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Lybecker et al.

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[45] **Dec. 18, 1973**

[54] **HYDRAULIC DRIVEN PISTON PUMP**

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[52] **U.S. Cl.** **417/393,** 417/397

[51] **Int. Cl.** **F04b 35/00**

[58] **Field of Search** 417/35, 245, 393, 417/397, 404

[56] **References Cited**

UNITED STATES PATENTS

2,185,727	1/1940	Emmons	417/378
3,363,575	1/1968	Potts	417/397 X
2,239,715	4/1941	Hollander	417/393
2,948,224	8/1960	Bailey	417/404 X
1,790,982	2/1931	Gamer	417/386
3,304,126	2/1967	Rupp	417/397
3,582,238	6/1971	Devine	417/397 X

FOREIGN PATENTS OR APPLICATIONS

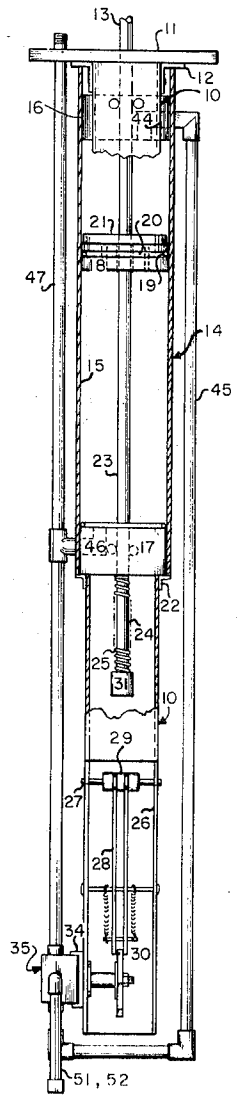
1,213,304	1/1959	France	417/397

Primary Examiner—William L. Freeh
Attorney—Willard J. Hodges, Jr.

[57] **ABSTRACT**

Apumping system utilizing drive means activating a top pump and a ratchet drive rotary control valve selectively switching fluid pressure to a double acting dual piston dual cylinder bottom pump. The two pumps are interconnected by dual pipes through a rotary valve and a multiplicity of check valves causing the dual pipes to alternatively function as a pressure power line or a delivery line depending on the relative position of the control valve. An alternative spool valve control may be employed in conjunction with any source of fluid pressure to activate the bottom pump.

6 Claims, 9 Drawing Figures



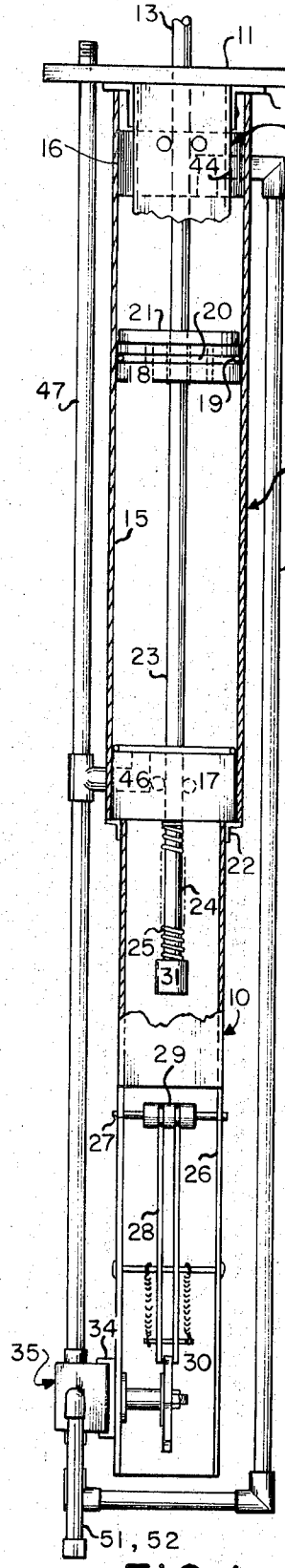


FIG. 1

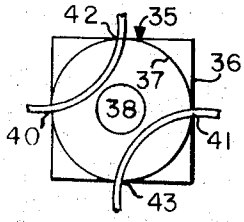


FIG. 2

FIG. 4

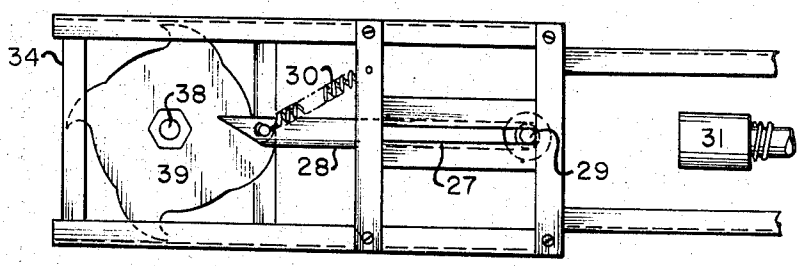


FIG. 3

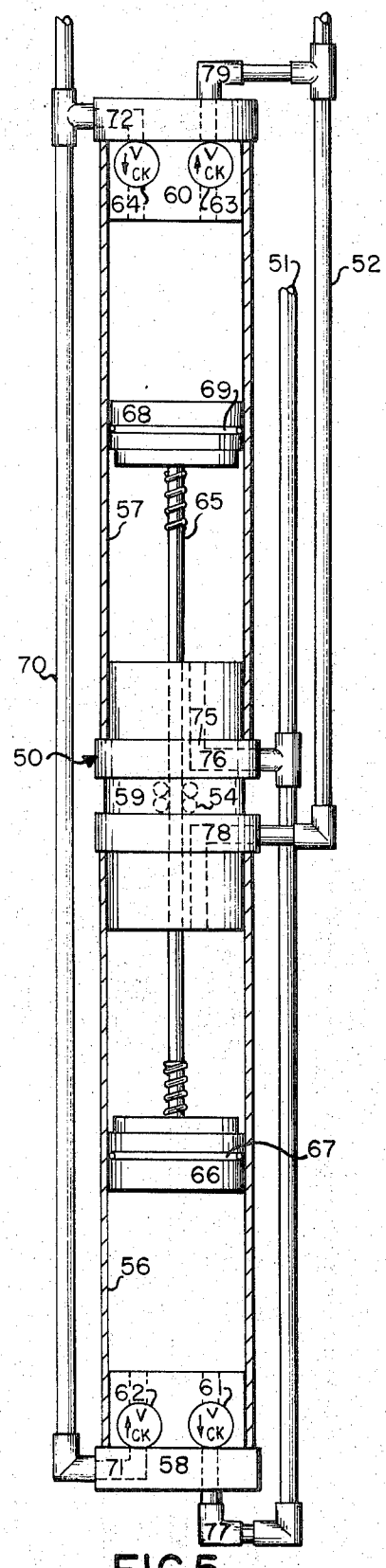


FIG.5

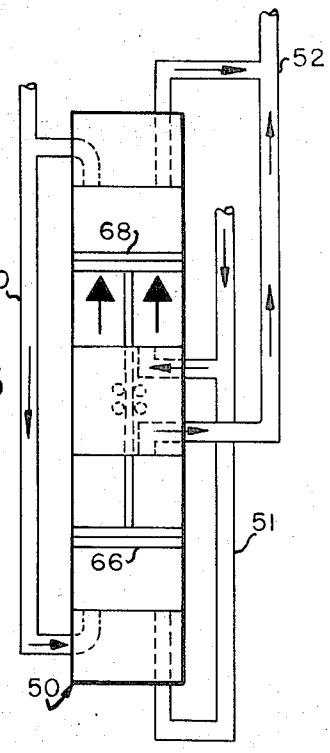


FIG.6

UP

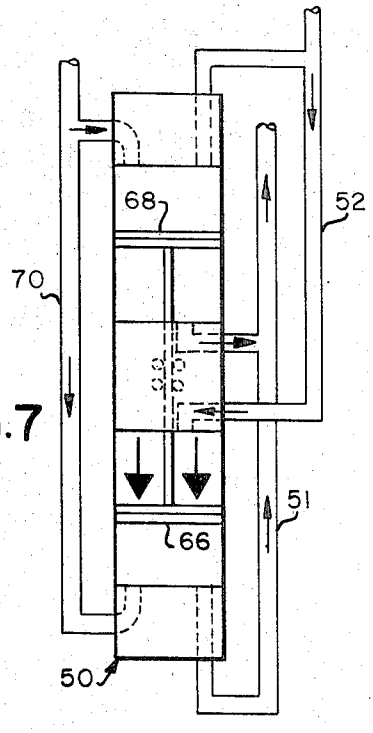


FIG.7

DOWN

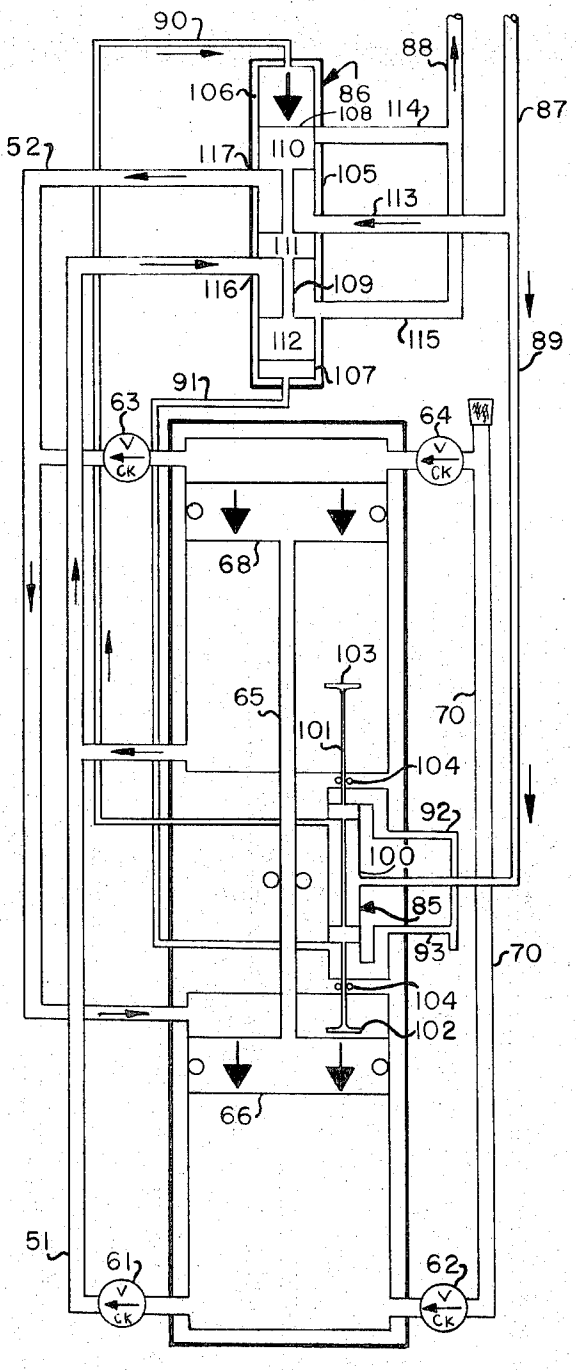

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FIG. 8

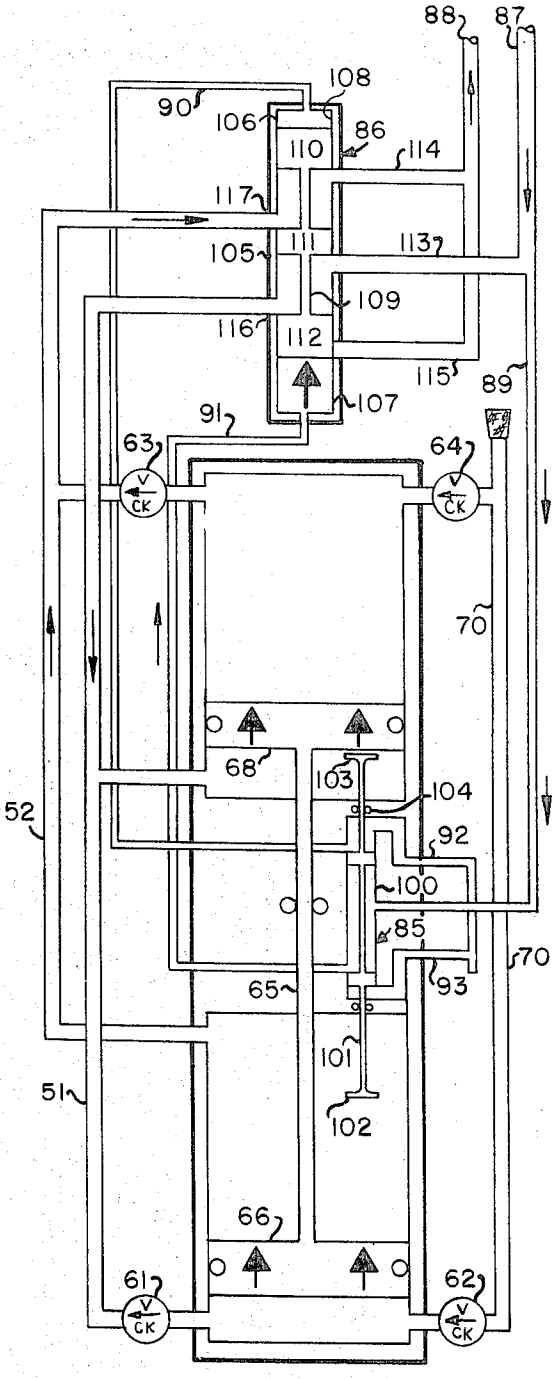

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FIG. 9

HYDRAULIC DRIVEN PISTON PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally pertains to a hydraulic well pumping mechanism more particularly utilizing a top pump driving through a control valve, a dual piston, dual cylinder bottom pump.

2. DESCRIPTION OF PRIOR ART

Pumps and pumping methods adapted to water wells or oil wells is a highly developed art. This invention falls in the field of hydraulic pumps or fluid driven pumps. Among the most pertinent examples of prior art patents are U.S. Pat. Nos. 2,162,748. 2,185,727. 2,287,709. 2,918,974.

SUMMARY OF THE INVENTION

This invention employs a power driven top pump which may be windmill driven. Alternatively, any power driven top pump may be employed. The top pump supplied fluid under pressure through a control valve alternatively switching to a first well line and a second well line. The well line to which pressure is applied drives either the top piston or bottom piston in the top or bottom cylinder of the bottom pump. The bottom pump through suitable porting and check valves employes a volume of one to drive a piston which, in turn, delivers a volume of two to the discharge end of the system. The preferred embodiment employed a plunger driven ratchet rotary valve to selectively power or discharge the flow to and from the bottom pump. The alternative valving system utilizes a spool pilot valve hydraulically positioning a spool control valve to interconnect and control the function of the pumping system.

One of the difficulties encountered in powering hydraulic driven pumps with windmills arises on the down stroke. Windmill towers are normally stressed for a compression load from the top. The inventor's preferred embodiment employs a top pump performing work only on the up stroke. The fluid load by-passes the piston on the down stroke thus avoiding intolerable stresses on the windmill tower. The foregoing was one object of the invention. A second object was to provide a pump capable of operating without heavy sucker rods. This is accomplished by utilization of hydraulic pistons interconnected by two light plastic well lines. The bottom pump may be placed in position and removed by hand with one man performing the task. The invention of this device is also highly suitable for employment in slant wells or pumping from streams which have been heretofore extremely difficult employing windmill as the motive force.

Other objects and advantages will be apparent to those skilled in the art from a study of the following views and the detailed description of the preferred embodiment.

For a description of the construction of the preferred embodiment as well as the alternative valving system, your attention is invited to the attached views wherein identical reference characters are utilized for referring to the same or equivalent components throughout several views and the following detailed description of the preferred embodiment.

FIG. 1 is a perspective view, partially fragmented, of the top pump.

FIG. 2 is a partially sectionalized view of the rotary valve comprising a portion of the top pump.

FIG. 3 is a partially sectionalized, partially fragmented, view illustrating the ratchet rotary valve cam of the top pump.

FIG. 4 is a schematic view partially illustrating the operation of the combination.

FIG. 5 is a perspective view partially fragmented illustrating principally the bottom pump.

FIG. 6 is a schematic view of the bottom pump with the piston powered in the up stroke as indicated by the large double arrows.

FIG. 7 is a schematic view of the bottom pump with the pistons powered in the down stroke as indicated by the large double arrows.

FIG. 8 is a schematic view of an alternative spool valve control mechanism illustrating the bottom pump on a down stroke.

FIG. 9 is a schematic view of an alternative spool valve control mechanism illustrating bottom pump on the up stroke.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For a detailed description of the construction of the preferred embodiment, reference is particularly invited to FIGS. **1, 2, 3,** and **5.** The top pump **14** has its various components secured to the frame **10** which is preferably constructed of a non-corrosive metal such as anodized aluminum. To secure and stabilize the top pump **14** and base **11** a base bracket **12** is employed to which frame **10** is securely attached. Projecting through the center for the entire length of the top pump **14** is pull rod **13** adapted to be secured to a windmill crank not shown or other suitable actuating means. Top pump **14** was constructed with a 2-inch interior diameter acrylic plastic cylinder **15.** Secured in the frame **10** mounted in and sealing the top end of cylinder **15** is top cylinder head **16.** This component as well as bottom cylinder head **17** and piston **18** may be constructed of plastic such as high density polyethylene. It should be understood that other plastics or metals could be employed as construction material without departing from the intended scope of this disclosure. Neoprene rubber piston "O" ring **19** mounted in a suitable "O" ring groove encircles piston **18** for sealing the piston **18** against the interior walls of cylinder **15.** Piston **18** should be constructed with a piston check valve **21** which would permit passage of fluid through the piston **18** on the down stroke and seal and pump on the up stroke. Such a construction and operating characteristics are particularly desirable in employing a windmill configuration as a source of power. The top pump cylinder **15** is secured to a frame **10** and retained in position by cylinder bracket **22.** Projecting through the center of cylinder **15** and the cylinder heads **16, 17,** and the piston **18** is piston rod **23.** The upper extremity is referred to as pull rod **13** with its lower extremity designated as ratchet push rod **25.** A return spring **24** may encircle rod **25** to urge the piston **18** to the bottom of the cylinder **15.** Mounted on frame **10** below cylinder **15** is ratchet bracket **26.** The center section of bracket **26** comprises a ratchet track **27** into which is mounted forreciprocal movement ratchet arm **28** which is pivotally attached at its upper end to ratchet pivot **29.** Ratchet arm **28** is tensionally stressed to a center line by means of ratchet spring **30.** Mounted on the end of ratchet push rod **25**

is ratchet drive cap **31** which may be of high density polyethylene or other suitable metal or plastic. In elongation of the top pump **14** structure, there is mounted on the frame **10** rotary valve **35.** This valve **35** is secured to the frame **10** and retained in position by rotary valve bracket **34.** Valve **35** comprises a valve housing **36** in which is rotatably mounted a rotary valve cylinder **37.** Secured to cylinder **37** and projecting through the housing **34** is rotary valve shaft **38.** Secured to the shaft **38** is rotary valve cam **39** which is mounted in position spaced from and in prolongation of ratchet arm **28.** Rotary valve housing **36** has constructed in this peripheral surface rotary valve first well port **40** and rotary valve second well port **41.** The porting also includes a rotary valve drive port **42** and tank port **43.** Constructed in top cylinder head **16** is drive passage **44** which communicates with top portion of cylinder **15** to receive fluid placed under pressure by piston **18.** Interconnection drive passage **44** and rotary valve **35** is drive conduit **45** conductively connected to drive port **42.** Constructed in the bottom cylinder head **17** communicating with the interior of cylinder **15** is charge passage **46.** This charge passage **46** is interconnected to tank port **43** of the rotary valve **45** by tank conduit **47.** Fluid flow through this tank conduit is a work product of this system as well as providing the required fluid loading of cylinder **15** through charge passage **46.** The foregoing described structure principally comprises the components of the preferred embodiment mounted on the surface of the ground at the well head.

To complete an operable system, a bottom pump **50** best illustrated in FIG. **5** is required. Bottom pump **50** and top pump **14** are interconnected by first well line **51** and second well line **52.** The bottom pump **50** is constructed utilizing dimensions and materials of the type utilized in construction of top pump **14.** Bottom pump **50** comprises a dual cylinder structure which includes bottom cylinder **56** and upper cylinder **57.** For compactness and ease of placing in the well and removing from the well bottom pump **50** has made an integral structure without utilizing a frame member **10.** Bottom cylinder **56** is enclosed at its lower extremity by bottom block **58.** The two cylinders are secured by intermediate block **59.** The upper most portion of upper cylinder **57** has secured to it a top block **60.** In the preferred embodiment, the cylinder blocks are formed or shaped to snuggly fit into the interior of cylinders **56** and **57.** They well might be glued into position or secured by pins (not shown) or sealed by "**0**" ring (not shown). The method of interconnecting the components could utilize a wide variety of accepted securing means. The bottom pump **50** which employs a dual cylinder piston mechanism functioning as driven or pumping components depending upon the position of rotary valve **35** and whether or not the first well line **51** or second well line **52** is powered or placed under pressure to operate bottom pump **50.** To control the fluid flow, a suitable system of check valves must be employed. In the preferred embodiment, a spring loaded ball check valve structure was employed. Mounted in the bottom block **58** is lower discharge check valves **61** and lower intake check valve **62.** Comparably, mounted in the top block **60** was upper discharge check valve **63** and upper intake check valve **64.** Slidably mounted and sealed by means such as intermediate "**0**" rings **54** projecting through the center of intermediate block **59** is piston rod **65.** Secured adjacent the lower portion of rod **65** is bottom piston **66** which is sealed against the interior wall of bottom cylinder **56** by bottom piston "**0**" ring **67.** The upper extremity of the piston rod **65** is upper piston **68** which is likewise sealed to upper cylinder wall **57** by upper piston "**0**" ring **69.**

Again referring to FIG. **5,** extending along the entire length of the bottom cylinder **56** is intake line **70.** This line **70** communicates with bottom inlet passage **71** which is interconnected through lower intake check valve **62** to the interior of the bottom cylinder **56.** Likewise, the top intake passage **72** is interconnected to the interior of upper cylinder **57** through upper intake check valve **64.** The structure is illustrated on the right hand side of FIG. **5** illustrates an interconnection of first well line **51** through first well line power port **75** communicating through intermediate block **59** to the lower portion of upper cylinder **57** against the lower face of upper piston **68.** This internal conduit is illustrated as first well line power passage **76.** When the first well line **51** is being powered, driving upper piston **68,** flow into the bottom cylinder **56** is blocked by lower discharge check valve **61.** In the reverse mode of operation, fluid could pass through lower discharge check valve **61** and flow through first well line discharge passage **77** into first well line **51.** To interconnecting second well line **52** and bottom cylinder **56** there is constructed in intermediate block **59** a second well line power passage **78.** This passage **78** would admit fluid under pressure to the upper extremities of bottom cylinder **56** and the upper surface of bottom piston **66.** The moving of this fluid under pressure from second well line **52** is blocked from flowing into the upper cylinder **57** by upper discharge check valve **63.** The foregoing description is designed to describe the preferred embodiment which was actually reduced to practice and proved successful in operation in a windmill powered configuration. Other means of motive power were, however, successfully employed. The device operates successfully under field conditions.

For a description of an alternative valving arrangement powering the bottom pump **50,** your attention is particularly invited to FIGS. **8** and **9.** This alternative structure employs a spool pilot valve **85** which may be constructed internal or integral with intermediate block **59.** In this alternative structure, construction valving arrangement of bottom pump **50** is as has been previously described. The only variation in this alternative construction is spool pilot valve **85** being contacted and in turn, controlling the system by the reciprocation of the bottom piston **66** and upper piston **68** of bottom pump **50.** The system is controlled by piston position in the bottom pump **50** rather than reciprocation of top pump **14** as heretofore described. This alternative system employs a well pressure line **87** and a well pressure line **87** and a well return line **88** in lieu of the first well line **51** and second well line **52.** These lines are identical structurally, but vary functionally in this alternative configuration. A pressure pilot line **89** interconnects well pressure line **87** to the center section of spool pilot valve **85.** Top control line **90** andbottom control **91** interconnect spool pilot valve **85** and spool control valve **86.** The top section of pilot valve **85** is vented through top relief line **92.** A similar structure, bottom relief line **93,** vents the bottom of spool pilot valve **85.** As previously was stated, the spool pilot valve **85** may be constructed integral with intermediate block **59.** In any configuration, however, this spool pilot valve must in-

clude a pilot valve cylinder **100**. Slidably mounted in cylinder **100** is pilot spool **101**. To control and position spool **101**, lower plunger **102** projects into bottom cylinder **86** where it may be contacted by bottom piston **66**. To position the pilot spool **101** reciprocally, upper plunger **103** projects into upper cylinder **57** where it is contacted by upper piston **68** to shift pilot spool **101**. A frictional collar **104** such as neoprene "0" ring or a spring loaded teflon collar encircles these plungers **102, 103** to insure that pilot spool **101** is positioned by contact of the respective pistons rather than drifting by gravity. Spool control valve **86** is constructed with a control valve cylinder **105** and is normally positioned above and external of the bottom pump **50**. This spool control valve **86** comprises a control valve cylinder **105** including a top control chamber **106** and a bottom control chamber **107** which are respectively connected to top **90** and bottom **91** control lines. Control valve spool **108** is reciprocally mounted in control valve cylinder **105**. Structurally, control spool **108** comprises a spindle **109**, upper piston **110**, center piston **111**, and lower piston **112**. The valve cylinder **105** is constructed with a pressure inlet port **113**, an upper return port **114**, and a lower return port **115** positioned in the control valve cylinder **105** intermediate pressure inlet port **113** and the upper **114** and lower **115** return ports is a first well line port **116** and a second well line port **117**. In this alternative system, the lines interconnecting the spool control valve **86** and the bottom pump **50** are identical structurally and functionally to first well line **51** and second well line **52** initially described as communicating with the bottom pump **50**.

OPERATION

In placing the device of this invention in operation, the top pump **14** is secured in position by fixing base **11** to a stable means. Pull rod **13** is attached to an external motive force such as a windmill (not shown), bottom pump **50** is immersed in the fluid to be pumped. First well line **51** and second well line **52** are connected. Initially, it is necessary to prime the system through the tank line **47**. As piston rod **23** reciprocates fluid is delivered through drive conduit **45** into rotary valve **35**. As illustrated in FIG. **4**, rotary valve **35** is so positioned as to deliver fluid to the bottom pump **50** through first well line **51**. This fluid pressure drives upper piston **68** to the top of its stroke. This action discharged fluid through upper discharge check valve **63** as well as fluid from the upper portion of bottom cylinder **65**. This fluid proceeds through well line **52** through the passage in rotary valve **35** through tank line **47**. A portion of the fluid is diverted to re-charge bottom section of top pump cylinder **15**. The remainder of the fluid is the work product of the system and is discharged through the tank line **47**. As piston **18** returns to the bottom of its stroke, fluid below piston **18** passes through piston check valve **21** into the top of cylinder **15**. Ratchet drive cap **31** moves ratchet arm **28** rotating rotary valve cam **39** by 90°re-routing the flow channels through the valve **35**. In the mode of operation previously described, rotary valve drive port **42** was common with rotary valve first well port **40**. When rotated 90°, rotary valve second well port **41** will be common with rotary valve drive port **42**. Following this sequence as piston **18** returns toward top cylinder head **16**, fluid under pressure through drive conduit **45** would proceed through second well line **52** driving bottom piston **66** of bottom pump **50** down. Fluid from bottom cylinder **56** would be discharged through lower discharge check valve **61** into first well line **51**. Similarly fluid from the lower part of upper cylinder **57** would be discharged into first well line **51**. This fluid would proceed through rotary valve first well port **40** through the valve and be discharged through rotary valve tank port **43** into tank line **47**. As piston **18** reciprocates, the cycle is repeated.

For a description of the operation of the alternative embodiment, illustrated in FIGS. **8** and **9**, reference is first made to FIG. **8**. In this configuration, the lower plunger **102** has been contacted by piston **66** moving the pilot valve **85** to the up position as illustrated in FIG. **8**. Fluid through pressure pilot line **89** proceeds through the valve **85** through top control line **90** forcing spool control valve **86** to the position illustrated. When this is accomplished, pressure from well pressure line **87** proceeds through valve **86** down second well line **52** driving bottom piston **66** downward. This results in discharge of fluid through lower discharge check valve **61** as well as the fluid in the bottom of upper cylinder **67**. This fluid proceeds up through first well line **51** through valve **86** and into lower return port **115** into well return line **88**. For the opposite cycle, reference is made to FIG. **9**. As upper piston **68** strikes upper plunger **103**, pilot valve **85** is moved to position illustrated in FIG. **9**. Pressure from pilot line **89** moves through pilot valve **85** through bottom control line **91** shifting spool control valve **86** into position illustrated in FIG. **9**. This results in fluid from well pressure line **87** moving through pressure inlet **113** through valve **86** out first well line port **116** down first well line **51** into bottom part of upper cylinder **57** driving upper piston **68** up. This action discharges fluid through upper discharge check valve **63** as well as fluid from bottom cylinder **56** through second well line **52**. This fluid moves through second well line port **117** through passage between upper piston **110** and center piston **111** of spool control valve **86** through upper return port **114** into well return line **88**. When bottom piston **66** again strikes lower plunger **102**, pilot spool valve **85** is again shifted and the cycle repeated.

In the configuration of the device as illustrated in FIGS. **8** and **9**, any source of positive water pressure might be utilized in the combination. A windmill driven pump such as illustrated in FIG. **1** would be a satisfactory source of positive pressure; however, there would be no necessity for employing rotary valve **35** and its drive and control mechanism in such a configuration. Tank conduit **47** could communicate directly with passage **46** and be connected to well return line **88** and drive conduit **45** would be connected directly to well pressure line **87**.

The construction and operation of the preferred embodiment and an alternative valve control system for bottom pump **50** have been described in detail. What is desired to be claimed is all embodiments not departing from the scope or equivalents of the appended claims.

I claim:

1. A hydraulic pumping system comprising:

a. an elongated frame projecting on an axis,

b. a top pump operably mounted in said frame,

c. said top pump further comprising:

1. a cylinder,

2. a top cylinder head enclosing the first end of said cylinder,
e. a bottom cylinder head enclosing the second end of said cylinder, and
4. a piston having a top side and a bottom side mounted for reciprocal movement in said cylinder,
d. a piston check valve constructed in said piston, said valve permitting flow of fluid from the bottom side of said piston to the top side of said piston, and conversely stopping the flow of fluid from the top side of said piston to the bottom side of said piston,
e. an elongated piston rod slidably mounted for reciprocal movement along the axis of said top piston,
f. said piston rod's upper extremity comprising a pull rod capable of being reciprocated by a windmill,
g. said lower extremity comprising a ratchet push rod,
h. a rotary valve mounted on the axis of said frame in a position to be operably contacted by said ratchet push rod,
i. control means in association with said rotary valve and said ratchet push rod for operably positioning said rotary valve,
j. said rotary valve further comprising at uniform intervals:
1. a rotary valve first well line port,
2. a rotary valve second well line port,
3. a rotary valve drive port, and
4. a rotary valve tank port,
k. a first well line connected to said rotary valve first well line port,
l. a second wall line operably connected to said rotary valve second well line port,
m. a drive conduit operably connected to said rotary valve drive port adapted to receive fluid under pressure from the top side of said piston of said top pump,
n. a tank conduit operably attached to said rotary valve tank port,
o. a hydraulic driven bottom pump operably attached to said first and said second well lines adapted to be alternately driven by said first and said second well line and to alternately deliver the work product from said bottom pump to said first and said second well line.

2. The invention of claim **1** further comprising a return spring encircling said ratchet push rod, said spring being stressed to retain said top pump piston adjacent the said bottom cylinder head.

3. The invention of claim **1** wherein said bottom pump comprises:
a. an upper cylinder having an elongated configuration,
b. a bottom cylinder mounted in line with and in elongation with said top cylinder,
c. an intermediate block interconnecting said top and said bottom cylinder,
d. an elongated piston rod projecting through said intermediate block projecting into said top and said bottom cylinders,
e. a piston mounted for reciprocal movement in said top cylinder,
f. a piston mounted for reciprocal movement in said bottom cylinder,
g. a first well line conductively communicating with said top and said bottom cylinder,
h. a second well line conductively communicating with said top and said bottom cylinder,
i. an intake line communicating with said top and said bottom cylinders,
j. an intake check valve in said intake line adjacent said top cylinder admitting fluid to said cylinder,
k. an intake check valve in said intake line adjacent said bottom cylinder admitting fluid to said cylinder,
l. an upper discharge check valve adjacent said upper cylinder conductively connected to a well line admitting fluid to said well line,
m. the lower check valve adjacent said bottom cylinder conductively connected to a well line admitting fluid to said well line.

4. The invention of claim **3** further comprising:
a. a first well line power passage interconnecting a said first well line and the bottom interior of said upper cylinder, and
b. a second well line power passage interconnecting a said second well line and the top portion of said bottom cylinder.

5. The invention of claim **1** wherein said control means in association with said rotary valve further comprising:
a. a rotary valve shaft secured to said rotary valve,
b. a rotary valve cam secured to said rotary valve shaft, and
c. cam drive means intermediate said rotary valve and said ratchet push rod driving said cam responsive to contact by said ratchet push rod.

6. The invention of claim **3** wherein said drive means comprises:
a. a ratchet track secured to said frame adjacent said ratchet push rod,
b. a ratchet arm flexibly secured to,
c. a ratchet pivot, and
d. a ratchet spring tensioned to retain said ratchet arm in engagement with said rotary valve cam.

* * * * *