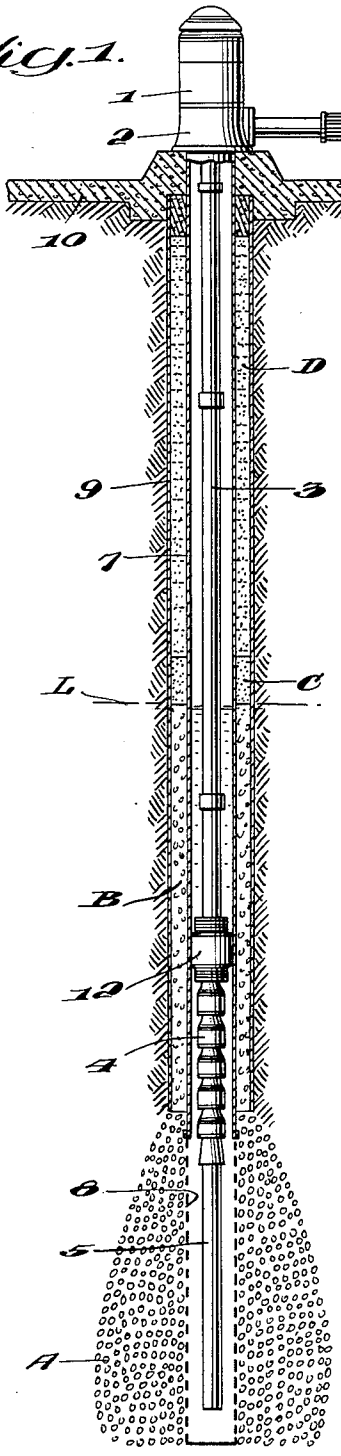
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WELL PUMPING SYSTEM

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Fig. 1.



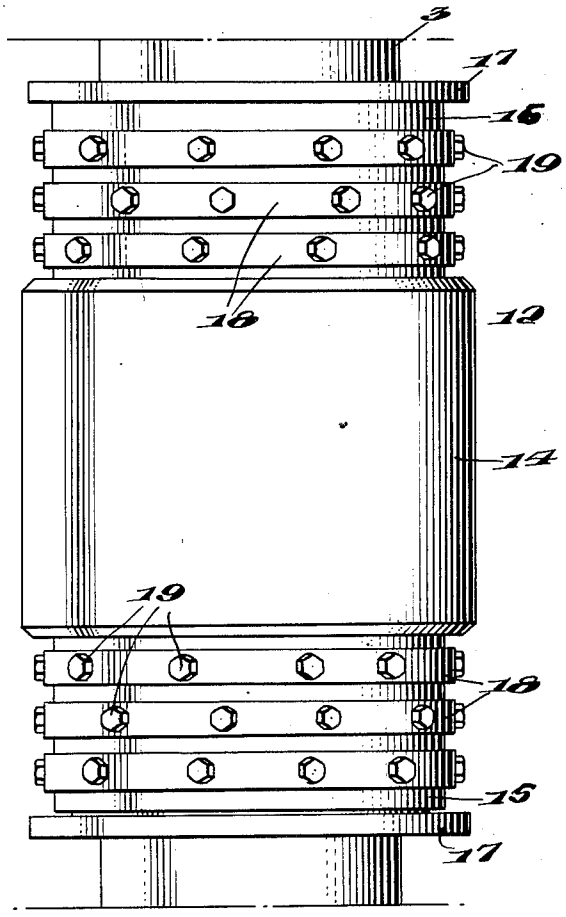


Fig. 2.

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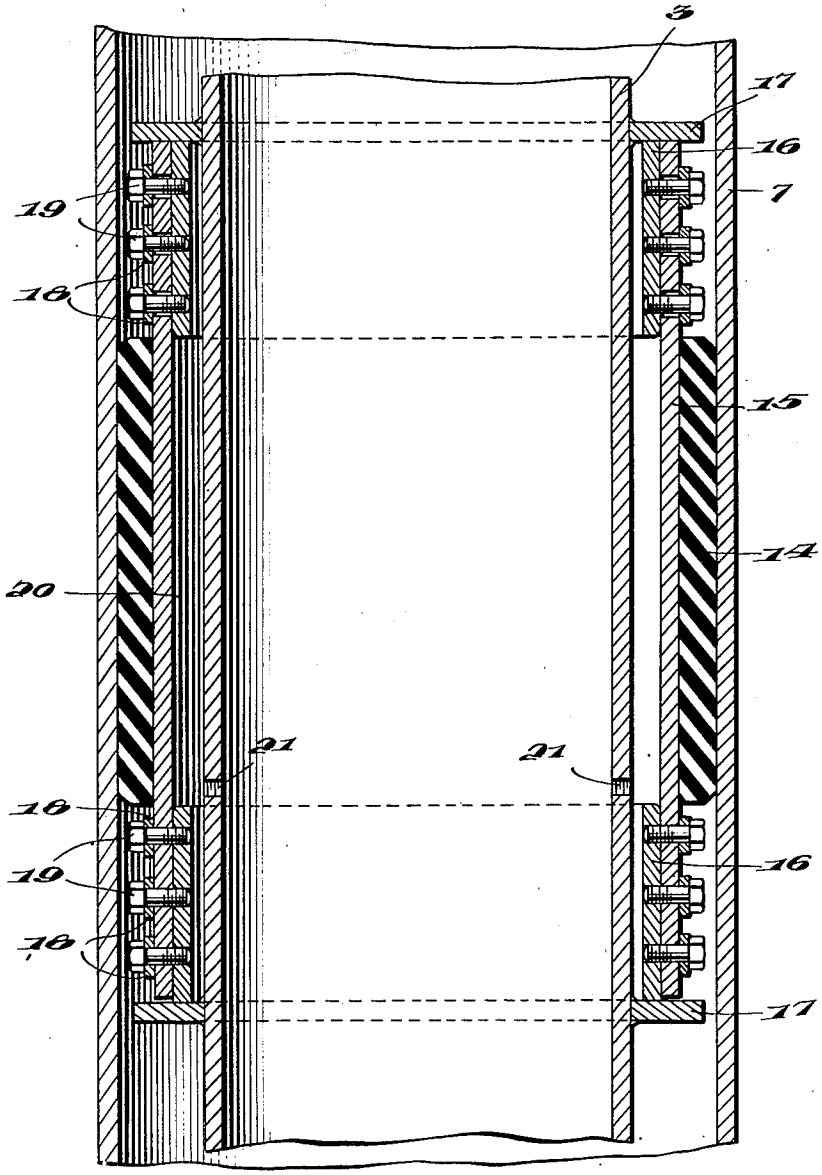
his Attorney

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Fig. 3.



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WELL PUMPING SYSTEM

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3 Claims. (Cl. 103—219)

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This invention relates to an improvement in well pumping systems of the character adapted particularly for the pumping of water from artesian and drilled deep wells.

As is well-known when a tube is inserted in water and the atmospheric pressure removed within the tube, the water will rise in the tube to a height greater than twenty feet, depending upon the elevation above sea level of the water table and other factors. A suction pump when set above the water level from which the water is taken, operates on this principle, removing the air from the suction tube, creating a vacuum within this tube. The atmospheric pressure bearing down on the water table will cause the water to rise within the tube in proportion to the suction thus created by the pump.

The purpose of the pump is to lift the water from the pumping level in the well to its ultimate desired elevation, which is frequently a considerable height above the ground level. The capacity and effectiveness of the pump depend upon its ability to create a sufficient dynamic head to force the water to the desired elevation. The position of the pump below the static water level affects its pumping capacity because of the atmospheric pressure acting on the static water level tending to force it down on the outside of the pumping column as suction is created on the inside thereof.

Various conditions encountered in the drilling of wells frequently make it impractical, if not actually impossible, to place the pump at a sufficient depth below the static water level to provide the desired quantity of water for forcing to the desired elevation above the ground, according to pumping systems used heretofore. The position of the water-bearing stratum may limit the depth of the pump below the surface of the ground. Where it must be placed at a substantial depth, even if permitted by the static water level, the increase of drilling cost, shafting, tubing and column pipe extension within the well, increase materially the cost of the well, and yet have been necessary heretofore to provide a sufficient source for the purpose of lifting the water to the desired elevation.

The object of this invention is to improve the well pumping system by increasing the well capacity very materially, sometimes it has been found in practice to be nearly 100%, to augment the supply of water induced by atmospheric pressure to the suction side of the pump.

This object is accomplished by sealing off the space between the pumping column and the casing at a point above the pump, which seal permits the pump to operate and cause a pumping action with the aid of a partial vacuum. This partial vacuum will deliver the water to the pump through proper hydraulic laws from a hydraulic level below the pump at least 20 feet greater than if the seal had not been applied. In a shallow well where it is mechanically impractical to place the pump at this lower level, the seal makes up for this deficiency and thereby increases the hydraulic capacity of the well by shutting off the atmospheric pressure from within the well casing itself, inducing a greater supply of water under atmospheric pressure to the suction side of the pump. The seal also proportionately decreases the cost of the shafting, tubing, and column pipe extension within the well, which more than offsets the cost of the seal.

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The invention is directed also to a seal which will operate in response to internal pressure within the pumping column to seal the space between said column and the casting. This causes a sealing action above the pump only when needed during the pumping operation, and thereafter allows the seal to be broken automatically to purge the space of air by allowing it to leak out through the casing from around the pump. Accordingly, the seal is constructed preferably of a hydraulically expansible packing sleeve adapted to seal against the inside of the well casing, and which sleeve is confined securely by being fastened to the periphery of the pump column, and having an internal chamber in open communication with the interior of the pump column. Thus, when water is forced through the pumping column by the pump, the pressure thereof will act through the communicating openings on the interior of the sealing sleeve to expand the latter tightly against the inside of the well casing. This allows also for the automatic contraction of the sleeve when the pumping pressure is released.

An embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view through an artesian well, with the pumping system including the seal in side elevation;

Fig. 2 is a side elevation of the seal, somewhat enlarged; and

Fig. 3 is a vertical sectional view therethrough.

The invention is shown as applied to an artesian well in which deep-well pumping equipment of well-known commercial form, is utilized for the pumping of water from a point below the static water level to the desired elevation. This pumping equipment includes a motor 1 combined

with a head 2 from which the pump column 3 extends downwardly to a multiple-stage impeller-type centrifugal pump 4 having a depending tailpiece 5. The head 2 is provided with a discharge pipe 6 for directing the water from the pumping column 3 to the desired point of use.

Surrounding the pump column 3 is a casing 7 extending downwardly from the well foundation 10 to the developed area within the water-bearing strata, where the usual screen 8 attached to the lower end of the casing 7 is provided. The screen 8 surrounds and encloses the tailpiece 5. This structure is enclosed within an outside casing 9 which extends downward from the well foundation 10 to a point adjacent the pumping level.

The static water level is designated generally at L, the pump being submerged to the desired or required extent therebelow. At the bottom of the well, surrounding the screen 8 is the developed area A, and a column of coarse granular material B extends upwardly from the developed area A between the inside and outside casings 7 and 9 substantially to the water level L. The space thereabove between the casings is substantially closed by a foot of coarse sand at C, above which is a lining of sand and wet clay at D, extending upwardly between the casings to the well foundation 10.

The pumping structure according to this invention includes also a well seal designated generally by the numeral 12 in Fig. 1 and shown more in detail in Figs. 2 and 3. This seal surrounds the pump column 3 between the latter and the casing 7, so as to seal off the space therebetween at a point preferably just above the pump 4. The seal 12 is placed also preferably below the static water level L so as to be submerged in the water within the casing. This helps to assure air tightness of the seal, and the effectiveness thereof.

As shown in Fig. 3, the seal is formed of a sealing sleeve 14, preferably of elastic material, such as gum rubber, and of substantial thickness so as to be readily expansible under pressure. The sealing sleeve 14 is carried by a backing sleeve 15 which is preferably of heavy fabric or the like that will be expansible and to which the rubber sealing sleeve may be secured effectively. The sleeve 14 in normal condition will be of slightly smaller external diameter than the internal diameter of the casing 7 but is capable of expansion into tight sealing relation therewith.

The sealing sleeves 14, 15 are secured to and supported upon rings 16 that extend into opposite ends of the fabric sleeve 15, and which rings 16 are carried by flanges or rings 17 upon the periphery of the pumping column 3. These parts may be assembled by welding the rings 16 and flanges or rings 17 together and to the pumping column. To provide a tight joint between the fabric sleeve 15 and the rings 16, bands 18 encircle the opposite ends of the sleeve 15 and are clamped thereon by bolts 19 which extend through slightly elongated slots in the bands and opposite ends of the sleeve 15 and are threaded into the rings 16.

This assembly holds the sleeves 14, 15 spaced from the periphery of the pump column 3, leaving a chamber 20 therebetween within the expansible sealing sleeve. This chamber 20 communicates through ports 21 with the interior of the pumping column, whereby fluid under pressure forced through the column will be directed also through the ports 21 into the chamber 20 to apply expansive action to the sealing sleeve 14 against the inner wall of the casing 7, to seal the space betwen the pump column 3 and the casing 7, whenever the pump is functioning.

In operation, with the well constructed substantially as shown in Fig. 1, the seal 12 is mounted as a part of the pumping apparatus surrounding the pump column 3 at a point above the centrifugal pump 4, preferably below the static water level and adjacent the pump. Then upon operation of the pump in the usual manner of pumping water from the well, the water will be drawn in from the developed area A through the screen 8 and the lower end of the tailpiece 5, to the pump 4. The pump will force the water upward through the pump column 3 and discharge it through the head 2 and the pipe 6 to the desired point of storage or use.

This circulation of water under pressure through the pump column 3 will cause it to be forced outward through the ports 21 into the chamber 20, and there to act against the inner face of the yieldable sleeves 14, 15, to expand the latter against the inner surface of the well casing 7. This will cause a sealing relation between the pump column 3 and the casing 7 during the operation of the pump in forcing water upward through the pump column.

Inasmuch as the interior of the casing is sealed off above the pump, it is thus impossible for the pump to act first to draw out the water within the casing. Thus the suction created in the pump column will allow atmospheric pressure surrounding the casing to force the water through the screen and into the tailpiece more effectively than would be possible without the seal. The seal permits the pump to operate and cause a pumping action with the aid of a partial vacuum. This partial vacuum will deliver the water to the pump through proper hydraulic laws from a hydraulic level below the pump, at least twenty feet greater than if the seal had not been applied. The seal thereby increases the hydraulic capacity of the well by shutting off the atmospheric pressure from within the well casing itself. In some instances, it has been found in actual practice that the seal doubles the capacity of the well, appreciably increasing the amount of water produced from the well with the present standardized type of deep-well pumping equipment.

When the operation of the pump is discontinued, the expansive action within the chamber 20 is withdrawn, and the sealing sleeve 14 may then relax from its sealing relation against the well casing 7. This will allow any air accumulated below the seal to leak out through the pump casing, thus purging the space around the pump of accumulated air.

Although the form of seal here described is preferable, it will be understood that the mechanical construction of the seal may be improved and modified, while accomplishing the hydraulic principle described, without departing from the invention as claimed.

I claim:

1. In a pumping system, the combination of a well casing, a pump column extending into the well casing, means for pumping fluid upwardly through said pump column, and means for sealing the space between the casing and pump column, said sealing means including a resilient sleeve surrounding the pump column in position for bearing relation against the casing, rings surrounding the pump column and rigidly fixed

thereto, means telescoped with opposite ends of the sleeve and securing said sleeve in sealed relation with the rings, said sleeve being spaced outwardly from the pump column forming a hydraulic chamber within the sleeve, said pump column having an opening through a side thereof to the chamber for admitting fluid under the pressure of the pumping means into said chamber and in pressure relation against the sleeve to force the sleeve in sealing relation against the casing.

2. A well seal comprising a pump column adapted for flow of liquid under pressure therethrough, a sleeve of resilient material surrounding the pump column in spaced relation therewith forming a chamber between said sleeve and the pump column, flanges surrounding the pump column and rigidly fixed thereto, rings fixed to the flanges and extending into opposite ends of the sleeve, bands extending about opposite end portions of the sleeve and the rings, and screw fastenings extending through the bands, sleeve and rings for securing said parts rigidly together, said pump column having an opening through a side thereof into the chamber for admitting fluid into expanding action against the sleeve for forcing said sleeve into sealing relation against a casing.

3. In a well seal having a pump column adapted for flow of liquid under pressure therethrough, and means for sealing the space around the pump column, said sealing means including a resilient

sleeve surrounding the pump column, rings surrounding the pump column and rigidly fixed thereto, rings fixed to the first-mentioned rings and extending into opposite ends of the sleeve, bands extending about opposite ends of the sleeve and the last-mentioned rings and securing the sleeve thereto, said pump column having an opening through a side thereof for admitting fluid into expanding action against the sleeve.

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