

Nov. 5, 1968

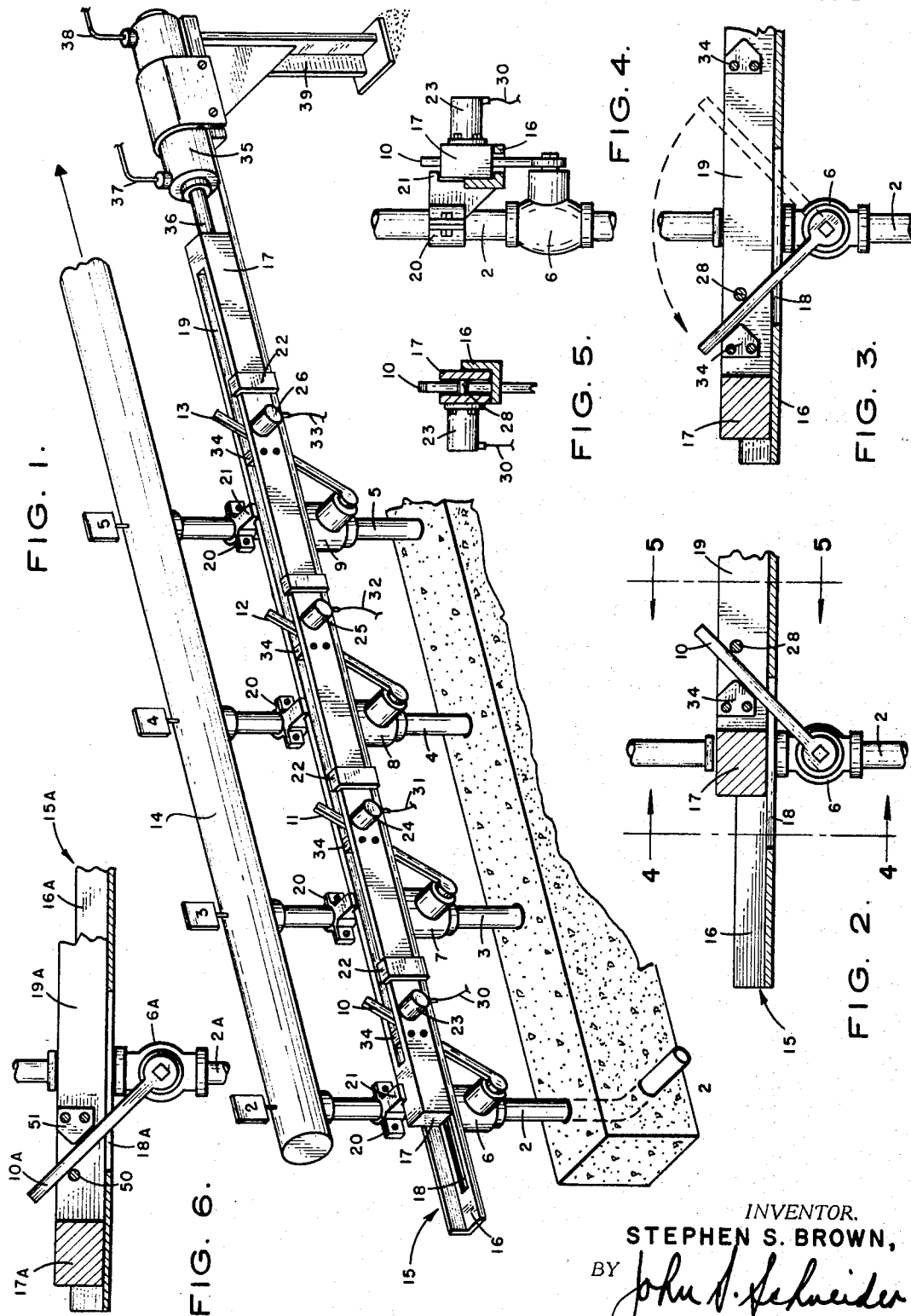
S. S. BROWN

3,409,048

MULTIPLE VALVE SELECTOR AND ACTUATOR

Original Filed Aug. 23, 1965

2 Sheets-Sheet 1



INVENTOR.
STEPHEN S. BROWN,
BY *John D. Schneider*
ATTORNEY.

Nov. 5, 1968

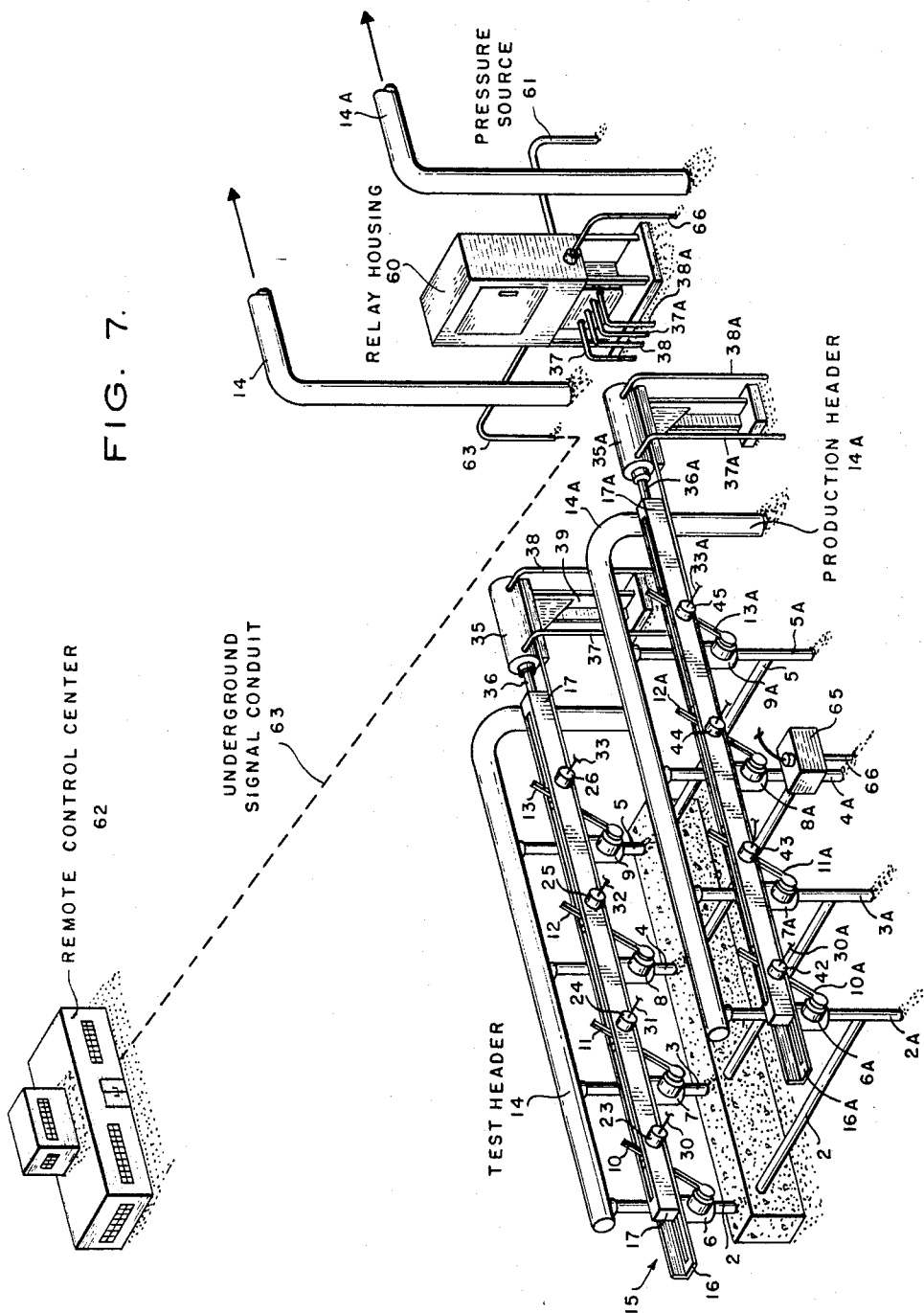
S. S. BROWN

3,409,048

MULTIPLE VALVE SELECTOR AND ACTUATOR

Original Filed Aug. 23, 1965

2 Sheets-Sheet 2



INVENTOR.

STEPHEN S. BROWN,

BY *John F. Schneider*

ATTORNEY.

1

2

3,409,048

MULTIPLE VALVE SELECTOR AND ACTUATOR
Stephen S. Brown, Harris County, Tex., assignor to
Esso Production Research Company
Continuation of application Ser. No. 481,841, Aug. 23,
1965. This application Dec. 15, 1967, Ser. No. 691,063
25 Claims. (Cl. 137—635)

ABSTRACT OF THE DISCLOSURE

A multiple valve selector and actuator apparatus to be used in controlling the flow of fluid through a plurality of conduits having a valve member arranged on each conduit adapted to control the flow of fluid therethrough. Valve operating means having two positions, a valve-open position and a valve-closed position, is attached to each valve. Slidable means movable between two positions is arranged adjacent the valves. Extendible-retractable means, adapted when extended to actuate and move the valve operating means from one to the other of its positions when the slidable means moves from one to the other of its positions, is mounted on the slidable means adjacent each valve operating means, and means is provided for moving the slidable means between its two positions.

This application is a continuation of application Ser. No. 481,841, and now abandoned entitled "Multiple Valve Selector and Actuator," filed Aug. 23, 1965, by Stephen S. Brown.

The present invention concerns the operation of valves in automatic systems such as automatic well test systems. More particularly, the present invention concerns a valve selector and actuator system which is capable of selectively opening and closing a valve or valves in a multiple valve bank.

The invention is especially useful when converting existing tank batteries to an automatic well test system.

The oil wells on a particular lease are located on a varied spacing pattern and have flow lines laid to a central location on the lease where production from all wells is commingled, treated, and delivered to a pipeline. The distance from the central location to the wells varies from a few hundred feet to several thousand feet. Since production from the individual well is commingled, to measure an individual well's production it is necessary to isolate the production from this well in a separate system and test it. At most central points or tank batteries where this is done, the individual well flow lines are connected to two headers. These headers are equipped with valves, usually plug valves, and are known as the test and production headers. When it is desired to test a well, the plug valve on the well flow line leading to the test header is opened and the valve leading to the production header is closed. Production from the well then, is directed through the test header to various separators and meters which record or measure the amount of oil, water, and gas produced by the individual well.

With as many as 20 or 30 wells coming to a central point, testing wells is a necessary and important function. However, it is time-consuming and expensive when done manually. Automatic well test equipment is available for testing the wells automatically. The well test programmer panel automatically selects the well to be tested, opens it into the test manifold, and closes the valve leading to the production manifold. In the past, to set up such an automatic well test program it has been necessary to replace all of the manually operated plug valves on both the production and test manifolds with pneumatically operated valves. In most cases, rather than make the actual valve replacement, a new header was built using three-

way, two-position pneumatically operated valves so that these wells could be operated by the well test programmer through electro-pneumatics.

The present invention overcomes these disadvantages in automating well testing operations. The cost per well of automation by use of the apparatus described herein is considerably less than the cost of installing individual three-way valves. Since the construction of manual well test and production manifolds is generally uniform with all of the valves on each header being in line, the valve selector and actuator of the present invention is easily and readily adapted to any existing manifold which is equipped with plug valves.

Briefly, the multiple valve selector and actuator apparatus of the invention to be used in selectively controlling fluid flow to a test (or production) header which is connected to a plurality of conduits comprises a valve-member arranged on each conduit adapted to control the flow of fluid therethrough; valve operating means attached to each valve member and having a valve open position and a valve closed position; slidable means arranged adjacent the valve members and movable between two positions; extendible-retractable means mounted on said slidable means adjacent each of the valve operating means and adapted when extended to engage the valve operating means and move the valve operating means from one of its positions to the other of its positions when the slidable means is moved from one to another of its positions; lug means arranged on said slidable means adjacent each valve operating means adapted to engage the valve operating means to move the valve operating means from its other position to its one position when the slidable means is moved from one to another of its positions; and actuating means adapted to move the slidable means between its two positions. When controlling fluid flow to a test header, the extendible-retractable means when extended moves the valve operating means from its closed to its open position, and when controlling fluid flow to a production header, the extendible-retractable means when extended moves the valve operating means from its open to its closed position. Contrarily, the lug means moves the valve operating means from its open to its closed position and from its closed to its open position when used in conjunction with a test header and production header, respectively.

The objects and advantages of the invention will be more apparent from the following description thereof when taken with the drawings wherein:

FIG. 1 is a perspective view of multiple valves arranged for selective operation according to the system of the present invention;

FIG. 2 is a front elevational view partly in section of one of the valve members in one position;

FIG. 3 is a sectional view similar to that of FIG. 2 showing the valve member in another position;

FIG. 4 is a view taken along lines 4—4 of FIG. 2;

FIG. 5 is a view taken along lines 5—5 of FIG. 2;

FIG. 6 is a sectional view similar to FIG. 3 of another valve member; and

FIG. 7 is a perspective view showing the apparatus of the invention installed for field operation.

For a more complete description of the invention, reference is made to the drawings in greater detail. A series of aligned risers 2, 3, 4, and 5 connect at their upper ends to a test header pipe 14. Identification tags or plates are affixed to the top side of header 14 for individual well identification. Each riser is provided, respectively, with a plug valve 6, 7, 8, and 9, to which is attached, respectively, a valve handle 10, 11, 12, and 13. The lower end of each riser is elbowed at its lower end and mounted in a concrete block.

As shown in FIGS. 1 and 4, a rack assembly 15 is

clamped to the risers, above valves 6, 7, 8, and 9, by means of clamps 20. Rack 15 consists of a stationary track member 16 and a slidable valve actuator member 17. The member 17 slides on track 16 guided by brackets 21 and 22. Each valve handle 10, 11, 12, and 13 extends through a slot 18 in track 16 and through an opening 19 in slidable member 17.

Solenoids 23, 24, 25, and 26 are arranged on slidable member 17. The plunger or pin 28 of each solenoid is positioned to extend across opening 19 of slidable member 17 when the solenoid with which it is associated is energized. In its extended position, pin 28 engages one side of the valve handle adjacent it when the slidable member 17 is moved in one direction. Thus, as shown in FIGS. 2 and 3, pin 28 engages the right side of valve handle 10 and causes the valve to be moved from a closed to an open position when the slidable member 17 moves to the left. Electrical leads 30, 31, 32, and 33 are connected to solenoids 23, 24, 25, and 26, respectively.

Closure lugs 34 are positioned in opening 19 and secured to slidable member 17. Each of these lugs is arranged on the other side of the valve handle adjacent it opposite to the valve handle side engaged by pin 28. Lugs 34 engage valve handles 10, 11, 12, and 13 and move them from their valve open to their valve closed positions when slidable member 17 moves to the right, as illustrated in FIGS. 1 and 2.

As shown in FIGS. 1, 2, and 3, all of the valve handles are moved to their valve closed positions when the slidable member 17 is moved to its extreme position to the right. However, each valve handle is moved to its valve open position only when the solenoid adjacent it is energized and slidable member 17 is moved to its extreme position to the left.

A pneumatic cylinder 35 containing a reciprocal piston (not shown) is mounted on one end of track 16. A piston rod 36 extends from cylinder 35 and connects the reciprocal piston to slidable member 17. Movement of rod 36 (and slidable member 17) is controlled by means of gas fed under pressure to the ends of cylinder 35 through conduits 37 and 38. Cylinder 35 and the end of track 16 on which it is arranged are supported by a support member 39.

Referring to FIGS. 6 and 7, and more specifically to FIG. 7, a production header pipe 14A is shown positioned parallel to test header pipe 14. Connected to production header pipe 14A is a series of parallel flow line risers 2A, 3A, 4A, and 5A from various spaced-apart producing wells. Risers 2A, 3A, 4A, and 5A are provided with plug valves 6A, 7A, 8A, and 9A, respectively. Each of the risers 2, 3, 4, and 5 is connected, respectively, to risers 2A, 3A, 4A, and 5A below each plug valve 6A, 7A, 8A, and 9A, respectively. Each valve handle 10A, 11A, 12A, and 13A is attached to the plug valve associated with it and each handle extends through a rack assembly 15A in a manner similar to that described with reference to valve handles 10, 11, 12, and 13. A slidable member 17A of rack assembly 15A is also provided with solenoids and lug members. However, as shown in FIG. 6, the positions of the lugs and solenoids are reversed from their positions in FIGS. 2 and 3. Lugs 51, secured to slidable member 17A, are positioned on the right side of the valve handles and engage the handles to move them to a valve open position when slidable member 17A is moved to the left. The solenoids 42, 43, 44, and 45 are fixed to slidable member 17A and are positioned so that their plunger pins 50, when extended, engage the left side of the valve handles 10A, 11A, 12A, and 13A and move them to valve closed positions when the slidable member 17A is moved to the right.

Movement of slidable member 17A on track 16A is effected by a cylinder-piston assembly 35A powered by gas pressure fed alternately through conduits 37A and 38A.

Thus solenoids 23, 24, 25, and 26 are energized to open valves 6, 7, 8, and 9, respectively, when the slidable member 17 is moved to the left, and solenoids 42, 43, 44, and 45 are energized to close valves 6A, 7A, 8A, and 9A when the slidable member 17A is moved to the right.

Referring again to FIG. 7, it will be seen that power fluid conduits 37, 38, 37A, and 38A are connected to a housing 60 which contains equipment for selectively transmitting gas pressure from a pressure source 61 to the conduits leading to cylinders 35 and 35A. This equipment is controlled electrically from a remote control center 62 through a signal conduit 63. The various solenoids are also controlled from the control center 62 by means of signal conduit 63. The electrical leads 30, 31, 32, 33, 30A, 31A, 32A, and 33A connect the solenoids to housing 60 and signal conduit 63 by way of junction box 65 and underground cable 66.

Production header 14A directs the fluid flowing from the various wells to a collection point (not shown), such as tank storage, separators, etc., or to a transmission pipeline. Test header 14 selectively directs the flow of fluid from a particular well to the testing equipment, such as separators, metering tanks, etc.

In the operation of the apparatus of the present invention all of the valves on risers 2A, 3A, 4A, and 5A connected to header 14A are initially in open positions with rack 17A in its position to the left, as shown in FIG. 6, and all of the valves on risers 2, 3, 4, and 5 connected to header 14 are initially in closed positions with rack 17 in its position to the right, as seen in FIG. 1. Fluid flows from the various wells through risers 2A, 3A, 4A, and 5A and header 14A to storage or a pipeline.

When it is desired to test the fluid flowing from a specific well through one of the risers, as for example, riser 2A, a signal is transmitted from the control center 62 to solenoid 42 through conduit 63, cable 66, and lead 30A to energize solenoid 42 and extend pin 50 across opening 19A. Another signal is sent to housing 60 through conduit 63 to direct gas pressure into cylinder 35A through conduit 37A, and move slidable member 17A to the right. Pin 50 engages handle 10A and moves it to the valve closed position. The pins of the other solenoids 43, 44, and 45 remain retracted and handles 11A, 12A, and 13A remain in their valve open positions when slidable member 17A moves to the right. In this manner, valve 6A is selectively closed while valves 7A, 8A, and 9A remain open.

A signal is then transmitted from control center 62 through conduit 63, cable 66 and lead 30 to energize solenoid 23 and extend pin 28 across opening 19. Another signal is then sent to housing 60 to direct gas under pressure into cylinder 35 through conduit 38 and move slidable member 17 to the left. Pin 28 engages handle 10 and moves it to the valve open position. The other handles 11, 12, and 13 are not moved since solenoids 24, 25, and 26 are not energized, and their pins remain retracted. Thus, valve 6 is selectively opened while valves 7, 8, and 9 remain closed.

With the valves in these positions, fluid flowing through risers 3A, 4A, and 5A is still directed through production header 14A, while fluid through riser 2A is directed through connecting riser 2, valve 6, and test header 14.

When the testing period is completed, signals are transmitted from the control center to housing 60 to direct gas pressure to conduit 37 and to conduit 38A. Slidable member 17 is moved to its position to the right, which action causes lug 34 to engage and move handle 10 to the right and thereby close valve 6. (Valves 7, 8, and 9 remain closed.) Slidable member 17A is moved to its position to the left, which action causes lug 51 to engage and move handle 10A to the left and thereby open valve 6A. Valves 7A, 8A, and 9A remain open during this operation. Fluid flow in riser 2A is again directed into pro-

5

duction header 14A. The operating signals transmitted from the control center may be manually or automatically controlled.

It is not necessary to increase piston size to accommodate a larger number of wells since only one valve is actuated no matter how many wells are in the battery.

Having fully described the apparatus, operations, objects, and advantages of my invention, I claim:

1. Multiple valve selector and actuator apparatus for use in selectively controlling the flow of fluid through a plurality of conduits comprising:

a valve arranged on each conduit adapted to control the flow of fluid therethrough;

valve operating means attached to each valve and having two positions, a valve-open position and a valve-closed position;

slidable means arranged adjacent said valves and movable between two positions;

extendible-retractable means mounted on said slidable means adjacent each valve operating means adapted when extended to actuate and move said valve operating means from one to the other of its positions when said slidable means moves from one to the other of its positions; and

means for moving said slidable means between its two positions.

2. Apparatus as recited in claim 1 including means adapted to extend and retract said extendible-retractable means.

3. Apparatus as recited in claim 1 in which said extendible-retractable means comprises a solenoid.

4. Apparatus as recited in claim 3 in which said slidable means moving means includes a gas operated piston-cylinder assembly.

5. Apparatus as recited in claim 4 in which said slidable means includes a track and a member slidable on said track, said track and said slidable member being provided with openings through which each valve operating means extends.

6. Multiple valve selector and actuator apparatus for use in selectively controlling fluid flow through a plurality of conduits comprising:

a valve arranged on each conduit adapted to control the flow of fluid therethrough;

valve operating means attached to each valve and having a valve open position and a valve closed position;

slidable means arranged adjacent said valves movable between two positions;

extendible-retractable means mounted on said slidable means adjacent each valve operating means adapted when extended to actuate and move said valve operating means from one of its positions to the other of its positions when said slidable means is moved from one to another of its positions;

means arranged on said slidable means adapted to actuate and move said valve operating means from its other position to its one position when said slidable means is moved from another of its positions to one of its positions; and

means for moving said slidable means between its two positions.

7. Apparatus as recited in claim 6 including means adapted to extend and retract said extendible-retractable means.

8. Apparatus as recited in claim 6 in which said extendible-retractable means comprises a solenoid.

9. Apparatus as recited in claim 8 in which said slidable means moving means includes a gas operated piston-cylinder assembly.

10. Apparatus as recited in claim 9 in which said slidable means includes a track and a member slidable on said track, said track and said slidable member being provided with openings through which each valve operating means extends.

11. Multiple valve selector and actuator apparatus for

6

use in controlling fluid flow through a plurality of conduits comprising:

a valve member arranged on each conduit adapted to control the flow of fluid therethrough; handle means adjacent each valve member and having first and second positions and adapted when moved from said first to said second position to open said valve member and when moved from said second to said first position to close said valve member;

slidable means arranged adjacent said valve members movable from a first to a second position and vice versa;

extendible-retractable means mounted on said slidable means adjacent each handle means adapted when extended to engage said handle means and move said handle means from its first to its second position when said slidable means is moved from its first to its second position to thereby open said valve member associated therewith;

lug means arranged on said slidable means and engageable with said handle means adapted to return said handle means from its second to its first position when said slidable means is moved from its second to its first position to thereby close said valve member associated therewith; and

actuating means for moving said slidable means from its first to its second position and vice versa.

12. Apparatus as recited in claim 11 including means adapted to extend and retract said extendible-retractable means.

13. Apparatus as recited in claim 11 in which said extendible-retractable means comprises a solenoid.

14. Apparatus as recited in claim 13 in which said actuating means includes a gas operated piston-cylinder assembly.

15. Apparatus as recited in claim 14 in which said slidable means includes a track and a member slidable on said track, said track and said slidable member being provided with openings through which each handle means extends.

16. Multiple valve selector and actuator apparatus for use in controlling fluid flow through a plurality of conduits comprising:

a valve member arranged on each conduit adapted to control the flow of fluid therethrough;

handle means adjacent each valve member and having first and second positions adapted when moved from said first to said second position to open said valve member and when moved from said second to said first position to close said valve member;

slidable means arranged adjacent said valve members movable from a first to a second position and vice versa;

extendible-retractable means mounted on said slidable means adjacent each handle means adapted when extended to engage said handle means and move said handle means from its second to its first position when said slidable means is moved from its second to its first position to thereby close said valve member associated therewith;

lug means arranged on said slidable means and engageable with said handle means adapted to return said handle means from its first to its second position when said slidable means is moved from its first to its second position to thereby open said previously closed valve member associated therewith; and actuating means for moving said slidable means from its second to its first position and vice versa.

17. Apparatus as recited in claim 16 including means adapted to extend and retract said extendible-retractable means.

18. Apparatus as recited in claim 17 in which said extendible-retractable means comprises a solenoid.

19. Apparatus as recited in claim 18 in which said actu-

ating means includes a gas operated piston-cylinder assembly.

20. Apparatus as recited in claim 19 in which said slidable means includes a track and a member slidable on said track, said track and said slidable member being provided with openings through which each handle means extends.

21. Multiple valve selector and actuator apparatus for use in controlling fluid flow through a plurality of conduits comprising:

- a test header;
- a plurality of first conduits connected to said test header;
- a production header;
- a plurality of second conduits connected to said production header;
- a first valve member arranged on each of said first conduits adapted to control the flow of fluid there-through;
- a second valve member arranged on each of said second conduits adapted to control the flow of fluid therethrough;
- each of said first conduits fluidly communicating with each of said second conduits upstream of said second valve member;
- first handle means adjacent each of said first valve members and having first and second positions adapted when moved from said first to said second position to open said first valve member and when moved from said second to said first position to close said first valve member;
- second handle means adjacent each of said second valve members and having first and second positions adapted when moved from said first to said second position to open said second valve member and when moved from said second to said first position to close said second valve member;
- first slidable means arranged adjacent said first valve member movable from a first to a second position and vice versa;
- second slidable means arranged adjacent said second valve member movable from a first to a second position and vice versa;
- first extendible-retractable means mounted on said first slidable means adjacent each of said first handle means adapted when extended to engage said first handle means and move said first handle means from its first to its second position when said first slidable means is moved from its first to its second position

to thereby open said first valve member associated therewith;

second extendible-retractable means mounted on said second slidable means adjacent each of said second handle means adapted when extended to engage said second handle means and move said second handle means from its second to its first position when said second slidable means is moved from its second to its first position to thereby close said second valve member associated therewith;

first lug means arranged on said first slidable means and engageable with said first handle means adapted to return said first handle means from its second to its first position when said first slidable means is moved from its second to its first position to thereby close said previously opened first valve member associated therewith;

second lug means arranged on said second slidable means and engageable with said second handle means adapted to return said second handle means from its first to its second position when said second slidable means is moved from its first to its second position to thereby open said previously closed second valve member associated therewith; and

actuating means for moving said first and second slidable means from their first to their second positions and vice versa.

22. Apparatus as recited in claim 21 which includes means adapted to extend and retract each of said extendible-retractable means.

23. Apparatus as recited in claim 22 in which each extendible-retractable means comprises a solenoid.

24. Apparatus as recited in claim 23 in which said actuating means comprises a gas operated piston-cylinder assembly.

25. Apparatus as recited in claim 24 in which each slidable means includes a track and a member slidable on said track, said track and said slidable member being provided with openings through which each handle means extends.

References Cited

UNITED STATES PATENTS

1,755,153	4/1930	Shield	137—635
1,801,501	4/1931	Griffin	137—635 X
2,730,130	1/1956	Guidry	137—635
3,187,766	6/1965	Black	137—635 X

CLARENCE R. GORDON, *Primary Examiner*.