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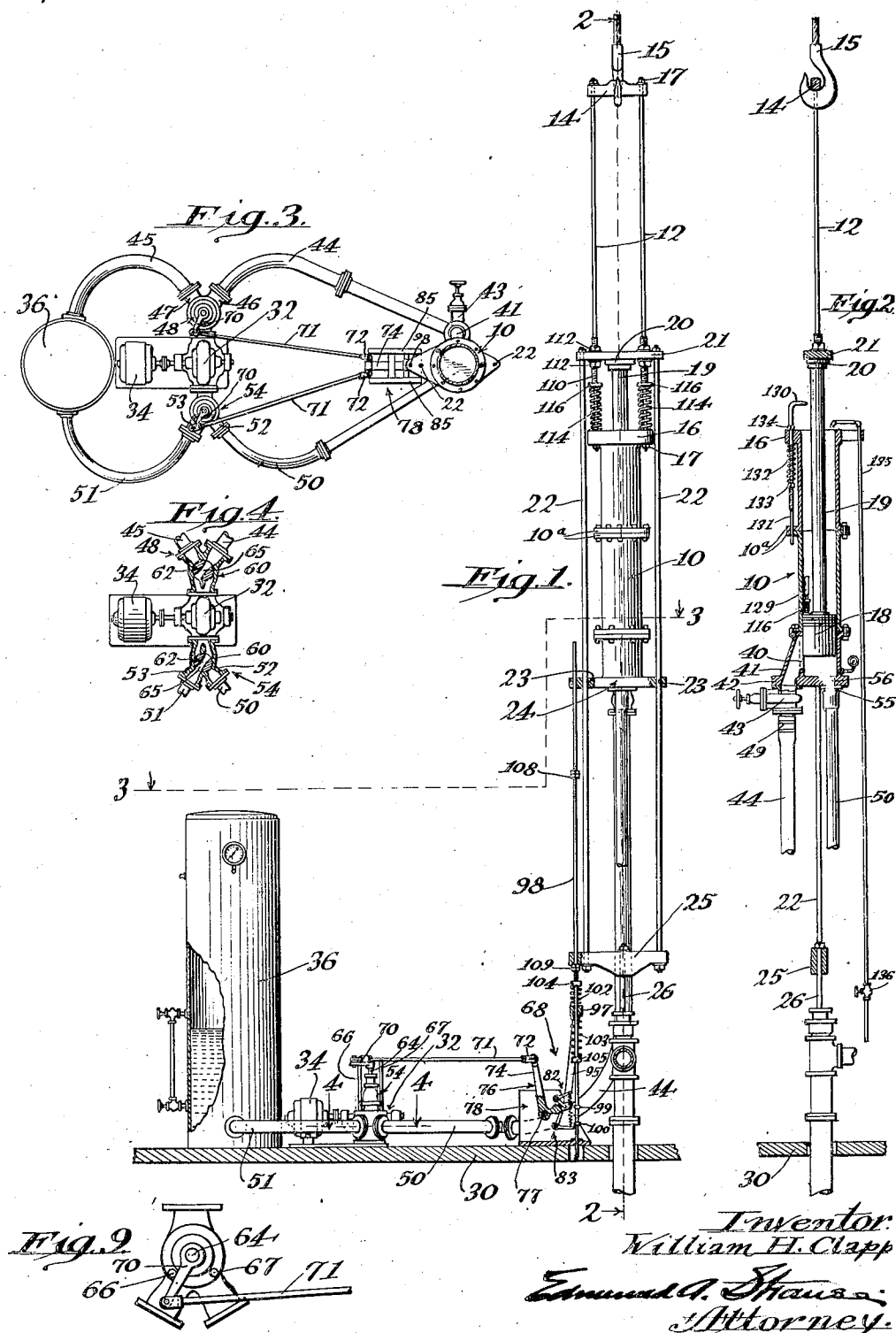
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OIL WELL PUMPING APPARATUS

Filed Oct. 28, 1930

2 Sheets-Sheet 1



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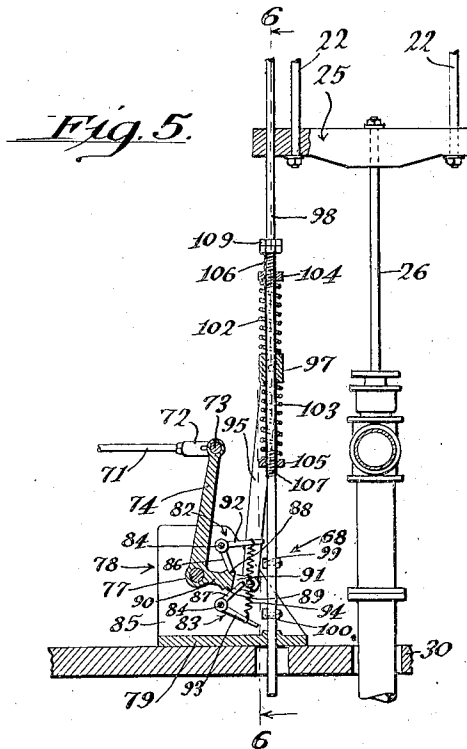
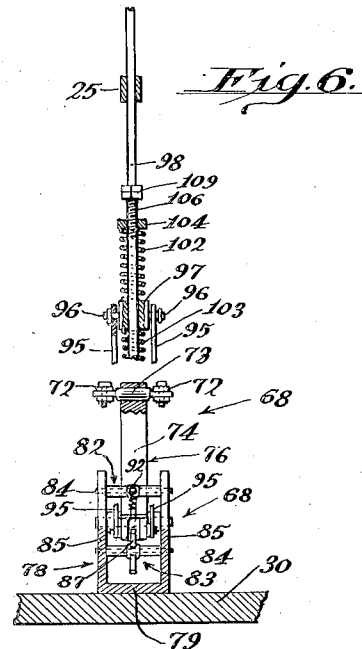
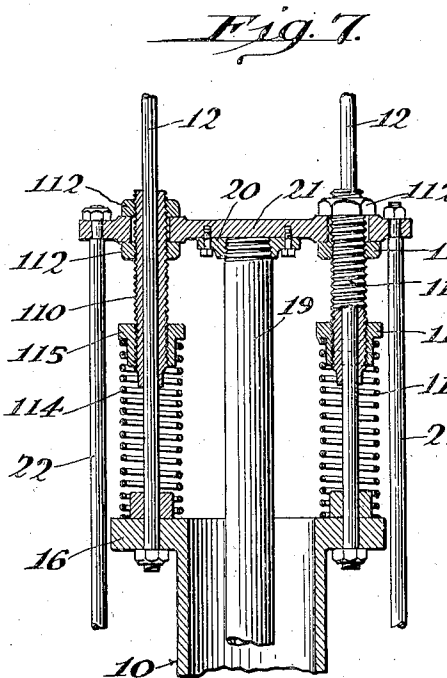
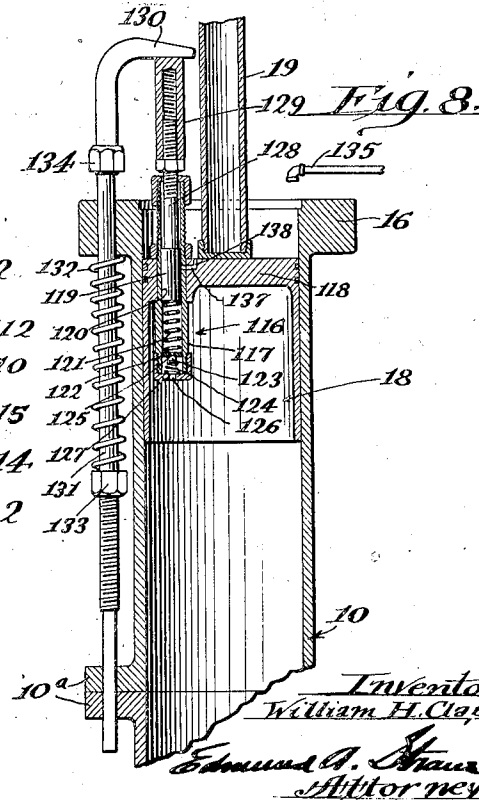
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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OIL WELL PUMPING APPARATUS

Application filed October 28, 1930. Serial No. 491,863.

This invention relates generally to oil well equipment more specifically to an apparatus for actuating the sucker of a usual plunger employed in pumping of oil wells.

5 The principal object of the invention is to provide an apparatus of the character described constructed in such a manner that a long stroke of the sucker rods may be obtained through the medium of a centrifugal pump operating under a practically constant head.

Another object of the invention is to provide a pumping apparatus in which actuation of the pump rods is effected by alternately admitting and withdrawing fluid from the lower end of a cylinder by means of a centrifugal pump working in conjunction with a source of fluid under an adjusted pressure.

20 Further objects and advantages are to provide a pumping apparatus which may be installed at a relatively low initial cost, which will operate at high mechanical efficiency, and in which the stroke of the rods may be regulated at will.

Other objects and advantages will be apparent from the following description, reference being had to the accompanying drawings, in which—

30 Fig. 1 is a side elevation of the improved pumping apparatus, parts being broken away and shown in section.

Fig. 2 is a vertical section taken substantially on line 2—2 of Fig. 1.

35 Fig. 3 is a horizontal section taken on line 3—3 of Fig. 1.

Fig. 4 is a detail section taken through the control valves as indicated by the line 4—4 of Fig. 1.

40 Fig. 5 is an enlarged fragmentary detail section taken through the control valve operating gear.

Fig. 6 is a vertical section taken substantially on line 6—6 of Fig. 5.

45 Fig. 7 is an enlarged fragmentary sectional view taken through the upper end of the pump cylinder and cross head.

Fig. 8 is a section taken through the piston and cylinder showing in detail the means for injecting water into the cylinder to replace

leakage in the system during operation of the apparatus.

Fig. 9 is a top plan view of one of the control valves on an enlarged scale.

Referring more specifically to the drawings, 10 designates a cylinder which is adapted to be mounted in vertical position directly above the casing head of an oil well.

Cylinder 10 is suspended on a pair of rods 12 depending from a yoke 14 carried by a hook 60 or other suitable supporting member 15. The opposite ends of the rods project through openings formed in the yoke and a flange 16 formed on the upper end of the cylinder, and are held in engagement therewith by nuts or the like 17.

Slidably mounted in the cylinder 10 is a piston 18 provided with a rod 19, the upper end of which projects above the top of the cylinder and is connected by a suitable fitting 20 to a cross head 21 slidably mounted on the rods 12. Rods 22 are connected to the cross head at each end thereof, and extend downwardly therefrom through openings 23 formed in the flanged end 24 of the cylinder and are connected to a yoke 25, which in turn is connected to the polished rod 26 of the well pump.

Mounted on the derrick floor 30 adjacent to the cylinder 10 is a centrifugal pump 32, and a receiver 36. The centrifugal pump is driven by an electric motor 34, or other suitable means. The pump operates in conjunction with the receiver to effect reciprocation of the piston 18 (which in turn actuates the pump rods) in a manner more fully hereinafter described; the pump being connected to the cylinder and receiver by pipe lines and control valves arranged as follows:

Formed in the cylinder wall adjacent the lower end thereof is a narrow elongated port 40; portions of the cylinder wall indicated at 41 form a passageway leading from the port and terminating in a flanged end 42 to which is secured a gate valve 43.

Pipe lines 44 and 45 are connected to lateral branches 46 and 47 of a control valve 48 secured to the suction side of the pump. The pipe 44 extends from the branch 46 and is connected by a suitable coupling 49 to the

gate valve 43. The pipe 45 extends from the branch 47 and is connected to the receiver. In a like manner pipe lines 50 and 51 are connected to the lateral outlets 52 and 53 of a control valve 54 secured to the discharge end of the pump. The pipe 50 extends from the outlet 52 and is connected to a coupling 55 located directly below an inlet port 56 formed in the bottom wall of the cylinder, while the pipe 51 extends from the outlet 53 and is connected to the receiver.

Referring to Fig. 4, the valves 48 and 54 are of the same construction, each of which consists of a body portion 60 in which is rotatably mounted a valve member designated at 62. Stems 64 are connected to said valve members and extend through stuffing boxes, the valve members having ports or passages formed therein designated at 65 which register with the suction and discharge orifices of the centrifugal pump 32.

The control valves are operated by a gear generally designated at 68 which serves to impart a quick movement of the valve members 62, and is arranged as follows:

Secured to the valve stems are arms 70 which are connected to links 71, the opposite ends of the links being connected by clevises 72 to each end of a cylindrical member 73 mounted in an opening formed in the upper end of an arm 74 of a quadrant 76 pivotally mounted on a pin 77 carried by a member 78 mounted on the derrick floor.

Bell cranks designated at 82 and 83 are pivotally mounted on pins 84 extending through openings formed in the side flanges 85 of the member 78. The arms 86 and 87 of the bell cranks alternately engage indents 88 and 89 formed in the arm 90 of the quadrant, the other arms 92 and 93 of the bell crank being connected together by a retractible coil spring 94 which serves to hold either of the arms 86 or 87 in engagement with the indents, the arm 90 of the quadrant being recessed as indicated at 91 to accommodate the arm which is disengaged from its respective indent.

Pivotally connected to the outer end of arm 90 is a pair of bars 95, the opposite end thereof being connected to pins 96 projecting from a block 97 slidably mounted on a tappet rod 98 having abutments 99 and 100 secured thereto, which contact with the arms 92 and 93 of the bell cranks, the tappet rod being slidably mounted in aligned apertures formed in the flange 24 of the cylinder, yoke 25, and base 79 of the member 78.

Coil springs 102 and 103 encircle the rod 98, the opposite ends of which engage the block 97 and collars or the like 104 and 105 engaging upset screw threaded portions 106 and 107 formed on the rod. Adjustable stops 108 and 109 engage the threaded portions of the tappet rod, which, when engaged by the yoke 25, transmit movement to said rod

which in turn actuates the valve members 62 through the gear 78 above described. The valves are provided with stops 65 and 67 (see Fig. 9) which prevent overlapping or overtravel of the valve members when actuated.

Referring to Fig. 7, sleeves 110 slidably engage the rods 12, and are adjustably secured to the cross head 21 by nuts 112 threaded thereon. Expansion coil springs 114 encircle the rods 12 and rest on the upper face of the flange 16 of the cylinder, the springs being engaged and compressed by members 115 screw threaded on the lower ends of the sleeves, when the piston approaches the termination of the down stroke. The springs act to store up a given amount of energy, this energy reacting at the beginning of the upstroke to aid in raising of the piston. It will be noted that, due to the gradual closing of the elongated port 40 in the cylinder by the piston on the down stroke, the centrifugal pump tends to keep operating at a practically constant head. It will be understood that means to absorb energy other than the springs may be employed in lieu of the springs, for example, such as air compressed under the head of the piston 18 within the walls thereof.

Means are provided for introducing water into the system to replace losses caused through absorption or leakage around the valve stems, etc. This is accomplished by an injector generally designated at 116, clearly shown in Fig. 8.

The injector consists of a barrel 117 mounted in an opening formed in the piston head 118. A plunger 119 is slidably mounted in the bore 120 of the barrel. An expansion spring 121 is disposed between the plunger and a plate 122 mounted in the lower end of the bore 120. A ball check valve 123 engages a seat formed in the plate 122 and is urged into engagement therewith by an expansion coil spring 124, there being an opening 125 formed in the plate above the valve seat, and an opening 126 formed in a cap 127 secured to the lower end of the barrel.

Extending upwardly from the plunger is a push pin 128 upon which is adjustably mounted, preferably by screw threads, a head 129, the head contacting with an inwardly projecting arm 130 formed on the upper end of a rod 131 slidably mounted in openings formed in the flange 16, and companion flanges 10a of the cylinder 10. An expansion coil spring 132 encircles the rod between the flange 16, and an adjusting nut 133 threaded thereon. A stop collar 134 mounted on the rod normally engages the upper face of the flange 16 and limits downward movement of the rod against the action of the spring 132.

The amount of water required to replenish that lost through leakage or absorption in the system is admitted into the open end of the cylinder through a pipe 135, the flow of water being controlled by a valve 136 which is

opened sufficiently to permit a small drip therethrough. During the down stroke of the piston the water thus admitted passes into the barrel through a port 137 formed therein communicating with a port 138 formed in the piston head 118, the ports then being uncovered by the plunger due to the action of the spring 121. On the upstroke of the piston, the water is forced from the barrel through the ports 125 and 126 into the cylinder by the plunger 119 after the head 129 on the pin 128 engages the arm 130, it being noted that the spring 132 is of sufficient strength to overcome the spring 121, and hydraulic pressure in the cylinder reacting on the plunger when the check valve is unseated.

The spring 132 is provided to compensate for any adjustments made in the stroke of the piston.

Although the injector provides a convenient means for introducing water into the system, it will be understood, however, that it functions only for its intended purpose, and operates independently of the actual working parts of the pumping mechanism.

The operation of the pumping apparatus is as follows:

The centrifugal pump 32 is driven at a constant speed, and alternately withdraws water from the receiver and delivers it to the cylinder on the upstroke, and withdraws it from the cylinder and delivers it to the receiver on the downstroke, the pressure developed in the receiver being adjusted so that the pump operates under substantially the same head during each stroke.

Assuming the piston is on the downstroke, water in the cylinder passes through the port 40 therein, pipe 44 (the valve 43 being fully open), passageway 65 in the valve member 62 of the control valve 48 to the suction of the pump, the water entering the pump being discharged therefrom through the passageway in the valve member of valve 54 and outlet 53, thence through pipe 51 to the receiver as shown in Fig. 4.

The valve members 62 of the control valves 48 and 54 are retained in their respective positions during the down stroke by engagement of the arm 87 of the bell crank 83 with the indent 89 formed in the arm 90 of the quadrant as shown in Fig. 1. As the piston approaches the termination of the down stroke, the yoke 25 engages the stop 109 and moves the rod 98 with it. The spring 102 then being compressed by the collar 104, continued movement of the rod next disengages the arm 87 from the indent by contact with the abutment 100.

Expansion of the spring 102 then actuates the quadrant through movement of the block 97 and bars 95, thus effecting a quick reversal of the valve members through the links 71 and arms 70. The arm 86 of the bell crank 82 then engages the indent 88 in the arm 90

due to the action of the spring 94 as shown in Fig. 5.

Water now passes from the receiver 36 through pipe 45, branch 47 of the valve 48, through the passageway in the valve member therein into the centrifugal pump and is discharged therefrom through the passageway in the valve member of the valve 54, outlet 52, pipe 50 and port 55 into the cylinder thus effecting the upstroke of the piston. The valve members and parts of the control gear remain in their respective positions during the upstroke until the yoke 25 engages the stop 108 on the rod 98, continued upward movement of the rod then compresses the spring 103 which actuates the quadrant through upward movement of the block and bars, i. e., when the abutment 99 engages the arm 92 of the bell crank 82, thus returning the valve members to the position shown in Fig. 1, the piston then moving on the down stroke as above described.

It will be noted that due to the construction and quick reversal of the valves water cannot by-pass or circulate through the ports 40 and 55 in the cylinder.

From the foregoing it will be seen that the pressure developed in the receiver acts as a counter balance to the pump rods, thereby permitting the pump to operate at a practically constant head. The closing of the elongated port 40 in the cylinder by the piston positively regulates the discharge and definitely limits the down stroke, this throttling of the suction to the pump also increasing the head at which the pump will deliver, especially so when a receiver is employed.

From the construction it will be seen that a long stroke pump is provided in which the movement of the rods is comparatively slow, thereby greatly reducing the inertia on the pump rods. When it is necessary to shut down the pump it is desirable to hold or retain the piston in elevated position in order that the pump may be readily started. This is effected by closing of the valve 43.

An accumulator, or static pressure tank mounted in the derrick may be substituted for the receiver, the pump and pipe lines being connected thereto in the same manner as with the receiver.

I claim:

1. An apparatus of the character described comprising a cylinder having an inlet port formed in its bottom and an elongated discharge port formed in its side wall adjacent the lower end thereof, a gravity depressed piston operable in said cylinder, a centrifugal pump, a source of fluid under an adjusted pressure, a valve connected to the intake and to the discharge ends of said centrifugal pump, pipe lines extending from said valves to the ports formed in said cylinder and to said source of fluid under pressure, means for simultaneously operating said valves,

whereby the flow of fluid induced by said pump will be withdrawn from said pressure source and delivered to said cylinder to effect the upstroke and withdrawn from the cylinder and delivered to the source of fluid under pressure during the downstroke of the piston, and compression means associated with said piston, said compression means storing up energy during the termination of the down stroke and reacting at the beginning of the up stroke to aid in raising of the piston, the down stroke of said piston being definitely limited and the discharge from the cylinder regulated due to closing of the elongated port by the piston.

2. An apparatus of the character described comprising a cylinder having a pair of ports formed therein adjacent the lower end thereof, a gravity depressed piston operating in said cylinder, a centrifugal pump, a valve connected to the intake and to the discharge end of said centrifugal pump, each of said valves comprising a body having a pair of lateral branches and a valve member having a port formed therein adapted to alternately register with the lateral branches, a receiver containing fluid under an adjusted pressure, pipe lines extending between one set of the branches on said valve bodies and the ports formed in said cylinder, pipe lines extending between the other set of branches on the valve bodies and the receiver at a point below the fluid level therein, a gear associated with said valves arranged to operate the valve members simultaneously, and means interconnected with said piston for actuating said gear as the piston approaches the termination of each stroke, whereby the flow of fluid induced by said centrifugal pump will be withdrawn from said receiver and delivered to the cylinder to effect the up stroke and withdrawn from the cylinder and delivered to the receiver during the down stroke of the piston.

3. An apparatus of the character described comprising a cylinder having a pair of ports formed therein adjacent the lower end thereof, a piston operating in said cylinder, a centrifugal pump, a valve connected to the intake and a valve connected to the discharge ends of said centrifugal pump, each of said valves comprising a body having a pair of lateral branches and a valve member having a port formed therein adapted to alternately register with the lateral branches, a receiver containing fluid under an adjusted pressure, pipe lines extending between one set of the branches on said valve bodies and the ports formed in said cylinder, pipe lines extending between the other set of branches on the valve bodies and the receiver at a point below the fluid level therein, a rod secured to said piston and extending upwardly therefrom, a cross head carried by said piston, a yoke secured to said rods and adapted to be connected to a weighted ob-

ject, a tappet rod slidably mounted in said yoke and having stops thereon in spaced relation above and below said yoke, a block slidably mounted on said rod below said yoke, spaced abutments secured to said rod, expansion coil springs encircling said rod between the abutments and said block, a pivoted quadrant, bars connected to said block and one arm of said quadrant, links connecting the other arm of said quadrant to said valve, latches for holding said quadrant against movement during compression of said springs, and stops secured to said tappet rod for disengaging said latches from said quadrant as the piston approaches the termination of each stroke to effect a quick movement of said valve member through expansion of said springs, whereby the flow of fluid induced by said centrifugal pump will be withdrawn from said receiver and delivered to the cylinder to effect the up stroke and withdrawn from the cylinder and delivered to the receiver during the down stroke of the piston.

In testimony whereof I affix my signature.
WM. HOWARD CLAPP.

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