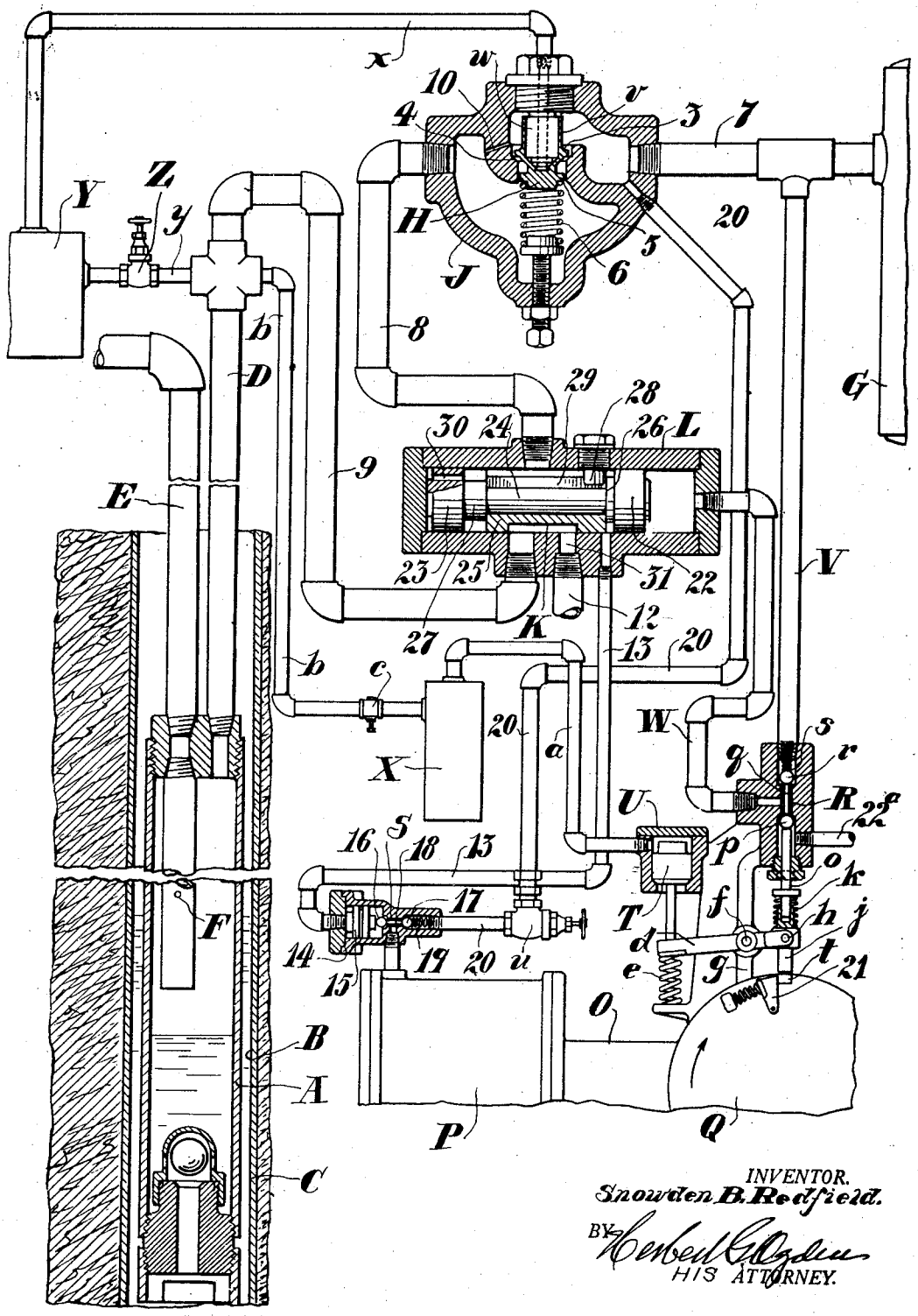
Oct. 21, 1930. S. B. REDFIELD 1,779,251

MOTOR DRIVEN TIMING DEVICE FOR WELL PUMPS

Filed Dec. 16, 1927



INVENTOR.
Snowden B. Redfield.
BY Herbert C. Ogden
HIS ATTORNEY.

Patented Oct. 21, 1930 1,779,251

UNITED STATES PATENT OFFICE

SNOWDEN B. REDFIELD, OF EASTON, PENNSYLVANIA, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

MOTOR-DRIVEN TIMING DEVICE FOR WELL PUMPS

Application filed December 16, 1927. Serial No. 240,488.

This invention relates to well pumps, but more particularly to a well pump having a tank adapted to be located in the well, and provided with a pressure fluid supply pipe and a discharge pipe in the usual manner.

In accordance with this invention the pumping operations are regulated by a motor driven timing device, which is so timed that the well tank will fill with oil or other liquid before the main pressure fluid is again supplied to discharge the tank.

The objects of the invention are to produce a timing device which is regulated with certainity and precision and controls the operation of an exhaust valve with which the main control valve of the pump is operatively connected. Another object is to enable the well tank to be exhausted through the exhaust valve during the whole time required for the tank to fill.

The pump may be operated with either compressed air or natural gas or any other suitable pressure fluid medium depending on the nature of the fluid to be pumped. In the case of natural gas, there would be no exhaust to atmosphere, but the exhaust would take place to a tank or receptacle of materially lower pressure than the main pressure of the supply. In those cases in this specification in which the term exhaust to atmosphere is used, it is to be understood that said exhaust will be to any region of low pressure in the case of natural gas, or gas of a similar nature as the pressure medium.

The invention is illustrated in one of its preferred forms in the accompanying drawing which is a diagrammatic view partly in vertical section and partly broken away showing a well and well pump constructed in accordance with the invention.

Referring to the drawing, the well tank A is located in the well B preferably having the casing C and the tank is provided with the usual pressure fluid supply pipe D and the discharge pipe E preferably having the small aeration hole F in the foot piece, by means of which the pressure fluid aerates the discharging column of oil on the air lift principle.

The hole F may be of any suitable diameter and is preferably located in the discharge pipe E at a point intermediate the ends of the tank A. The precise location of the hole F depends of course to some extent upon the length of the tank A, but in practice it has been found that good results may be obtained by locating the hole F nearer the bottom of the tank than the top. Due to this arrangement the hole F will be submerged by the oil rising in the tank, so that when pressure fluid is admitted into the tank for discharging the oil therefrom a column of oil of considerable length will be raised in the pipe E before the hole F is uncovered.

The column of oil in the pipe may be thus raised to a considerable height before pressure fluid is admitted through the hole F into the pipe E to aerate and extend it towards the discharge opening of the pipe E. It will therefore be seen that there will be no wastage of pressure fluid from the tank through the hole F and the discharge pipe E before the oil in the discharge pipe has risen to a height where aeration will be helpful in lifting the oil to the surface.

The main pressure fluid supply to the well tank from the reservoir G is controlled by the main control valve or choke valve H in the casing J and the exhaust from the well tank is controlled by the exhaust valve K in the casing L. The body K of this exhaust valve K is fully open to atmosphere or a region of low pressure in case natural gas is used from the moment all the oil is discharged from the well tank until the next discharge period starts, so that oil may fill the well tank.

The exhaust valve may be of any suitable construction, and in this instance comprises a double ended plunger having the heads 22 and 23 connected by the rod 24. A shoe or valve body 25 is held between the shoulders 26 and 27 on the heads and moves with the plunger, and a set screw 28 engaging a slot 29 in the valve body forms a guide for the valve body and prevents it from rotating. An aperture 30 in the head 23 permits pressure fluid to pass from the main central portion of the valve casing to the end of the casing beyond the head 23, and also permits reduction of pressure in the said end of the

casing upon reduction of pressure in the central portion of the valve casing. Full supply pressure from the main source of supply against the outer surface of the head 22 will cause the exhaust valve to move to the left into the position indicated in the drawing when there is reduction of opposing pressure against the outer surface of the head 23. When the exhaust valve is in the exhaust position indicated in the drawing the main supply of pressure fluid to the well tank is cut off and the said tank is open to atmosphere through the exhaust opening and pipe 12 on the valve casing as indicated.

A pressure fluid actuated motor driven timing device indicated generally by the character O is so constructed that the speed of the motor can be regulated by a hand valve to vary the time as desired in which the well tank is permitted to fill with oil or liquid to be pumped.

The pneumatic motor or engage P shown diagrammatically may be of any suitable type operatively connected to drive a timing cam wheel Q which controls the cam valve R through appropriate mechanism, and this cam valve in turn controls the operation of the exhaust valve K. The motor P is controlled by the pilot valve S which in turn is controlled by the movement of the exhaust valve K. A cam valve plunger T in the casing U operates in conjunction with the cam wheel Q in controlling the cam valve R. The cam valve R is held in raised position as indicated in the drawing and permits supply pressure fluid to pass through pipes V and W from the receiver G to the right hand end of the exhaust valve casing holding the exhaust valve open as long as pressure is maintained upon the cam valve plunger T.

A small receiver X is connected by pipes *a* and *b* between the plunger casing U and the main supply pipe D of the well tank, and a check valve *c* of any well known type is located in the pipe *b*, having a restriction which permits rapid flow of pressure fluid from the well pipe D to the receiver X, but restricts the flow in the opposite direction, so that the flow is slow. During the time that the pressure in the well tank A is low after the discharge of the contents, the pressure in the receiver X does not reduce materially owing to the check valve *c*, so that sufficient pressure is maintained on the cam plunger T to hold the plunger down in the position indicated in the drawing, and hold the lever *d* down against the pressure of the retracting spring *e*. The lever *d* is pivoted at *f* on the bracket *g* and the opposite end of the lever is pivoted at *h* to a latch *j* carrying a spring *k* and slidably engaging a stem *o* which bears against the ball valve *p*. A rod *q* bears on the valve *p* and a ball valve *r* is actuated by the rod *q* against a spring *s*. With the lever *d* in the position shown in the drawing, during the time that the well tank A is filling with oil, the ball valves *p* and *r* of the cam valve R are in uppermost position. By the time the pressure in the receiver X has become exhausted through the restriction in the check valve *c*, thus releasing the cam plunger T, and permitting the spring *e* to raise the plunger, the engine P will have started as will be explained and the cam latch *j* will not fall into the notch *t* of the cam but will bear upon the periphery of the cam until one revolution of the cam brings the notch beneath the latch *j*, and during this revolution of the cam, the cam valve R will be maintained in raised position as shown in the drawing.

The speed of the motor or engine P is regulated by the throttle valve *u*, so that the cam wheel Q makes one revolution during the time required for the filling of the well tank A. During this time period the pressure as stated has been reduced or exhausted above the cam plunger T, so that when the notch *t* arrives beneath the latch *j*, the latch will drop into the notch, and permit the stem *o* to fall, so that both ball valves *p* and *r* change their positions, causing the reversal of the exhaust valve K and supplying pressure fluid to discharge the well.

The main control valve or choke valve H has opened and remains open during the period that the well tank A is filling, and pressure fluid supply is cut off from the well tank at the exhaust valve K until the described operation of the cam valve R. The main control valve H comprises a cup or sleeve *v* fitting slidably but tightly over a plug or guide *w* and the inside of the cup is connected by a pipe *x* to a balancing receiver Y which in turn is connected by pipe *y* and check valve Z of any well known type to the main well tank supply pipe D. The check valve Z has a restriction which permits the supply pressure in the well supply pipe D to pass quickly to the inside of the cup *v* of the main valve H to balance said valve as far as pressure is concerned, but this restriction permits the pressure to leak out slowly and down the well when the pressure in the well tank A is exhausted during the time that the well tank is filling. The object of the restriction in the check valve Z is to afford a time element so that the change of pressure within the cup *v* of the main valve H always lags behind the pressure in the well. When the full supply pressure is supplied to the well tank for discharging the well tank, the full pressure is more or less quickly supplied to the inside of the cup *v*, and when the pressure in the well tank is exhausted, the pressure in the cup *v* is more slowly reduced.

The main valve H has a flange 3 seating on the seat 4, and a collar 5 forming a restriction between the collar and the side of the valve

casing. A spring 6 tends to force the valve open when pressure within the cup v is reduced sufficiently by reduction of the pressure in the well tank after the discharge of the tank contents as described. The momentary rush of pressure fluid from the main reservoir G through the pipe 7 and past the restriction formed by the valve collar 5, and down the pipe 8, through the exhaust valve K and through the pipe 9 to the well tank, when the well tank contents is fully discharged, blows the main valve H shut. After the main valve H has reopened during the filling period, and main pressure fluid is again supplied to the well tank for discharging the tank, the main valve will not again be blown shut by this second rush of pressure fluid, because the pressure inside the cup has at that time been exhausted and the valve spring 6 holds the valve open. More particularly the high pressure in casing J holds cup valve v in up position very powerfully, as the cup is exhausted.

The main valve casing J is provided with a small vent or leak port 10, so that when the pressure in the main well pipes 8, 9 and D drops due to the completion of discharge, the leakage of pressure fluid through the vent 10 permits pressure to quickly build up through pipe 8, and in the exhaust valve casing L. This vent 10 may be made adjustable if desired by means of a needle valve (not shown). It is here to be understood that the parts are in the position indicated in the drawing, in which main supply pressure is cut off from the well and the exhaust valve is still in exhaust position. The restoration of pressure through the vent 10 and underneath the main valve H will tend to balance the fluid pressures inside and outside the valve and cause the valve H to reopen under the influence of the spring 6. The building up of pressure in the exhaust valve casing L will not cause the exhaust valve K to move, since all internal movable parts will be under the same pressure on all pressure surfaces, except inside or under the valve K itself when open to the exhaust pipe or vent 12. The pressure fluid however leaking through vent 10 in the main valve casing, will then pass through the pipe 13 connected to the exhaust valve casing and also connected to the casing 14 of the motor pilot valve S. The piston 15 of the motor pilot valve will be actuated to force the ball valves 16 and 17 and the separating pin 18 against the resistance of the valve spring 19, thus permitting main actuating pressure fluid to pass to the motor P through the pipe 20 connected to the main supply through the main valve casing J. The motor will then start to rotate the cam wheel Q and after one revolution, clockwise starting from the position indicated in the drawing, the cam plunger T will have been raised by the plunger spring e, due to the exhaustion of pressure above the plunger, and the latch j will fall into the notch t in the cam wheel, when said notch comes under the latch. A swinging spring pressed plate 21 acts as a spring stop for the latch j, to prevent breakage of parts in case the motor or engine should over travel after the latch engages the notch. The dropping of the latch j, causes movement of the ball valves p and r to reverse positions from those indicated in the drawings, so that the pipe W connected to the exhaust valve casing L is vented to atmosphere through the vent pipe 22^a, and the pressure which has been built up in the exhaust valve casing forces the exhaust valve K to the right in position to supply main pressure fluid down the well tank supply pipe for discharging the well tank.

The operation of the pump will be recapitulated as follows:—

Let it be assumed that all the parts are in the positions indicated in the drawing at a time just after the well tank A has been discharged and is beginning to fill again with oil. The main control valve H is open and is held open by the spring 6 because the pressure inside the valve cup v has been reduced or exhausted back through the pipe x, balancing receiver Y, check valve Z and pipe y. The exhaust valve K has been moved to its left hand or exhaust position and is held in such position by main pressure fluid exerting pressure against the valve head 22. The main well pipes D and 9 are open to atmosphere through the atmospheric vent pipe 12 because the shoe or valve body 25 bridges the openings of the pipes 9 and 12.

The pressure above the cam valve piston T supplied through the pipe a from the auxiliary receiver X has not as yet reduced sufficiently by leakage through check valve c to permit the piston T to rise under the influence of the spring e, so that the cam valve R, including the two ball valves p and r are in the position shown, admitting supply pressure fluid to the head 22 of the exhaust valve to hold the exhaust valve in exhaust position.

Before the main valve H reopens, pressure fluid has leaked through the vent 10 in the main valve casing, and has built up pressure in the exhaust valve casing, and such pressure fluid has been supplied through pipe 13 to the motor pilot valve plunger 15, causing said plunger to actuate the ball valves 16 and 17 and admit motive fluid from pipe 20 to the motor to start the motor.

During the time required for the rotation of the cam wheel Q through one revolution, the cam plunger T is released and the latch j rests upon the periphery of the cam wheel until the notch t again comes opposite the latch, so that the latch drops into the notch and stops the motor and also permits the ball valves p and

r to change position. The pipe W is then opened to atmosphere through vent pipe 22a and the pressure within the exhaust valve casing will force the exhaust valve K to the right, until the head 22 stops against the casing head.

The exhaust valve is then in discharge position, it having been assumed that sufficient time has been allowed to permit the well tank to fill with oil. Main supply pressure fluid now passes through the main control valve which is open, through pipe 8, around exhaust valve K, and through pipes 9 and D to the well tank A to discharge the same. The motor pilot valve pipe 13 is also open to atmosphere through vent pipe 12 on the exhaust valve casing, and the pilot valve S has cut off pressure supply from the motor.

Pressure is being built up in the main control valve cup v from the balancing reveiver Y, so that the sudden rush of pressure fluid past the main valve collar 5, owing to the completion of discharge, and reduction of pressure in the well tank will blow the main valve H shut, but this valve will reopen when the pressure inside the cup v again reduces. The building up of pressure in the exhaust valve casing by leakage through the vent hole 10 in the main valve casing has been described in order to start the motor and the cycle of operations is repeated indefinitely.

The manner in which the oil is aerated during its passage through the discharge pipe E to the surface is as follows: As the liquid in the well and therefore in the tank A and the discharge pipe E rises, the hole F will be covered thereby. The liquid will continue rising until the devices provided for discharging the liquid from the tank are set in operation. The pressure fluid will then flow into the tank A and acting on the surface of the liquid therein will force the liquid through the discharge pipe E and will therefore lower the level of the liquid in the tank A. After the hole F is uncovered pressure fluid will flow through said hole into the discharge pipe E where it will mingle with the oil column therein and assist in raising it by extending it toward the outlet of the discharge pipe.

I claim:

1. In a timing device, the combination with a pressure fluid supply pipe, of a main pressure fluid control valve, an exhaust valve located in the main supply pipe on the down-stream end of the main valve, a motor and a timing device driven thereby, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and to vent said supply pipe between the main control valve and the point of pressure fluid delivery, and also operating to control the supply and exhaust of pressure fluid for the said motor, and a timing valve controlled by the timing device for controlling the exhaust valve.

2. In a timing device, the combination with a pressure fluid supply pipe, a main pressure fluid control valve, an exhaust valve located in the supply pipe between the main valve and the point of pressure fluid delivery, a motor and cam wheel timing device driven thereby, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and open the outlet end of said supply pipe to exhaust and also operating to control the supply and exhaust of pressure fluid for the said motor, and a cam valve controlled by said cam wheel timing device for controlling the exhaust valve.

3. In a timing device, the combination with a pressure fluid supply pipe, of a main pressure fluid control valve, an exhaust valve located in the main supply pipe between the main valve and the outlet of the supply pipe, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and open the down-stream portion of the supply pipe to exhaust, a motor and cam wheel timing device driven thereby, a motor pilot valve controlled by the exhaust valve, and a cam valve controlled by said cam wheel timing device for controlling the exhaust valve.

4. In a timing device, the combination with a pressure fluid supply pipe, a main pressure fluid control valve, an exhaust valve in the supply pipe between the main valve and the outlet end of the supply pipe, a motor and a timing device driven thereby, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and open the down-stream portion of the supply pipe to exhaust, and also operating to control the supply and exhaust of pressure fluid for the said motor, a timing valve controlled by the timing device for controlling the exhaust valve, and a pressure fluid actuated timing valve plunger operatively connected to regulate the timing valve independently of the timing device.

5. In a timing device, the combination with a pressure fluid supply pipe, a main pressure fluid control valve, an exhaust valve located in the main supply pipe between the main valve and the outlet end of the supply pipe, a motor and cam wheel timing device driven thereby, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and to open the outlet end of the supply pipe to exhaust, and also operating to control the supply and exhaust of pressure fluid for the said motor, a cam valve controlled by said cam wheel timing device for controlling the exhaust valve, and a pressure fluid actuated cam valve plunger operatively connected to regulate the timing valve independently of the cam wheel.

6. In a timing device, the combination with a pressure fluid supply pipe, a main pressure fluid control valve, an exhaust valve

located in the main supply pipe between the main valve and the outlet end of the supply pipe, said exhaust valve operating to cut off the flow of pressure fluid through the supply pipe and open the outlet end of the supply pipe to exhaust, a motor and cam wheel timing device driven thereby, a motor pilot valve controlled by the exhaust valve, a cam valve controlled by said cam wheel timing device for controlling the exhaust valve, and a pressure fluid actuated cam valve plunger operatively connected to regulate the timing valve independently of the cam wheel.

7. In a timing device, the combination with a pressure fluid supply pipe, of a main pressure fluid control valve, an exhaust valve located in the supply pipe between the main valve and the point of pressure fluid delivery, a motor to which the supply and exhaust of pressure fluid is controlled by the exhaust valve, and a timing device driven by said motor.

8. In a timing device, the combination with a pressure fluid supply pipe, of a main pressure fluid control valve, an exhaust valve located in the supply pipe between the main valve and the point of pressure fluid delivery, a motor to which the supply and exhaust of pressure fluid is controlled by the exhaust valve, means to regulate the speed of the motor, and a timing device driven by said motor.

In testimony whereof I have signed this specification.

SNOWDEN B. REDFIELD.