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W. WOLSKI.

HYDRODYNAMIC PUMP FOR BORE HOLES AND THE LIKE.

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Fig. 2.

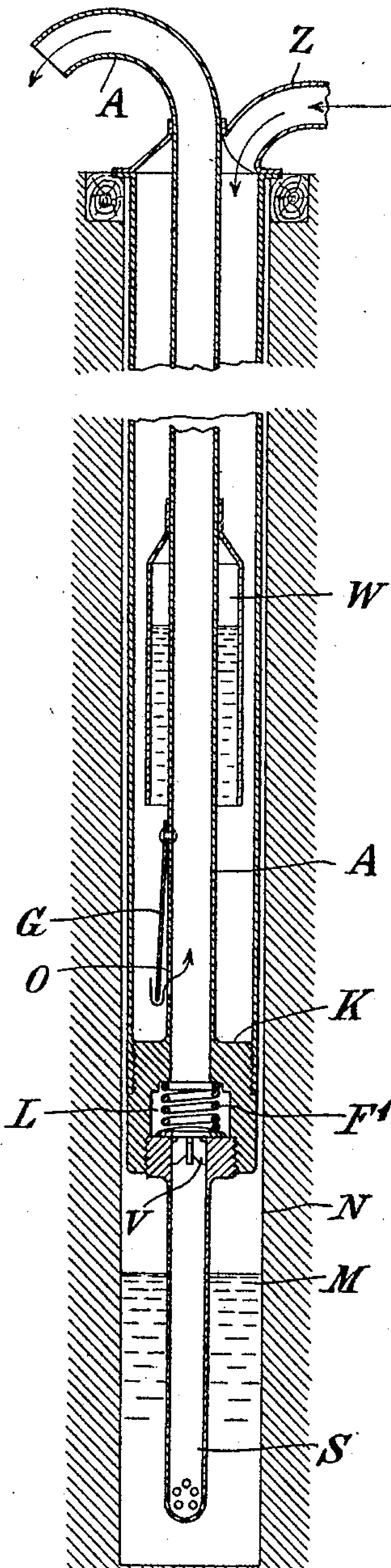
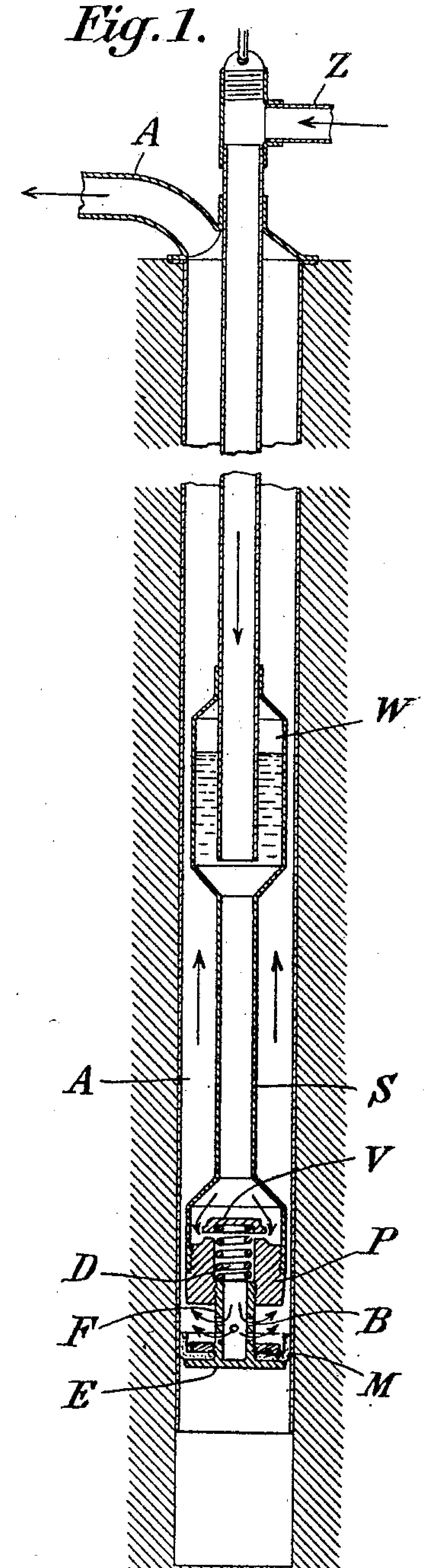


Fig. 1.



WITNESSES:

Henry J. Suhrbier.

INVENTOR

Waclaw Wolski

BY Goepel & Goepel

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WACLAW WOLSKI, OF LEMBERG, AUSTRIA-HUNGARY.

HYDRODYNAMIC PUMP FOR BORE-HOLES AND THE LIKE.

No. 799,428. Specification of Letters Patent. Patented Sept. 12, 1905.

Application filed March 8, 1905. Serial No. 249,058.

To all whom it may concern:

Be it known that I, WACLAW WOLSKI, a citizen of the Empire of Austria-Hungary, residing in Lemberg, in the Empire of Austria-Hungary, have invented a certain new and useful Improved Hydrodynamic Pump for Bore-Holes and the Like, of which the following is a specification.

The present invention relates to improvements in hydrodynamic pumps for bore-holes and the like.

The ordinary piston-pump when employed in connection with deep narrow bore-holes, and especially when the liquid to be raised carries sand with it, possesses the defect that the cylinder and piston-packing wear out quickly. Moreover, in petroleum bore-holes the small valves become blocked only too easily with paraffin which becomes separated out from the cold crude oil. The "Mammoth" pump which is much employed for raising water and which depends for its action on the difference of the specific weights of water, on the one hand, and of mixtures of air and water, on the other hand, as is well known, can never pump out the bore-holes deeper than to about half its depth.

The present invention has for its object to lift by suction and to raise to the surface liquids, especially petroleum, from bore-holes of any depth, even if said liquids are accompanied with much sand and the surface level of the liquid lies just above the bottom. The latter is of importance for petroleum bore-holes with low gas-pressure, in which case it is of importance to relieve the productive oil-sandstone from the hydrostatic pressure of the column of liquid.

In the case of the present invention water or oil under pressure (in contrast with the pneumatic raising in the case of the Mammoth pump) serves as a means for transmitting pressure, said water or oil under pressure being forced toward the bottom of the bore-hole by a force-pump arranged on the surface and lifting by suction the liquid to be raised and bringing the same with itself to the surface. The suction action is brought about on the principle of the suction-ram, which, as is well known, is based upon a moving column of liquid being deprived of its previous supply-inlet by the sudden closing of a valve which was previously open and producing a vacuum in a manner analogous to that of a suction-piston by rushing upward in consequence of its momentum, into which vacuum the liquid to be lifted by suction flows through a non-return valve. Instead of the quantity of liquid forced in a larger quantity is consequently obtained at the discharge, because the former quantity is increased by the amount of liquid raised by suction.

Two embodiments of the present invention are illustrated in the accompanying drawings, in which—

Figure 1 represents a vertical central section showing one embodiment applied to the pumping of liquids from a bore-hole, and Fig. 2 shows a similar section of the other embodiment applied to a bore-hole.

The arrangement shown in Fig. 1 is especially adapted for the pumping of oil which is rich in gas from the bore-holes of oil-wells. Z is the supply-pipe through which oil under pressure is supplied. The pipe Z is arranged inside the lift-pipe A, which forms at the same time the casing for the bore-hole. The supply-pipe Z passes into the air-chamber W, which is connected with the connecting-pipe S, provided with the main valve V, which is normally held by its spring D in the open position. The packing M of the tightly-fitted disk E, which serves to separate the lowest portion of the bore-hole from the upper portion, is pressed against the wall of the bore-hole or the casing of the same and forms a check-valve. The portion of the casing below the disk E forms a suction-pipe.

The action of the pump is as follows: Through the supply-pipe Z oil under pressure is supplied either by gravity or by a suitable force-pump into the air-chamber W and through the valve V into the lift-pipe A through the openings B in the piece of pipe F, supporting the disk E from the body P of the valve V. Inasmuch as the pressure of the actuating oil column is higher than the hydrostatic counter-pressure of the oil column in the lift-pipe, the excess of pressure produces an acceleration of motion in the oil column in the lift-pipe A. As soon as the oil column in the lift-pipe receives a certain velocity by means of its hydrodynamic action it suddenly closes the valve V. As the oil column in the lift-pipe A has at the moment of closing the valve V a considerable velocity, a momentary vacuum is formed below the valve V, which produces the opening of the check-valve having the packing M, so that the instant rising of the oil into the lift-pipe A takes place. The check-valve remains open until the momentum of the upwardly-moving oil column in

the lift-pipe A is exhausted. At this moment the oil column in the lift-pipe A comes to rest. It even makes a slight return motion, which is due to the fact that before the closing of the check-valve a small part of the oil is dropped back past the same into the bore-hole. This feature, which is also well known in the ordinary hydraulic ram and utilized in the same, produces the reopening of the main valve V, the return motion of the oil column in the lift-pipe A producing a slight shock on the main valve V, which was in its closed position, so that the same is opened. Oil under pressure is then again supplied through the pipe Z, the air-chamber W, and the valve V to the lift-pipe, and the action of the different parts of the pump is repeated. The effective work which is accomplished by the actuating body of oil supplied under pressure through the supply-pipe is utilized in the lifting of a quantity of oil by suction, so that the latter quantity is discharged, together with the supply-oil, at the upper end of the lift-pipe A. The formation of a vacuum below the disk E accelerates the escape of the oil from the surrounding strata of the bore-hole. When the liquid to be pumped is saturated with gases, (as, for instance, crude petroleum, which contains various hydrocarbon gases under high pressure,) then the repeated momentary vacuum formation is sufficient to produce a violent generation of gas, and thereby artesian discharges of the liquid from the well, whereby the proper functioning of the pump is considerably and effectively increased.

Referring now to Fig. 2, which shows an arrangement adapted for use in pumping water from the bore-holes of Artesian wells, Z is the supply-pipe and is concentric to the interior lift-pipe A, at the upper end of which the discharge takes place. Both pipes communicate with each other by an opening O, which is located in the lower part of the lift-pipe A. G is a spring-valve made in the form of a tongue and is adapted to close the opening O at the proper times. The air-chamber W is arranged in the form of a bell on the lift-pipe A and concentrically with it and the supply-pipe Z. K is the bottom of the supply-pipe Z. The lift-pipe is connected with said bottom above and the suction-pipe S below, said suction-pipe being normally closed by the check-valve V, which is subjected to the pressure of the spring F′, arranged in the central hollow L of the bottom K. M is the water at the bottom of the bore-hole N.

The pump illustrated in Fig. 2 acts similarly to the pump shown in Fig. 1. At the moment when the valve G is closed the column of water in the lift-pipe A produces a suction action, so that the check-valve V is opened against the tension of its spring F′ and a water column is drawn through the suction-pipe S into the lift-pipe A. In order to prevent the occurrence of a powerful shock in the supply-pipe at the instant when the main valve closes, the air-chamber is provided.

If the water, oil, or other liquid forced through the supply-pipe of a pump according to the present invention be suitably heated before being forced into the bore-hole, the running of the pump serves to simultaneously heat the bore-hole, which, as is well known, is of importance when obtaining petroleum rich in paraffin.

By means of the construction according to the present invention, in which the controlling-valve is arranged near the bottom, it is for the first time possible to use the suction-ram for pumping empty nearly to their bottoms bore-holes of a depth of several hundred meters, the vacuum necessary for the suction action arising directly over the bottom and the effectiveness of the pump being independent of the depth.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A hydrodynamic bore-hole pump consisting of the combination of a supply-pipe extending close to the bottom of the bore-hole for the supply of liquid under pressure, a lift-pipe extending from close to the bottom of the bore-hole to the surface and communicating with the supply-pipe through an opening, a valve controlling the opening between the supply-pipe and lift-pipe and adapted to open against the current in the supply-pipe, said valve being situated near to the bottom of the bore-hole, a check-valve in said lift-pipe opening in the direction of the current in the lift-pipe, and a suction-pipe communicating with the lift-pipe, the communication of which with said lift-pipe is controlled by said check-valve, substantially as and for the purpose set forth.

2. A hydrodynamic bore-hole pump consisting of the combination of a supply-pipe extending close to the bottom of the bore-hole for the supply of liquid under pressure, said supply-pipe having an air-chamber at a short distance from the bottom of the bore-hole, a lift-pipe extending from close to the bottom of the bore-hole to the surface and communicating with the supply-pipe through an opening, a valve controlling the opening between the supply-pipe and lift-pipe and adapted to open against the current in the supply-pipe, said valve being situated near to the bottom of the bore-hole, a check-valve in said lift-pipe opening in the direction of the current in the lift-pipe, and a suction-pipe communicating with the lift-pipe, the communication of which with said lift-pipe is controlled by said check-valve, substantially as and for the purpose set forth.

3. A hydrodynamic bore-hole pump consisting of the combination of a supply-pipe extending close to the bottom of the bore-hole

for the supply of liquid under pressure, a lift-pipe extending from close to the bottom of the bore-hole to the surface and communicating with the supply-pipe through an opening, a spring-pressed valve controlling the opening between the supply-pipe and lift-pipe and adapted to open against the current in the supply-pipe, said valve being situated near to the bottom of the bore-hole, a check-valve in said lift-pipe opening in the direction of the current in the lift-pipe, and a suction-pipe communicating with the lift-pipe, the communication of which with said lift-pipe is controlled by said check-valve, substantially as and for the purpose set forth.

4. A hydrodynamic bore-hole pump consisting of the combination of a supply-pipe extending close to the bottom of the bore-hole for the supply of liquid under pressure, a lift-pipe arranged within said supply-pipe and extending from close to the bottom of the bore-hole to the surface and communicating with the supply-pipe through an opening, a valve controlling the opening between the supply-pipe and lift-pipe and adapted to open against the current in the supply-pipe, said valve being situated near to the bottom of the bore-hole, a check-valve in said lift-pipe opening in the direction of the current in the lift-pipe, and a suction-pipe communicating with the lift-pipe, the communication of which with said lift-pipe is controlled by said check-valve, substantially as and for the purpose set forth.

5. A hydrodynamic bore-hole pump consisting of the combination of a supply-pipe extending close to the bottom of the bore-hole for the supply of liquid under pressure, a lift-pipe arranged within said supply-pipe and extending from close to the bottom of the bore-hole to the surface and communicating with the supply-pipe through an opening, a valve controlling the opening between the supply-pipe and lift-pipe and adapted to open against the current in the supply-pipe, said valve being situated near to the bottom of the bore-hole, a spring-pressed check-valve in said lift-pipe opening in the direction of the current in the lift-pipe, and a suction-pipe communicating with the lift-pipe, the communication of which with said lift-pipe is controlled by said check-valve, substantially as and for the purpose set forth.

6. A hydrodynamic bore-hole pump consisting of the combination of the supply-pipe Z having the air-chamber W, the lift-pipe A arranged within said supply-pipe and having the opening O, the valve G controlling said opening and adapted to open against the current in the supply-pipe, the valve V, the spring F acting on said valve, said valve opening in the direction of the current in the lift-pipe, and the suction-pipe S, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

WACLAW WOLSKI.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.