fit the bore 47 of the shell 12, and are accordingly smaller in diameter than the secondary bore 51 of the shell 12 so that the primary insert pump structure may pass readily from the rightward end of the shell 12 through the bore 51 into the bore 47. The elements of the primary and secondary insert pump structures may be assembled on the shaft 22, and then this assembly may be moved leftwardly into the shell 12 through the open rightward end thereof. When the rightward head 14 is bolted in place, the shoulder 66 thereof engages the rightward end of the discharge member 44 and forces the same leftwardly so that the bowls of the secondary insert pump structure are pressed tightly one against the other, and the shoulder 65 is pressed against the secondary annular shoulder 49 of the shell 12. Likewise, the bowls of the primary insert pump structure 29 are forced tightly one against the other, and the shoulder 64 is forced against the shoulder 46 of the shell 12, the result being that the peripheral portions of the pump bowls are sealed one against the other and the annular seals around the primary and secondary insert pump structures are formed by the cooperating shoulders 46-64 and 49-65.

Where the drop in pressure from the primary discharge member 36 through the outlet member 57, the oil heater, and the secondary inlet member 59, to the secondary intake 38 is relatively small, the "fit" of the members 36 and 38 in the rightward part of the primary bore 47 may hold the leakage from the secondary intake 38 to the primary discharge member 36 to a desired small value. Where the pressure differential between the members 36 and 38 is increased, we employ an annular gasket 67 which seals between these members and likewise forms a seal within the shell 12 between the primary outlet member 57 and the secondary inlet member 59. The especial utility of this gasket 67 is to provide a resilient or yieldable member for transmitting pressure from the secondary insert pump structure 30 to the primary insert pump structure 29,

thereby assuring that when the head 14 is bolted in place both the primary and secondary insert pump structures 29 and 30 will be held against the respective primary and secondary shoulders 46 and 49.

Although we have herein shown and described our invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same way to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

We claim as our invention:

1. A rotary pump of the character described, including: a tubular shell having an outlet port in the wall thereof in spaced relation to the forward end of said shell and an inlet port in the wall thereof between said outlet port and the rearward end of said shell; a primary insert pump structure in the forward part of said shell, said insert pump structure having an intake and a discharge, said discharge connecting with said outlet port of said shell; a secondary insert pump structure in the rearward part of said shell, said secondary insert pump structure having an intake and a discharge, said intake of said secondary insert pump structure connecting with said inlet port of said shell; heads closing the ends of said shell; an inlet member at the forward end of said pump connecting with the intake of said primary insert pump structure; an outlet member at the rearward end of said pump connecting with the discharge of said secondary insert pump structure; a drive shaft extending into said shell and being connected to both of said insert pump structures so as to drive the same; annular sealing means around said primary insert pump structure in a position between said outlet port and the forward end of said shell for preventing an external flow along the exterior of said primary insert pump structure from the discharge to the intake thereof; annular sealing means around said secondary insert pump structure between said inlet port and the rearward end of said shell for preventing an external flow along the exterior of said secondary insert pump structure from the discharge to the intake thereof; and sealing means in said shell between said discharge of said primary insert pump structure and said intake of said secondary insert pump structure.

2. A rotary pump of the character described, including: a tubular shell having a primary outlet port in the wall thereof in spaced relation to the forward end thereof, and a secondary inlet port in the wall thereof disposed rearwardly of said outlet port, there being a primary annular shoulder in said shell between said outlet port and the forward end of said shell and a secondary annular shoulder in said shell rearwardly of said secondary inlet port; a primary insert pump structure in the forward part of said shell, said insert pump structure having an intake and a discharge, said discharge communicating with said primary outlet port of said shell, and said insert pump structure having annular means engaging said primary shoulder of said shell so as to form a seal around said insert pump structure to prevent flow of fluid along the exterior thereof from said discharge to said intake thereof; a secondary insert pump structure in said shell rearwardly of said secondary inlet port, said

secondary insert pump structure having an intake and a discharge, said intake of said secondary insert pump structure communicating with said secondary inlet port of said shell, and said secondary insert pump structure having annular means engaging said secondary shoulder of said shell so as to form a seal around said secondary insert pump structure to prevent a flow of fluid exteriorly from the discharge to the intake thereof; walls closing the end of said shell; drive means for said insert pump structures; inlet and outlet means connecting respectively to the intake of said primary insert pump structure and the discharge of said secondary insert pump structure; and sealing means in said shell between said discharge of said primary insert pump structure and the intake of said secondary insert pump structure to minimize the flow of fluid therebetween within said shell.

3. A rotary pump of the character described, including: a tubular shell having means for closing the ends thereof; a pair of insert pump structures in said shell in end-to-end relation, the discharge of the first of said insert pump structures being adjacent the intake of the second of said insert pump structures; inlet means connected to the intake of said first insert pump structure; outlet means connected to the discharge of said second insert pump structure; sealing means in said shell between said discharge of said first pump structure and said intake of second pump structure; sealing means surrounding said first pump structure between said inlet means and said discharge thereof; sealing means surrounding said second pump structure between said intake and said discharge means thereof; means extending outside of said shell and forming a passage connecting said discharge of said first insert pump structure with the intake of said second insert pump structure; and drive means extending into said shell and having connection with said insert pump structures whereby to drive the same.

4. A rotary pump of the character described, including: a tubular shell having a primary outlet port and a secondary inlet port in the wall thereof in spaced relation to its forward end, there being a rearwardly faced primary annular shoulder in said shell forwardly of said primary outlet port and a rearwardly faced secondary shoulder in said shell rearwardly of said secondary inlet port; a primary insert pump structure in the forward part of said shell, said insert pump structure having an intake and a discharge, said discharge communicating with said primary outlet port of said shell, and said insert pump structure having a forwardly faced annular shoulder engaging said primary shoulder of said shell so as to form a seal around said insert pump structure to prevent flow of fluid along the exterior thereof from said discharge to said intake thereof; a secondary insert pump structure in said shell rearwardly of said secondary inlet port, said secondary insert pump structure having an intake and a discharge, said intake of said secondary insert pump structure communicating with said secondary inlet port of said shell, and said secondary insert pump structure having a forwardly faced annular shoulder engaging said secondary shoulder of said shell so as to form a seal around said secondary insert pump structure to prevent a flow of fluid exteriorly from the discharge to the intake thereof; walls closing the ends of said shell; drive means for said insert pump structures; inlet and outlet means connecting respec-

tively to the intake of said primary insert pump structure and the discharge of said secondary insert pump structure; means forcing said secondary insert pump structure forwardly so as to
5 bring the forwardly faced annular shoulder thereof into engagement with said secondary shoulder of said shell; and resilient means between said primary and secondary insert pump structures for transmitting a forwardly directed force from said
10 secondary insert pump structure to said primary insert pump structure to hold the forwardly faced shoulder thereof in engagement with said primary shoulder of said shell.

5. A rotary pump of the character described,
15 including: a tubular shell having means for closing the ends thereof; primary and secondary insert pump structures in said shell, each having an intake and a discharge, the discharge of said primary structure being arranged adjacent the in-
20 take of said secondary structure; an inlet and an

outlet port communicating through the wall of said shell with the intake and discharge of each pump structure; sealing means in said shell surrounding said primary structure between said
5 intake and discharge thereof, said means comprising abutting annular shoulders on said shell and said primary pump structure; sealing means in said shell surrounding said secondary structure between said intake and discharge thereof, said
10 means comprising abutting annular shoulders on said shell and said secondary pump structure; drive means for said pump structures; and resilient means between said primary and secondary structures for transmitting a force from said sec-
15 ondary structure to said primary pump structure, said force holding said abutting shoulders of both of said pump structures and said shell in en-
gagement.

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