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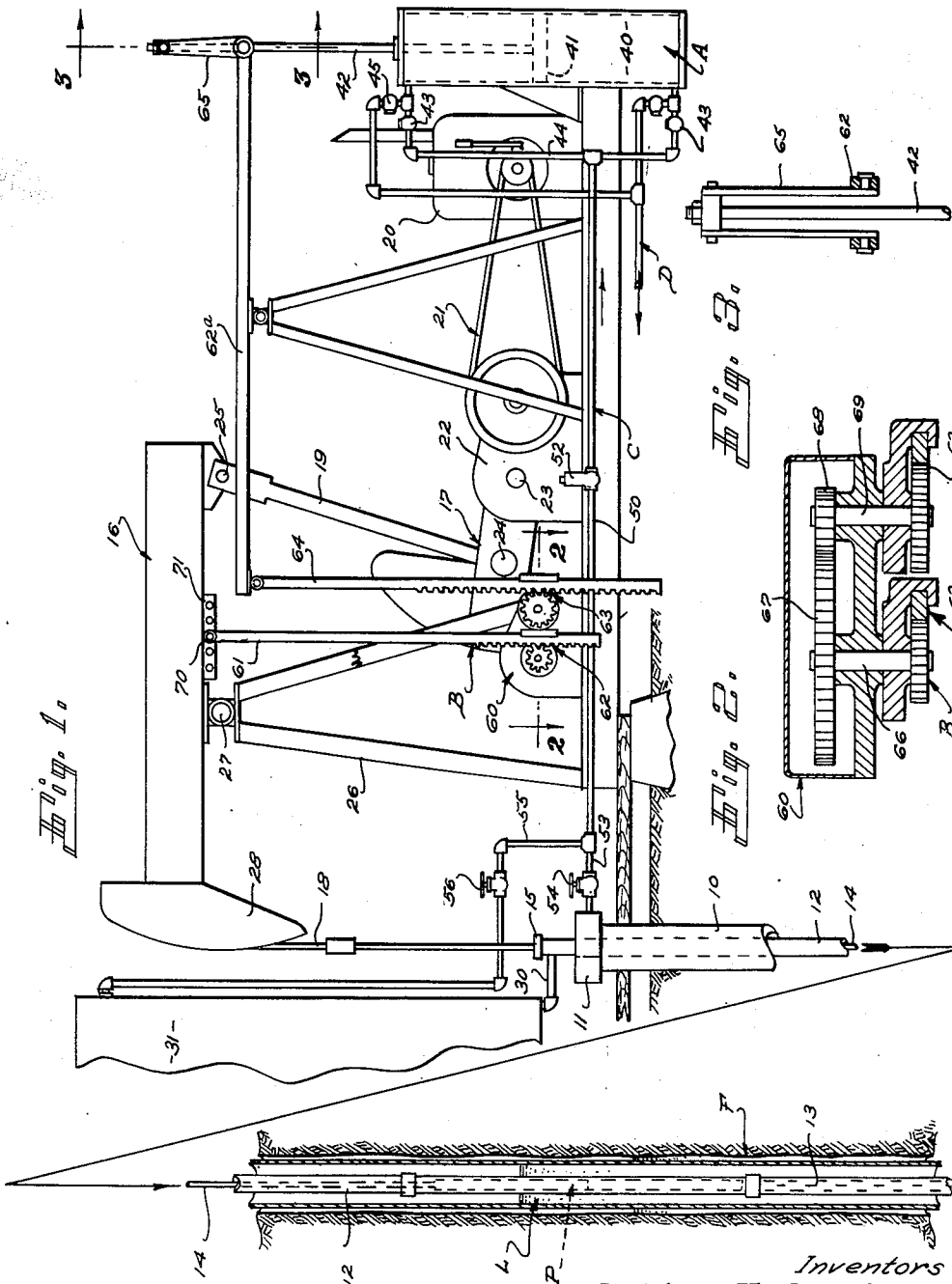
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SUPPLEMENTAL EQUIPMENT FOR PUMPING WELLS

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2 SHEETS—SHEET 1



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SUPPLEMENTAL EQUIPMENT FOR
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This invention has to do with supplemental equipment for a pumping well, that is, with equipment to be used on or in connection with a well from which fluid is being removed by means of a pump, and it is a general object of the invention to provide such supplemental equipment which serves to both increase the productivity of the well and also the efficiency or capacity of the pumping equipment.

Deep wells, such as oil wells, from which fluid is pumped are commonly equipped with a casing and a pump carrying tubing extends into the well through the casing. The usual pump is operated from equipment at the top of the well and as fluid from the formation flows into the casing at the bottom it is pumped out through a flow line or outlet at the top. In such ordinary installation there is at least atmospheric pressure on the casing and also on the flow outlet. The pressure that builds up or which is maintained in the casing has a direct bearing upon the flow of fluid into the well from the formation, and atmospheric pressure on the flow line or outlet presents resistance against which the pump must operate.

It is a general object of our present invention to provide supplemental equipment to be used in connection with a well equipped to be pumped as above described, which equipment is driven by the means operating the pump and serves to establish and maintain a reduced pressure in the casing in order to induce flow of fluid from the formation into the casing, with consequent increase in the liquid level within the casing.

A further object of this invention is to provide supplemental equipment of the general character referred to coupled with the outlet or flow line through which fluid being pumped from the well and which serves to establish a reduced pressure at the outlet or on the fluid, as it is pumped from the well, lowering the pressure against which the well pump must operate.

A further object of this invention is to provide supplemental equipment of the general character referred to which is such that it can be advantageously combined with standard or ordinary equipment such as is commonly used to operate a well pump and which provides for maintaining a suitable mechanical relationship between the operating means for the well pump and a suction pump which operates to establish and maintain the desired reduced pressure or pressures, as the case may be.

The various objects and features of our invention will be fully understood from the following

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detailed description of typical preferred forms and applications of our invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a view illustrating equipment embodying the present invention showing it applied to a well equipped with a casing, tubing, a pump, and pump operating means. Fig. 2 is an enlarged detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged detailed view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is a diagrammatic view showing the flow connections that occur in the installation as shown in Fig. 1. Fig. 5 is a view similar to Fig. 1, showing a modified form of the invention, and Fig. 6 is an enlarged detailed sectional view of a part of the equipment shown in Fig. 5.

The structure provided by the present invention is intended to be used in connection with various well installations. In the drawings, particularly in Fig. 1 of the drawings, we show a typical or conventional situation wherein the structure of the present invention can be used to advantage.

In the situation shown in Fig. 1 the well is equipped with a casing 10 provided at its upper end with a usual head 11. A tubing 12 depends into the casing 10 from the head 11 and supports a perforated liner 13. The liner is submerged in the body of fluid L located in the casing 10 and a suitable pump is located in the tubing. An operating string of sucker rod sections 14 extends from the pump to the top of the well where it projects through a suitable stuffing-box 15. The operating means shown for operating the pump through the sucker rod 14 involves, generally, walking beam 16, a crank 17, a flexible connection 18 between the beam 16 and the sucker rod, a link 19 connecting the crank and the beam and power means 20 operating the crank through a suitable drive 21.

It is to be understood that the invention can be used in connection with arrangements other than the ordinary pumping arrangement shown and that when it is so applied suitable modifications or variations may be necessary or desirable.

The power means 20 shown in the drawings is a suitable prime mover such as an internal combustion engine and the drive 21 is a flexible drive from the power means to a unit 22 through which power is communicated to the crank shaft 23 carrying the crank arm 17. The link 19 is carried by the crank pin 24 and is pivotally connected to one end of a walking beam 16 by a connecting pin 25. The beam 16 is shown sup-

ported on a suitable standard 26 through a pivot pin 27 and a head 28 is carried by the other end of the beam to operate over the head 11 of the casing 10. The connection 18 is preferably a flexible connection between the head 28 on the beam 16 and the upper end of the sucker rod projecting above the head 11 of the casing.

Through the general combination and relationship of parts just described the prime mover or engine 20 drives the crank 17 which operates the beam 16 through the link or connecting rod 19 and as the beam 16 is operated or oscillated the sucker rod 14 is reciprocated causing operation of the well pump so that fluid admitted from within the casing to the pump through the liner 13 is circulated up through the tubing and out through a flow outlet 30. The structure provided by this invention will be referred to as connected with or operated by the walking beam since this element is a typical operating part which is ordinarily convenient for that purpose. Where other arrangements are used for instance in the case of some pump jacks parts other than walking beams may be employed to operate the present equipment.

In the particular arrangement illustrated the flow outlet 30 is shown delivering the fluid to a tank 31 which may be considered a part of the flow outlet or as a receiver for the flow delivered by the outlet. It is to be understood that the fluid standing in the casing 10 is admitted into the casing from its lower end or through a perforated portion of the casing in the usual manner, and that the fluid enters the casing by reason of a differential in pressure between that occurring in the formation F and the casing.

The supplemental equipment or apparatus provided by the present invention and as shown in Figs. 1 to 4 of the drawings involves, generally, a suction pump A operating to develop a negative pressure, a drive B from the operating means actuating the well pump and the suction pump, and a suction line C connecting the tank 31 and also the casing 10 with the suction pump so that a reduced pressure may be established and maintained either in the tank 31 or in the casing 10, or both, as circumstances may require. The supplemental apparatus further includes a discharge or delivery line D from the pump A and various other elements or features as will be apparent from the drawings and the following description.

The suction pump A as shown in Figs. 1 to 4, inclusive, is a double acting cylinder and piston type of pump involving, generally, a cylinder 40, a piston 41 operating in the cylinder 40 and a piston rod 42 carrying the piston and extending from one end of the cylinder. Inlet valves 43 are arranged to admit flow into the ends of the cylinder from a common connection or manifold 44 and outlet valves 45 pass flow outward from the cylinder to the outlet connection or line D. In the arrangement illustrated both outlet valves are connected to the single outlet line D and in practice if vapors or gases are present the line D may be extended in any suitable manner so that the materials received by it are properly handled or conserved.

The connection or suction line C provided by the present invention has a main portion 50 shown connected to the manifold 44 so that it is in communication with both ends of cylinder 40 through the inlet valves 43. In the preferred arrangement a pressure relief valve 52 is provided in the main section 50 of connection C opening to

admit air into the connection C when the pressure therein is lowered beyond a predetermined value.

The connection C or suction line, as shown in the drawings, is provided with a branch 53 extending to and connecting with the casing 10 through the head 11. A suitable control valve 54 is provided in the branch 53. A second branch 55 of the connection C may extend to the top of tank 31 and a control valve 56 is preferably provided in the branch 55.

Through the arrangement just described as the suction pump A operates a reduced or negative pressure is established in the suction line of connection C and if the valve 54 is open such suction or reduced pressure is established in the casing 10. If valve 56 is open the reduced pressure or suction is established in the tank 31. When the reduced or negative pressure is established in the casing 10 the pressure on the gasses or fluids in the casing above the liquid L is reduced and the differential of pressure between the casing and the formation into the casing, causing the liquid level within the casing to rise. As the negative or reduced pressure is established in the tank L the head against which the well pump must operate is reduced, with corresponding improvement in the efficiency or action of the well pump. It will be apparent that either one or both of the control valves 54 and 56 may be opened to gain the actions just described, and that when valve 54 alone is open the action of the suction pump A is confined to the casing 10 whereas when valve 56 alone is open the action of the suction pump is confined to the tank 31.

The drive B shown in Fig. 1 connects the beam 16 of the well pump operating means with the piston rod 42 of suction pump A. In the particular arrangement illustrated the drive B includes a power transmission 60 operated from the beam 16 through a connecting rod 61 and a rack and pinion mechanism 62. The power transmission drives a rocker arm 62^a through a rack and pinion mechanism 63, the mechanism 63 being coupled to the arm by a connecting rod 64. Links 65 suitably couple the arm 62^a with the piston rod 42 so that as the arm 62^a is rocked or oscillated the piston 41 of pump A is reciprocated in the cylinder 40 of pump A. The power transmission 60, as shown in Fig. 2 of the drawings, involves a drive shaft 66 operating a drive gear 67 meshed with and operating a driven gear 68 on a driven shaft 69. The drive shaft 66 is driven by the rack and pinion mechanism 62 while the driven shaft 69 operates the rack and pinion mechanism 63.

In the form of the invention illustrated the connecting rod 61 that operates the rack and pinion mechanism 62 is connected to the walking beam 16 by a pivot pin 70 and the pivot pin is carried by a bracket 71 on the beam so that it can be connected to the beam at various points removed from the pivotal mounting 27 of the beam. This construction provides for adjusting the relationship of the beam 16 and the pump A.

Through the drive B above described it will be apparent that the power or motion taken from the walking beam 16 is communicated to the pump A which may be located at a suitable distance remote from the beam or from the head of the well, and it will be apparent that the desired length of stroke can be gained at the pump A so that the pump A may be of large capacity and such as to effectively establish and main-

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tain the desired negative or reduced pressure either in the casing 10, in the tank 31, or both.

In the form of the invention shown in Fig. 5 the suction pump A' instead of being a double acting cylinder and piston type of pump is a simple single acting diaphragm pump involving a case 41' carrying a diaphragm 80 to which an operating rod 42' is connected. The rod 42' is shown extending to and directly connected with the walking beam 16 of the operating means provided for driving the well pump. The main section 50 of the connection or suction line C is connected with the pump A' through an inlet valve 43'. The delivery or outlet line D' is connected with the pump A' through an outlet valve 45'.

In the form of the invention just described as the beam 16 operates the diaphragm 80 of the pump A' is flexed with consequent pumping action causing fluid to be drawn either from the well casing 10 or from the tank 31, or from both, and the fluid thus withdrawn is delivered to the line D' to be suitably handled thereby.

It is to be observed that the form of the invention just described is more simple than that first described and it will be apparent that by proper proportioning and relating of the various parts the pump A' will operate in synchronism with the pump in the well, so that the desired negative or reduced pressure condition is maintained in the casing or in the tank, or both, as circumstances may require.

Having described only typical preferred forms and applications of our invention we do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described our invention, we claim:

1. In combination, a well casing, a tubing in the casing, a well pump carried by the tubing, operating means for the pump, a storage tank, a fluid connection from the tubing to the storage

tank, a suction pump, a drive from the operating means to the suction pump, and a connection between the top of the casing and the suction pump through which fluid is exhausted from the casing, and a connection between the storage tank and suction pump through which fluid is exhausted, the suction pump being a double acting cylinder and piston pump and the drive including a centrally pivoted walking beam, a member oscillated by the walking beam and driving the piston of the suction pump.

2. In combination, a well casing, a tubing in the casing, a well pump carried by the tubing, a centrally pivoted oscillating walking beam operating the pump from one of its ends, a suction pump, a drive from the other end of the beam to the suction pump, and a fluid connection between the uppermost end of the casing and the suction pump through which fluid is exhausted from the casing, a fluid connection between the uppermost end of the tubing and the suction pump through which fluid is exhausted from the tubing, the suction pump including a piston operating in a cylinder and the drive including a power transmission, a rack and pinion drive from the walking beam to the transmission, a rocker arm operating the piston, and a rack and pinion drive from the transmission to the arm.

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