G. McKERAHAN.

AIR PUMP.

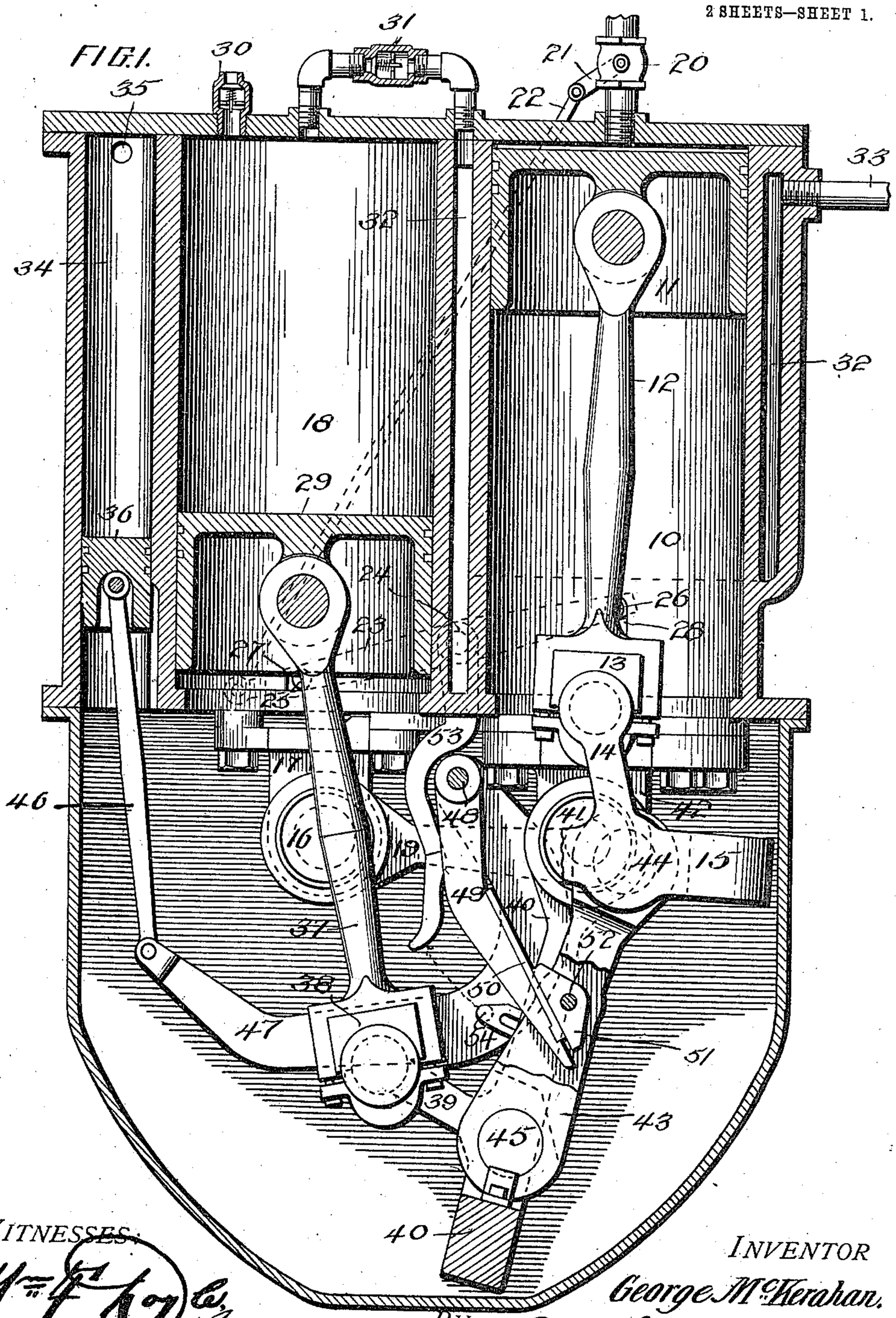
APPLICATION FILED FEB. 23, 1910.

963,923.

Patented July 12, 1910.

2 SHEETS—SHEET 1.

FIG. 1.




WITNESSES:

W. F. Hoge.

Alfred T. Gage.

INVENTOR

George McKerahan.

BY E. B. Stocking

Attorney

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2 SHEETS—SHEET 2.

FIG. 2.

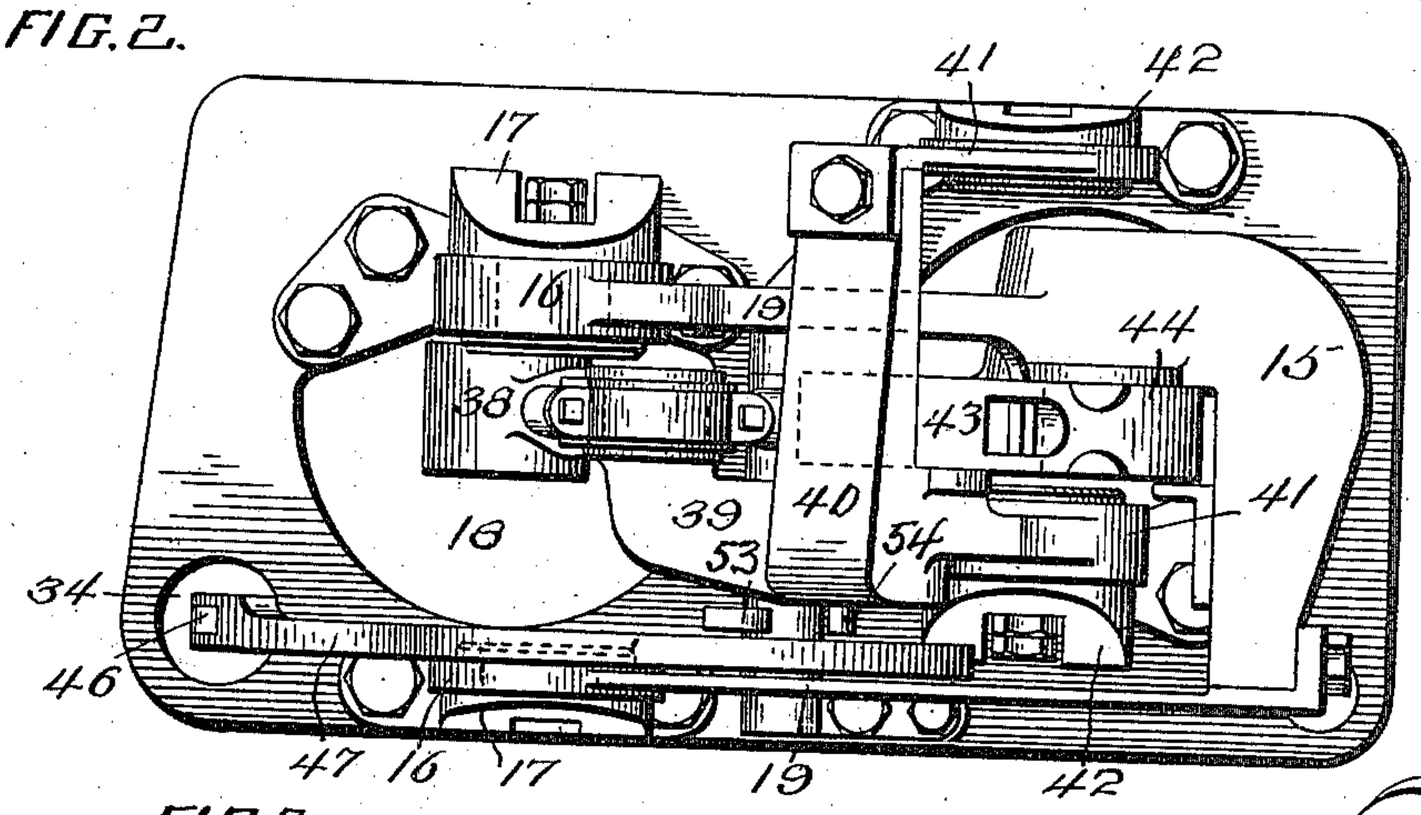



FIG. 3.

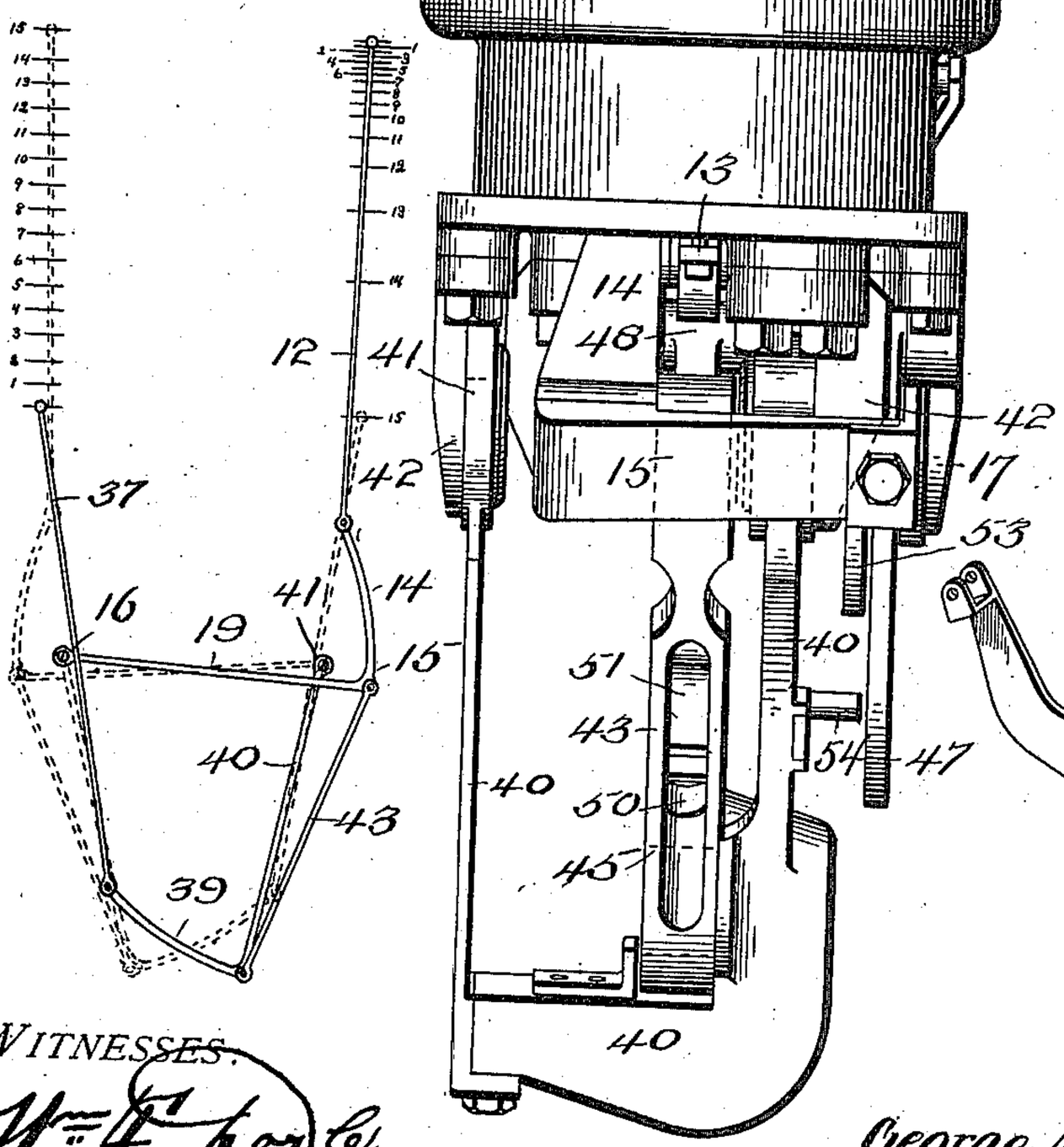



FIG. 5.

FIG. 6.

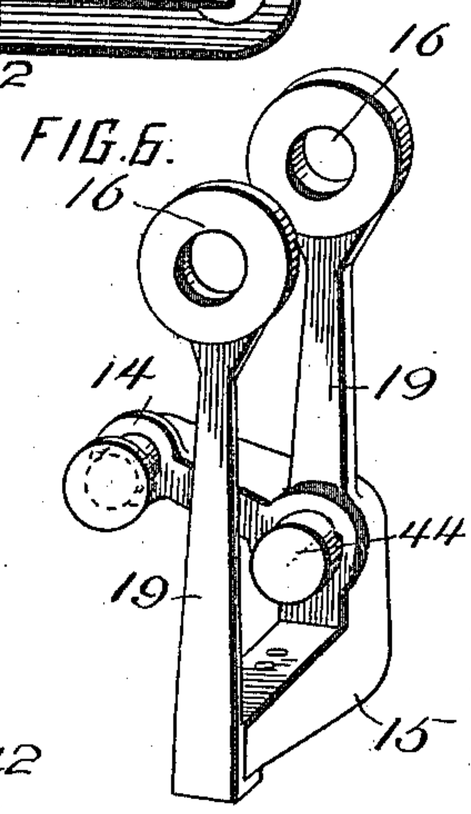
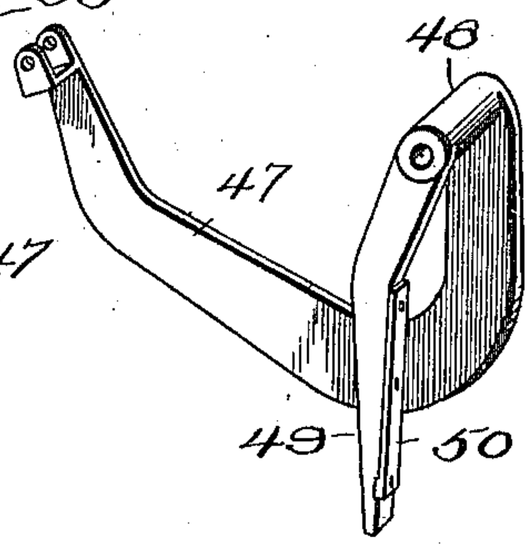



FIG. 4




WITNESSES.

W. F. Hoffer

Alfred T. Gage

INVENTOR

George McKerahan.

BY

E. B. Stocking

Attorney

# UNITED STATES PATENT OFFICE.

GEORGE McKERAHAN, OF ALTOONA, PENNSYLVANIA.

## AIR-PUMP.

963,923. Specification of Letters Patent. Patented July 12, 1910.

Application filed February 23, 1910. Serial No. 545,348.

*To all whom it may concern:*

Be it known that I, GEORGE McKERAHAN, a citizen of the United States, residing at Altoona, county of Blair, State of Pennsylvania, have invented certain new and useful Improvements in Air-Pumps, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an air pump and particularly to a structure embodying the use of steam and air cylinders.

The invention has for an object to provide a novel and improved construction of air pump in which the crank arm connection between the steam and air cylinders is adapted to have a changing leverage by which the excess of power at the beginning of the stroke of the air piston is reserved and applied toward the close of such stroke when a greater pressure is necessary owing to the compression of air in this cylinder.

The invention also presents a novel and improved construction of returning lever for restoring the parts to initial position when the exhaust valve of the steam cylinder is opened.

Other and further objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawings—Figure 1 is a vertical section through the return, air and steam cylinders; Fig. 2 is a bottom plan of the pump; Fig. 3 is a detail end elevation thereof; Fig. 4 is a detail perspective of the lever connection from the return cylinder; Fig. 5 is a diagram illustrating the increasing pressure upon the air piston; and Fig. 6 is a detail perspective of one of the crank connections between the steam and air pistons.

Like numerals of reference refer to like parts in the several figures of the drawings.

The numeral 10 designates the steam or other power cylinder which is provided with a piston 11 from which a piston rod 12 extends and is provided at its outer end with a bearing box 13 in which an arm 14 from the transmitting lever 15 is pivotally mounted. This lever being also pivoted at 16 in the lugs 17 at opposite sides of the air cylinder 18. For this purpose, the lever 15 is formed U-shaped and the arms 19 thereof mounted at the pivots 16. The steam or power cylinder is provided with an inlet and exhaust valve 20 from which a lever arm 21 extends and is connected by a rod 22 with an actuating lever 23 pivoted at 24 as shown by dotted lines in Fig. 1, and provided at its opposite ends with pins or projections 25 and 26 extending through apertures 27 and 28 respectively, in the steam and air cylinders so as to be engaged and moved by the pistons therein. The air or compression cylinder is provided with a piston 29 and a valve inlet opening 30 and the discharge therefrom passes through a valve connection 31 to an air jacket 32 surrounding the steam cylinder from which the compressed air is discharged through the pipe 33. As the air under compression is raised to a high temperature, it prevents condensation of the steam in its cylinder. A suction or return cylinder 34 is provided and is in constant communication with the steam pressure through a port 35 so that the piston 36 therein is maintained under tension in its inward movement during the travel of the other parts.

The air piston 29 is provided with a piston rod 37 having at its outer end a bearing box 38 in which an arm 39 of the crank lever 40 is mounted. This lever 40 is pivotally mounted at 41 upon bearings 42 at opposite sides of the steam cylinder 10. The lever 40 is U-shaped similar to the lever 15 and one arm thereof passes between the arms of the lever 15. The levers 15 and 40 are connected by a link 43 pivoted at 44 upon the lever 15 and at 45 upon the lever 40 and adapted to properly transmit motion from one lever to the other in their movement.

The steam cylinder and valve shown are of a single acting type and for the purpose of restoring the parts to their initial position, the returning piston 36 is connected by a rod 46 with a lever 47 which is pivotally mounted upon a fixed part at 48 and provided with an angularly disposed arm 49 having a wear plate 50 upon one face thereof as shown in Fig. 4. This plate is adapted to engage a block 51 pivoted at 52 upon the link 43 and thus transmit motion through the link to restore the steam piston when its cylinder exhaust is open and also return the air piston for its suction stroke. The lever 23 controlling the steam valve is provided at its pivot 24 with an actuating arm 53 which is extended to contact with the striker arm 54 of the lever 40 so as to

be actuated thereby in the movement of the parts to insure a positive operation of this valve for cutting off steam at any desired point of the stroke.

In the operation of the invention, when steam or other fluid pressure is admitted to the power cylinder, the piston thereof is forced outwardly and through the lever connections the piston of the compression cylinder travels inward, compressing the air or other fluid which is forced through the valve connection into the air jacket surrounding the power cylinder. When this air is compressed to a high degree, it is raised to such a temperature as will prevent the condensation of the steam in the power cylinder and have an active regenerating effect thereon, especially during expansion. During this action, the returning piston is forced inward against the steam pressure, while, when the exhaust from the power cylinder is opened, the steam pressure in the return cylinder forces its piston outwardly to restore the parts to the initial position shown in Fig. 1. The inlet and exhaust from the power cylinder is positively controlled both by the pins projecting into the path of their pistons and also the lever arm which engages one of the main piston levers. As shown in Fig. 5, the outward movement of the power piston produces an increasing leverage upon the compression piston during its inward travel which is important for the most effectual operation as the fluid, being compressed, requires greater pressure toward the end of the inward stroke of its piston. The construction shown provides for a compact arrangement of the main levers and their connecting link and also a favorable disposition of the pressure thereon, and the clearance necessary for the proper movement thereof. It will be obvious, however, that the particular construction of these parts may be varied to conform to different conditions of use, as the main object of the invention is to provide a changing leverage upon the compression piston by which the excess of power at the beginning of the stroke is reserved and used toward the close thereof. This permits the use of an expansion steam valve with an early cut-off, thus materially saving in the steam consumption.

Having described my invention and set forth its merits what I claim and desire to secure by Letters Patent is:

1. In an air pump, a power piston and cylinder, a compression piston and cylinder, and an independent lever for each piston having a fixed pivot and connected to the other lever to effect a movement of the compression piston in a direction opposite to the travel of the power piston and to secure an increasing leverage on the compression piston during its inward stroke.

2. In an air pump, a power piston and cylinder, a compression piston and cylinder, an independent lever for each piston having a fixed pivot and connected to the other lever to effect a movement of the compression piston in a direction opposite to the travel of the power piston and to secure an increasing leverage on the compression piston during its inward stroke, and a return piston and cylinder connected to one of said levers.

3. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever connection between said pistons, and an air jacket surrounding said power cylinder and connected to the discharge from said compression cylinder.

4. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever connected to each piston and to the other lever to transmit motion thereto, an inlet and exhaust valve for said power cylinder, and connections from said valve disposed in the path of travel of said pistons to be actuated thereby.

5. In an air pump, a power piston and cylinder, a lever pivotally connected to said power piston, a compression piston and cylinder, a lever pivotally connected to said compression piston, and a link pivotally connected to said levers to transmit motion from one to the other.

6. In an air pump, a power piston and cylinder, a lever pivotally connected to said power piston, a compression piston and cylinder, a lever pivotally connected to said compression piston, and a link pivoted to said levers below the connection thereto of the rods from said pistons.

7. In an air pump, a power piston and cylinder, a lever pivotally connected to said power piston, a compression piston and cylinder, a lever pivotally connected to said compression piston, a link pivotally connected to said levers to transmit motion from one to the other, and a return piston and cylinder connected to restore said levers to initial position.

8. In an air pump, a power piston and cylinder, a lever pivotally connected to said power piston, a compression piston and cylinder, a lever pivotally connected to said compression piston, a link pivotally connected to said levers to transmit motion from one to the other, a return piston and cylinder, and a lever connection therefrom adapted to engage said link.

9. In an air pump, a power piston and cylinder, a lever pivotally connected to said power piston, a compression piston and cylinder, a lever pivotally connected to said compression piston, a link pivotally connected to said levers to transmit motion from one to the other, a return piston and cylinder, a lever connection therefrom adapted to engage said link, inlet and ex-

haust means for said power cylinder, a lever for controlling said means, and an arm carried by said lever and disposed for contact with the power or compression lever.

10. In an air pump, the combination of parallel cylinders, of pistons therein having rods extended therefrom, and angular levers connected to each of said rods and to each other to transmit motion from one piston to the other.

11. In an air pump, the combination of parallel cylinders, of pistons therein having rods extended therefrom, and angular levers connected to said rods and to each other to transmit motion from one piston to the other, said levers being pivoted respectively, each at a point opposite the other lever's piston.

12. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever pivoted at one end of said power cylinder and connected to said compression piston, and a lever pivoted to the piston of said power cylinder and a connection to actuate said compression piston from the power cylinder.

13. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever pivoted at one end of said power cylinder and connected to said compression piston, a lever pivoted to the piston of said power cylinder and connected to actuate the first named lever, a return piston and cylinder, and a lever connected to said return piston and pivoted at one side of the compression piston and disposed to contact with the lever of the power piston to secure movement therefrom.

14. In an air pump, a power piston and cylinder, a compression piston and cylinder, oppositely disposed levers each pivoted at one end of one of said cylinders and pivotally connected with the piston of the adjacent cylinder, and a connection between said levers.

15. In an air pump, a power piston and cylinder, a compression piston and cylinder, oppositely disposed levers each pivoted at the end of one of said cylinders and pivotally connected with the piston of the adjacent cylinder, a connection between said levers, a return piston and cylinder, a lever connected thereto and provided with an operating arm, and means upon said first mentioned connection to engage the lever from said return cylinder.

16. In an air pump, a power piston and cylinder, a compression piston and cylinder, oppositely disposed levers each pivoted at the end of one of said cylinders and pivotally connected with the piston of the adjacent cylinder, a connection between said levers, a return piston and cylinder, a lever connected thereto and provided with an operating arm, and a slide bar pivoted upon said first mentioned connection and slidingly mounted upon an arm of the lever from the return cylinder.

17. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever connection between said pistons for simultaneous operation therewith, a valve mechanism connected to said power cylinder, an operating lever connected thereto, and an arm extended from said lever into the path of travel of said lever connection.

18. In an air pump, a power piston and cylinder, a compression piston and cylinder, means connecting the same for simultaneous operation, a valve mechanism connected to said power cylinder, an operating lever connected to said valve mechanism, an arm extended from said lever and connected for operation by said connecting means, and projections at each end of said operating lever extending into the path of travel of the power and compression pistons respectively.

19. In an air pump, a power cylinder and piston, a compression piston and cylinder each having rods extended therefrom, a lever pivoted at one end of the compression cylinder and having an angular arm connected to the piston of the power cylinder, a lever pivoted at one end of the power cylinder and having an arm connected with the compression piston, a connection between said levers, a return cylinder and piston, and a connection carried thereby and having a driving connection with the connection between said levers.

20. In an air pump, a power cylinder and piston, a compression piston and cylinder, each having rods extended therefrom, a lever pivoted at one end of the compression cylinder and having an angular arm connected to the piston of the power cylinder, a lever pivoted at one end of the power cylinder and having an arm connected with the compression piston, a connection between said levers, a return cylinder and piston, a lever arm from the connection of the return piston, and a pivoted block upon the lever connection for the driving and compression pistons adapted to travel upon said arm.

21. In an air pump, a power piston and cylinder, a compression piston and cylinder, a lever pivoted at one end of said power cylinder and connected to said compression piston, a lever pivoted at the similar end of said compression cylinder and connected to said power piston, and a connection between said levers to transmit motion from one to the other.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE McKERAHAN.

Witnesses:
JOSEPH C. McKERAHAN,
EDWARD SULLIVAN.