No. 737,336. PATENTED AUG. 25, 1903.

F. C. CAIN.

PUMPING APPARATUS.

APPLICATION FILED SEPT. 19, 1902.

NO MODEL. 2 SHEETS—SHEET 1

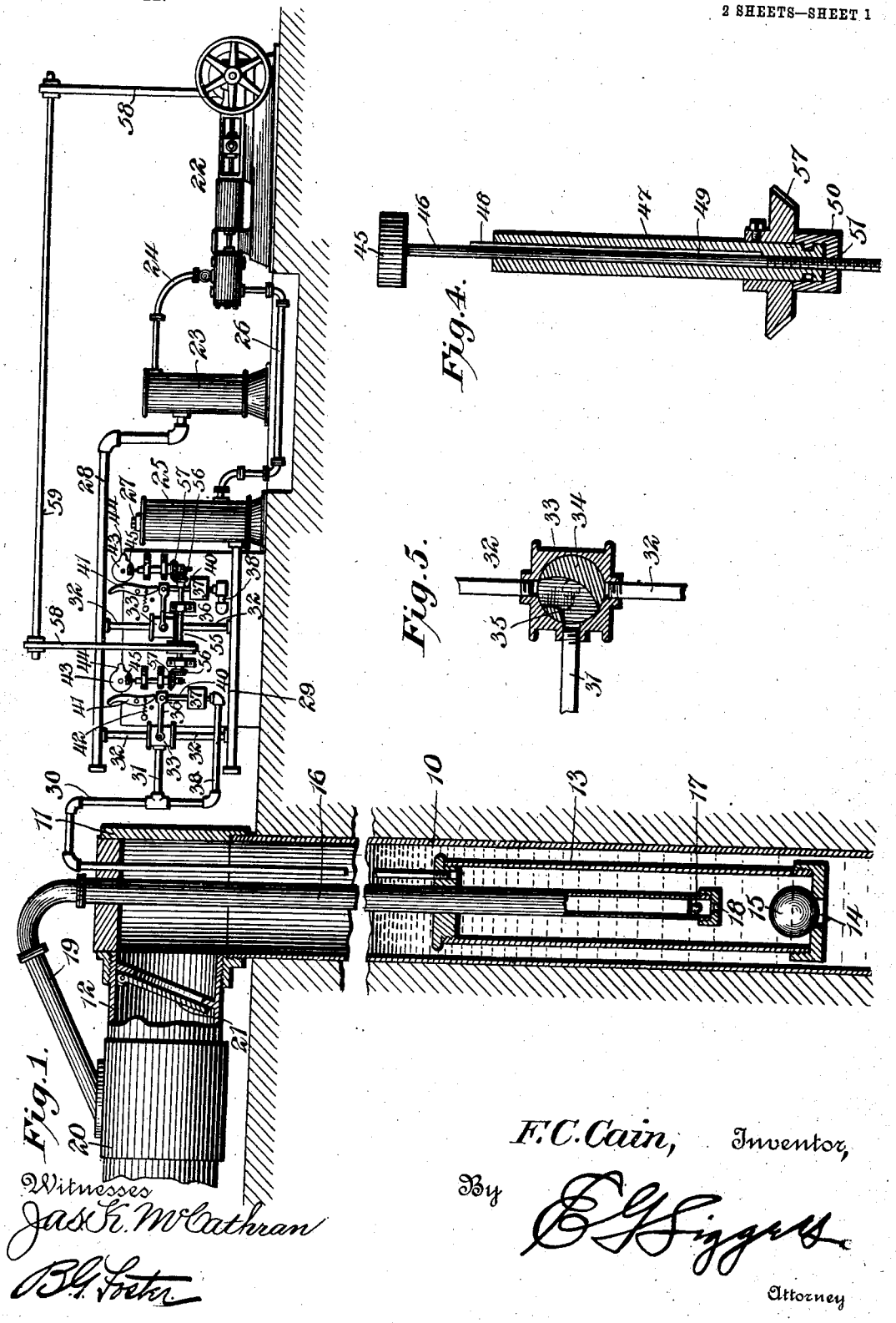


Fig. 1.

Fig. 4.

Fig. 5.

Witnesses
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

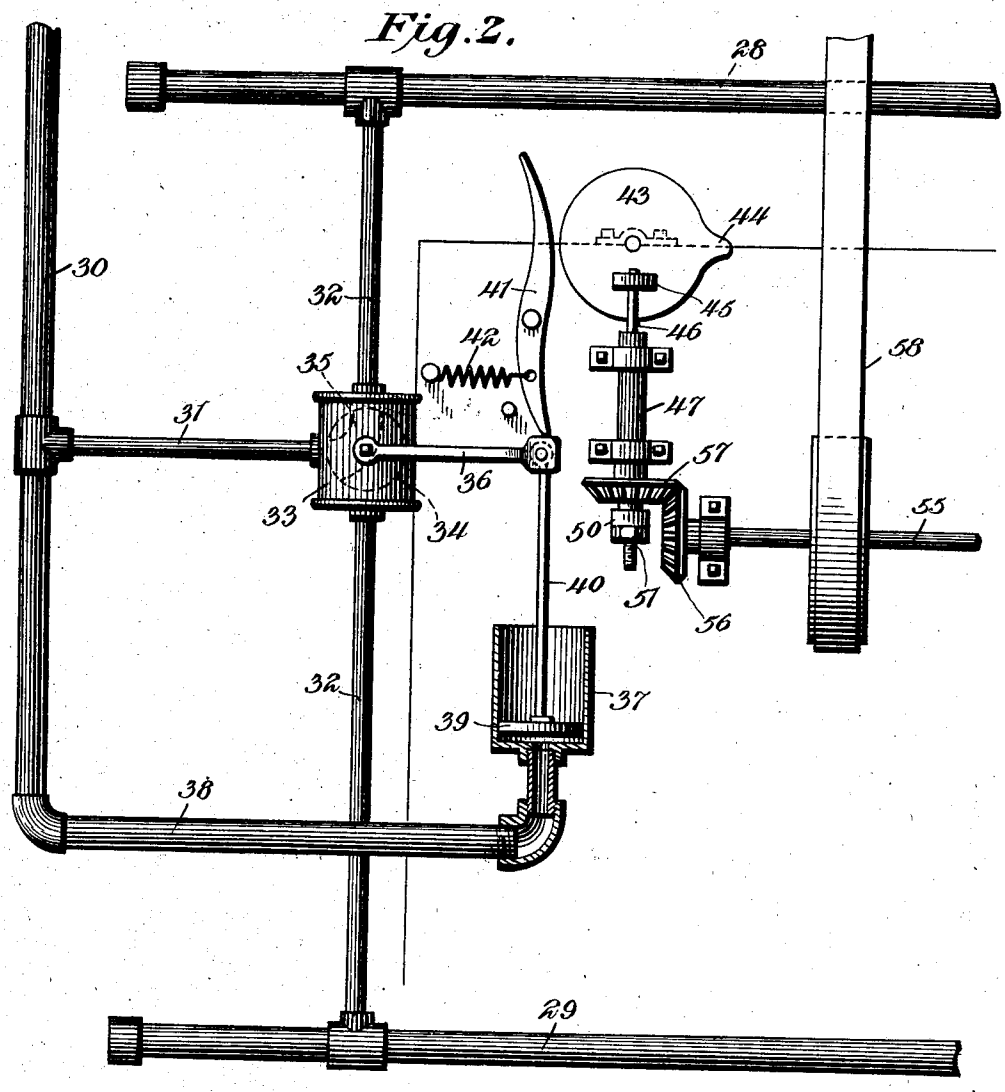
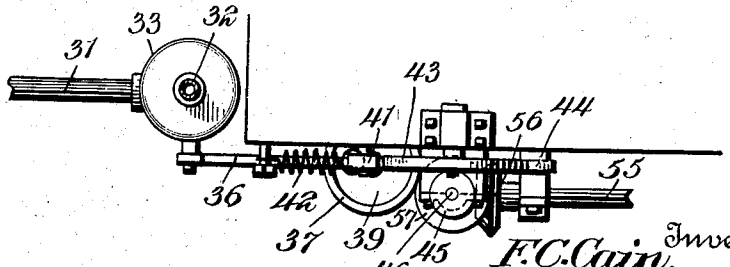


Fig. 3.



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No. 737,336. Patented August 25, 1903.

UNITED STATES PATENT OFFICE.

FRANCIS CHARLES CAIN, OF BEAUMONT, TEXAS, ASSIGNOR OF ONE-HALF TO OSCAR CHARLES HERRENKIND, OF BEAUMONT, TEXAS.

PUMPING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 737,336, dated August 25, 1903.

Application filed September 19, 1902. Serial No. 124,052. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS CHARLES CAIN, a citizen of the United States, residing at Beaumont, in the county of Jefferson and State of Texas, have invented a new and useful Pumping Apparatus, of which the following is a specification.

The present invention relates to apparatus for elevating liquids by means of compressed air, and is particularly intended for deep oil-wells.

One of the objects of the invention is to provide means that is entirely automatic for alternately forcing the air into the pump-barrel and exhausting it therefrom to respectively raise the liquid to the top of the well and refill the barrel, this mechanism being so arranged that it will perform the above operations with speed and precision and being regulatable to the flow of the well. At the same time the air in its compressed state is used over and over again, thus avoiding to a great extent the loss of power.

Another object is to provide mechanism whereby a plurality of wells may be operated by the air from a single compressor, each well being entirely independent of the others and separately governed to suit its particular flow.

It is a well-known fact that in pumping many wells the agitation of the liquid causes the formation of gas, and very often the well will flow or "gush."

Another and very important object of this invention is to provide pumping mechanism which will not interfere with this natural operation, but will, in fact, assist it to a very great extent.

The preferred form of the apparatus is fully illustrated in the accompanying drawings and is described in the following specification, but an inspection of the claims hereto appended will show that the construction is open to various changes and modifications.

In the drawings, Figure 1 is a view in elevation of the entire apparatus, the elevating means being illustrated on an enlarged scale and being shown in section. Fig. 2 is an elevation, on an enlarged scale, of the governing mechanism for the compressed-air supply and exhaust of one well. Fig. 3 is a top plan view of the same. Fig. 4 is a sectional view through the speed-regulating device, and Fig. 5 is a detail sectional view through the controlling-valve for the supply and exhaust.

Similar reference-numerals denote corresponding parts in all the figures of the drawings.

As shown in the drawings, the well is provided with the usual tubing 10, the upper end being closed by the head 11, to which is coupled a pipe-line 12. In the lower end of the well is placed a pump-barrel 13, that is of smaller diameter than the tubing and is preferably arranged concentric within the same. This barrel has the usual inlet 14 at its lower end, which is controlled by the foot-valve, as 15. A liquid-conveyer pipe 16, that is entirely separated from the tubing, leads from the lower portion of the barrel 13 to the top of the well, projecting through the head 11, as shown. This conveyer-pipe is also provided in its lower end with a foot-valve, as 17, which controls the inlet-opening 18 therein. The upper end of the pipe is curved, as shown, and has its terminal formed into a nozzle portion 19, which communicates with the pipe-line through a coupling 20 at one side of the tubing, said nozzle portion being located above and at an inclination to the pipe-line. A suitable check-valve 21 is located in the pipe-line between the discharge end of the liquid-conveyer pipe and the well-tubing.

Arranged in convenient relation to the well or wells is an air-compressor, (designated as a whole by the reference-numeral 22,) which compressor may be of any desired or well-known construction. An air-compression tank 23 is located adjacent to the compressor and is connected to the high-pressure side of the same by means of a suitable pipe, as 24. A vacuum-tank 25 is also located near the compressor and is connected with the inlet of the compressor by means of a pipe 26, this vacuum-tank having a suitable inlet-valve, as 27, normally held closed, but arranged to open when the pressure upon the outside exceeds that within at any amount desired. An air-supply pipe 28 leads from the compression-tank, while an exhaust-pipe 29 leads to the vacuum-tank, as is clearly shown in Fig. 1.

Connected with the upper end of the pump-barrel 13 is an air-conducting pipe 30, which

leads to the top of the well and has a suitable branch 31, connected by separate pipes 32 with the supply and exhaust pipes 28 and 29. The connection between the branch 31 and the pipes 32 is in the form of a valve-casing 33, within which is rotatably mounted a three-way valve 34, having a passage-way 35 therein designed to aline with the branch 31 and either of the pipes 32, said valve carrying an exteriorly-arranged crank-arm 36. An air-cylinder 37 has communication at one end with the conducting-pipe 30 through the medium of the pipes 38, the other end being open to the outer air. A plunger 39 is slidably mounted in the cylinder and carries a stem 40, that is connected to the crank-arm 36. When the plunger 39 is at the lower end of the cylinder 37, the conducting-pipe 30 will be in communication with the supply-pipe 28 because of the position of the rotary valve 34, as indicated in Fig. 2. Said plunger is normally held in this depressed position by means of a suitable lock in the form of a latch 41, that is pivoted intermediate its ends, the lower end bearing upon the free end of the crank-arm 36 and being maintained in this position by a coiled spring 42. Journaled directly adjacent to the upper end of the latch is a rotatable disk 43, upon the periphery of which is a projection 44, arranged to engage the upper end of the latch 41 and move it out of engagement with the crank-arm 36. The disk is rotated by means of a friction-wheel 45, attached to the end of a stem 46, that is longitudinally adjustable in a hollow shaft 47, journaled adjacent to the disk, said stem being held to turn with the shaft by means of a key 48, slidably mounted in a key-way 49, formed in the shaft. The adjustment of the stem is obtained by means of a nut 50, journaled upon the lower end of the shaft and having a threaded engagement, as shown at 51, with the lower end of the stem which projects below the shaft, all of which is illustrated in Fig. 4. A suitable counter-shaft 55, driven by any suitable power, has a beveled gear-wheel 56, which meshes with a similar wheel 57, attached to the lower end of the hollow shaft 49. The means for driving the shaft 55 is shown in the form of suitable belting and shafting 58 and 59, driven by the compressor; but other means may be employed, if desired.

In Fig. 1 two sets of air-controlling means are shown. Both sets, it will be noted, are separately connected to the supply and exhaust pipes 28 and 29, each set being driven, however, from the counter-shaft 55. One of these sets is employed in connection with the well illustrated, and it will be understood that the other set is used in connection with a separate well.

The operation of the apparatus may probably be best described as follows: The compressor is in continuous operation, so that the tank 23 will contain a supply of compressed air, (generally four to five hundred pounds pressure being employed,) while the vacuum-tank 25 will contain a partial vacuum. Assuming the pump-barrel 13 filled with oil and the plunger 33 locked in its lowermost position by means of the latch 41, it will be seen that compressed air will pass from the supply-pipe 28 through the valve and to the air-conducting pipe 30. This compressed air will displace the oil within the barrel and raise it through the liquid-conveyer pipe 16, from which it will be discharged into the pipe-line 20. During this operation the disk 43 is being revolved by means of the mechanism described, and the projection 44 will therefore be brought periodically into contact with the upper end of the latch 41. This contact will disengage said latch from the free end of the crank-arm 36, and the compressed air in the air-conducting pipe 30 and the pipes 38 will cause the plunger 39 to be elevated, thereby revolving the valve 34, and consequently cutting off the compressed air, while at the same time opening communication between the branch 31 and the exhaust-pipe 29. As a result the compressed air now contained in the pump-barrel will rush through the exhaust-pipe into the vacuum-tank, the speed being accelerated by the partial vacuum therein. This movement will continue until the pressure of the air within the pipe 38 will fall below the pressure of the outer air, whereupon said greater outer pressure will cause the depression of the plunger 39. This movement will return the valve to the position shown in Figs. 2 and 5, and the spring 42, connected to the latch, will again move the same to its operative position, for by this time the projection 44 has passed out of its zone of action. The speed at which the disk 43 rotates may be readily varied by adjusting the friction-wheel 45 toward or from the journal-axis of said disk, and thus the periodicity of movement of the latch, and consequently the valve-operating mechanism, can be varied to suit the flow of the well. It will be observed that in operating a number of wells, though all the disks are operated from a common shaft, their rate of speed is entirely independent and they will not interfere in action. In case the well should flow naturally or gush it will be seen by reference to Fig. 1 that the oil may freely pass outside the barrel to the head and raising the valve 21 will flow into the pipe-line. In like manner if the pump should be in operation and the agitation caused thereby should occasion the natural flow of the well the action of the pump will not be interfered with and it would assist said natural operation, for the oil discharging with great force from the nozzle portion 19 of the conveyer-pipe will cause a vacuum behind the same in a manner well understood, thereby assisting in the elevation of the oil through the well-tubing. It will thus be seen that an automatic system is provided which is very simple in operation and will pump as rapidly or as slowly as the well will permit. At the same time the power em-

ployed is used over and over again with comparatively small loss, (in the neighborhood of twenty per cent.,) and is thus advantageous over those systems wherein compressed air is discharged into the open air, so that its force is entirely lost after it has performed the pumping operation. At the same time the apparatus does not interfere with the desirable gush of the well, and, as already shown, it assists in this operation.

The compression and vacuum chambers are of great utility, especially in connection with this system, where independent wells of varying capacities are being independently pumped from one source of air-supply. This will be understood when it is considered that the compressor is continuously in operation, withdrawing a determinate quantity of air from the vacuum-chamber and forcing it into the compression-chamber while the supply and exhausts are varied. At times there may be very little compressed air in use while a plurality of the pumps are exhausting, or the reverse may be true, the relative movements of the pumps all the time changing, as some operate faster than others, according to the capacity of the wells, as already explained. In either case, however, the chambers are of sufficient capacity to take care of the changing and sometimes abnormal conditions of supply and exhaust, the vacuum-chamber having sufficient area to supply considerable air to the compressor and receive considerable quantities of exhausted air without balancing the pressure of the supply.

From the foregoing it is thought that the construction, operation, and many advantages of the herein-described invention will be apparent to those skilled in the art without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, and a lock for holding the operating mechanism against movement.

2. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, air-controlled operating mechanism connected with the conducting-pipe for moving the controlling means, and an automatically-operated lock for holding the air-controlled mechanism against movement.

3. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism against movement, and means for periodically operating the lock.

4. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with a conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, a pivoted latch arranged to engage the operating mechanism to hold the same against movement, and means for automatically moving the latch to an inoperative position.

5. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with a conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, a pivoted latch arranged to engage the operating mechanism to hold the same against movement, means for automatically moving the latch to an inoperative position, and means for returning said latch to its operative position.

6. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, air-controlled operating mechanism connected with the conducting-pipe for moving the controlling means, a pivoted latch arranged to engage the operating mechanism to hold the same against movement, means for periodically moving the latch to an inoperative position, and a spring for returning said latch to its operative position.

7. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, a pivoted latch arranged to engage the operating mechanism to hold the same against movement, and a rotatable member arranged to periodically engage the latch to move it to an inoperative position.

8. In apparatus of the class described, the combination with a conducting-pipe, of an air-supply and an air-exhaust having communication with the conducting-pipe, means for controlling said communication, operating mechanism for moving the controlling means, a pivoted latch arranged to engage the operating mechanism to hold the same against movement, and a rotatable disk having an eccentric projection arranged to periodically engage the latch to move it to an inoperative position.

9. In apparatus of the class described, the

combination with compressed-air elevating means, of a conducting-pipe leading thereto, an air-supply and an air-exhaust communicating with the conducting-pipe, means for controlling the communication, and mechanism for periodically moving the controlling means, said mechanism being adjustable to vary the periodicity of movement of said controlling means.

10. In apparatus of the class described, the combination with compressed-air elevating means, of a conducting-pipe leading thereto, an air-supply and an air-exhaust communicating with the conducting-pipe, means for controlling the communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism inactive, and automatic means for periodically actuating the lock, said actuating means being adjustable to vary the periodicity of movement of said controlling means.

11. In apparatus of the class described, the combination with compressed-air elevating means, of a conducting-pipe leading thereto, an air-supply and an air-exhaust communicating with the conducting-pipe, means for controlling the communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism inactive, and automatic means for periodically actuating the lock, said means including a rotatable disk and an operating-wheel frictionally engaging the disk.

12. In apparatus of the class described, the combination with compressed-air elevating means, of a conducting-pipe leading thereto, an air-supply and an air-exhaust communicating with the conducting-pipe, means for controlling the communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism inactive, and automatic means for periodically actuating the lock, said means including a rotatable disk and an operating-wheel frictionally engaging the disk and adjustable toward and from the journal-axis of said disk.

13. In apparatus of the class described, the combination with compressed-air elevating means, of an air-supply and an air-exhaust communicating with the elevating means, means for controlling the communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism inactive, and automatic means for periodically actuating the lock, said means including a rotatable disk, a hollow shaft arranged at one side of the disk, and a stem slidably mounted in the shaft and carrying an operating-wheel that frictionally engages the disk.

14. In apparatus of the class described, the combination with compressed-air elevating means, of an air-supply and an air-exhaust communicating with the elevating means, means for controlling the communication, operating mechanism for moving the controlling means, a lock for holding the operating mechanism inactive, and automatic means for periodically actuating the lock, said means including a rotatable disk, a hollow shaft arranged at one side of the disk, a stem slidably mounted in the shaft and carrying an operating-wheel that frictionally engages the disk, and a nut journaled upon the shaft and having a threaded engagement with the stem.

15. In apparatus of the class described, the combination with compressed-air elevating means, of an air-supply and an air-exhaust communicating therewith, means for controlling the communication, an air-cylinder having air communication with the elevating means, a plunger in the cylinder connected to the said controlling means for the supply and exhaust and actuated by the compressed air in the elevating means, and a lock arranged to hold the plunger against movement.

16. In apparatus of the class described, the combination with compressed-air elevating means, of an air-supply and an air-exhaust communicating therewith, means for controlling the communication, an air-cylinder having an air communication at one side with the elevating means and having the other side in communication with the open air, a plunger in the cylinder connected to the controlling means for the supply and exhaust and actuated by the compressed air in the elevating means, and a lock arranged to hold the plunger against movement.

17. In apparatus of the class described, the combination with compressed-air elevating means, of an air-supply and an air-exhaust communicating therewith, means for controlling the communication, an air-cylinder having an air communication at one side with the elevating means and having the other side in communication with the open air, a plunger in the cylinder connected to the controlling means for the supply and exhaust and actuated by the compressed air of the elevating means, a lock arranged to hold the plunger against movement, and mechanism for operating the lock to release the plunger.

18. In apparatus of the class described, the combination with an air-compressor, of a compression-chamber and a vacuum-chamber communicating respectively with the high and low pressure sides of the compressor, a supply-pipe leading from the compression-chamber, an exhaust-pipe leading to the vacuum-chamber, a plurality of compressed-air elevating mechanisms, each including a conducting-pipe independently communicating with both the supply and exhaust pipes, and independent valves for controlling the communication of each conducting-pipe.

19. In apparatus of the class described, the combination with the well-tubing, of a barrel located therein and of less diameter than the same, a pipe-line in communication with the upper end of the well-tubing, and a separate

conveyer-pipe leading from the barrel to the upper end of the well and communicating with the pipe-line.

20. In apparatus of the class described, the combination with the well-tubing, of a barrel located therein and of less diameter than the same, a pipe-line in communication with the upper end of the well-tubing, and a separate conveyer-pipe leading from the barrel to the upper end of the well and having a nozzle portion at its upper end that communicates with the pipe-line and is located at an inclination to the latter.

21. In apparatus of the class described, the combination with the well-tubing, of a barrel located therein and of less diameter than the same, a pipe-line in communication with the upper end of the well-tubing, and a separate conveyer-pipe leading from the barrel to the upper end of the well and having a nozzle portion at its upper end that is arranged above the pipe-line and communicates with the same.

22. In apparatus of the class described, the combination with the well-tubing, of a barrel located therein and of less diameter than the same, a pipe-line in communication with the upper end of the well-tubing, a separate conveyer-pipe leading from the barrel to the upper end of the well and communicating with the pipe-line at one side of the tubing, and a valve located in the pipe-line and interposed between the upper end of the conveyer and the well-tubing.

23. In apparatus of the class described, the combination with the well-tubing, of a barrel located therein and of less diameter than the same, a pipe-line in communication with the upper end of the well-tubing, a separate conveyer-pipe leading from the barrel to the upper end of the well and communicating with the pipe-line, and a check-valve located in said line.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FRANCIS CHARLES CAIN.

Witnesses:
J. WEISS,
ROBERT STEINER.