

W. R. BURROWS.  
APPARATUS FOR PRODUCING HIGH VACUUMS.  
APPLICATION FILED APR. 8, 1901.

Fig. 2.

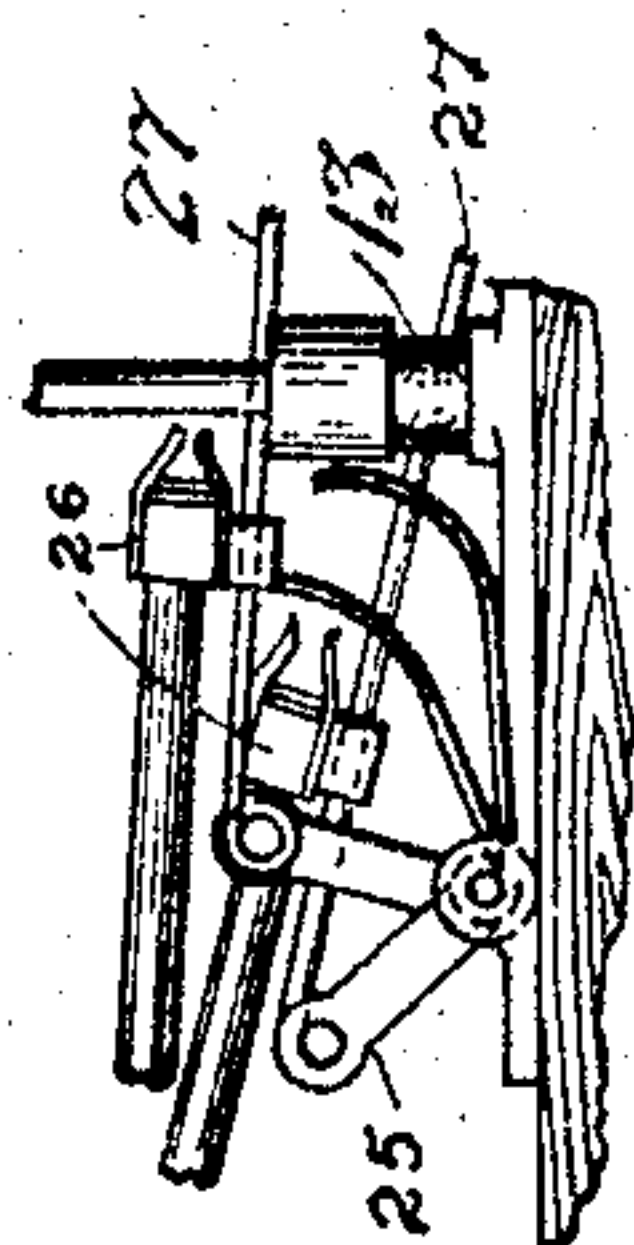


Fig. 3.

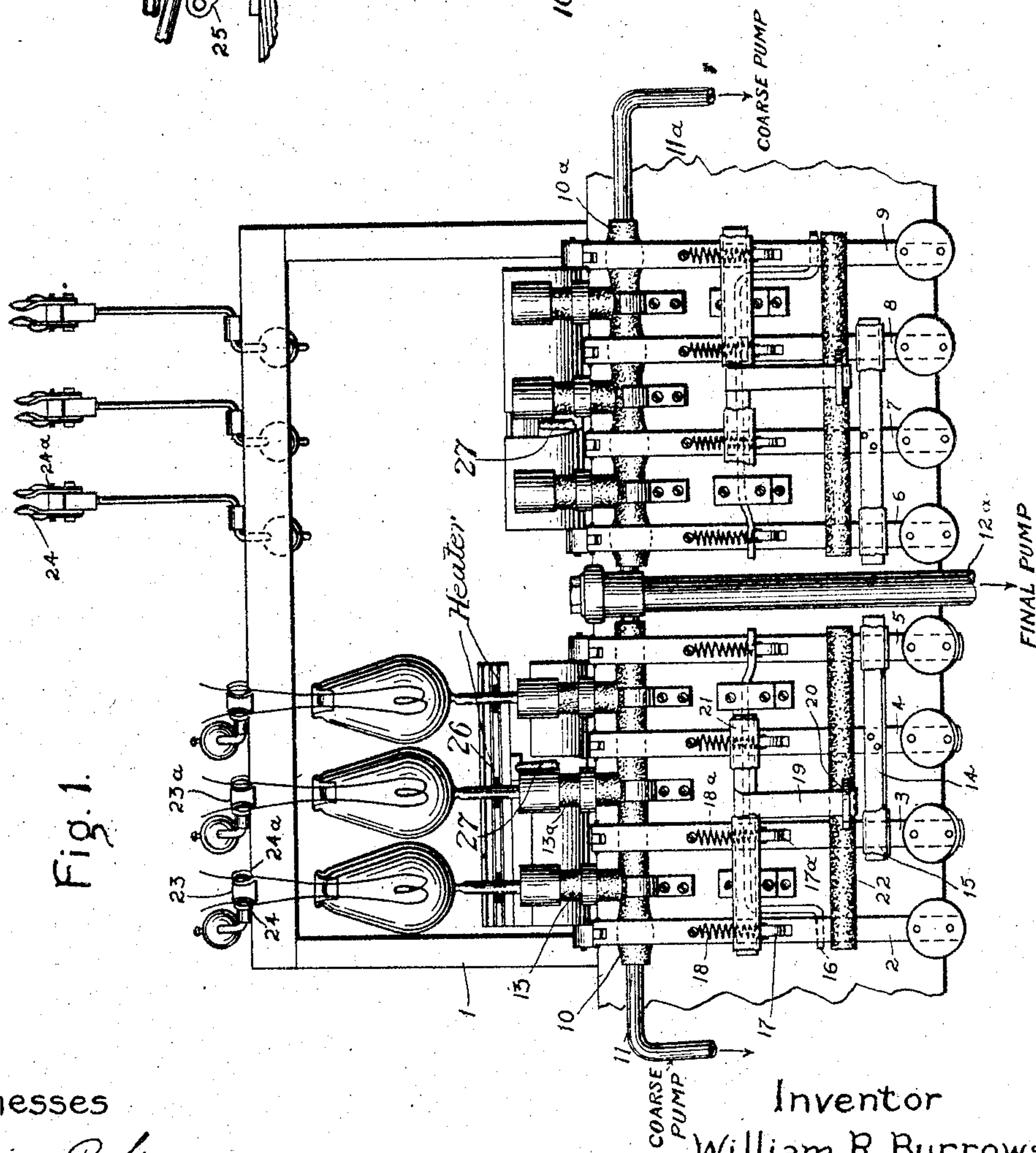
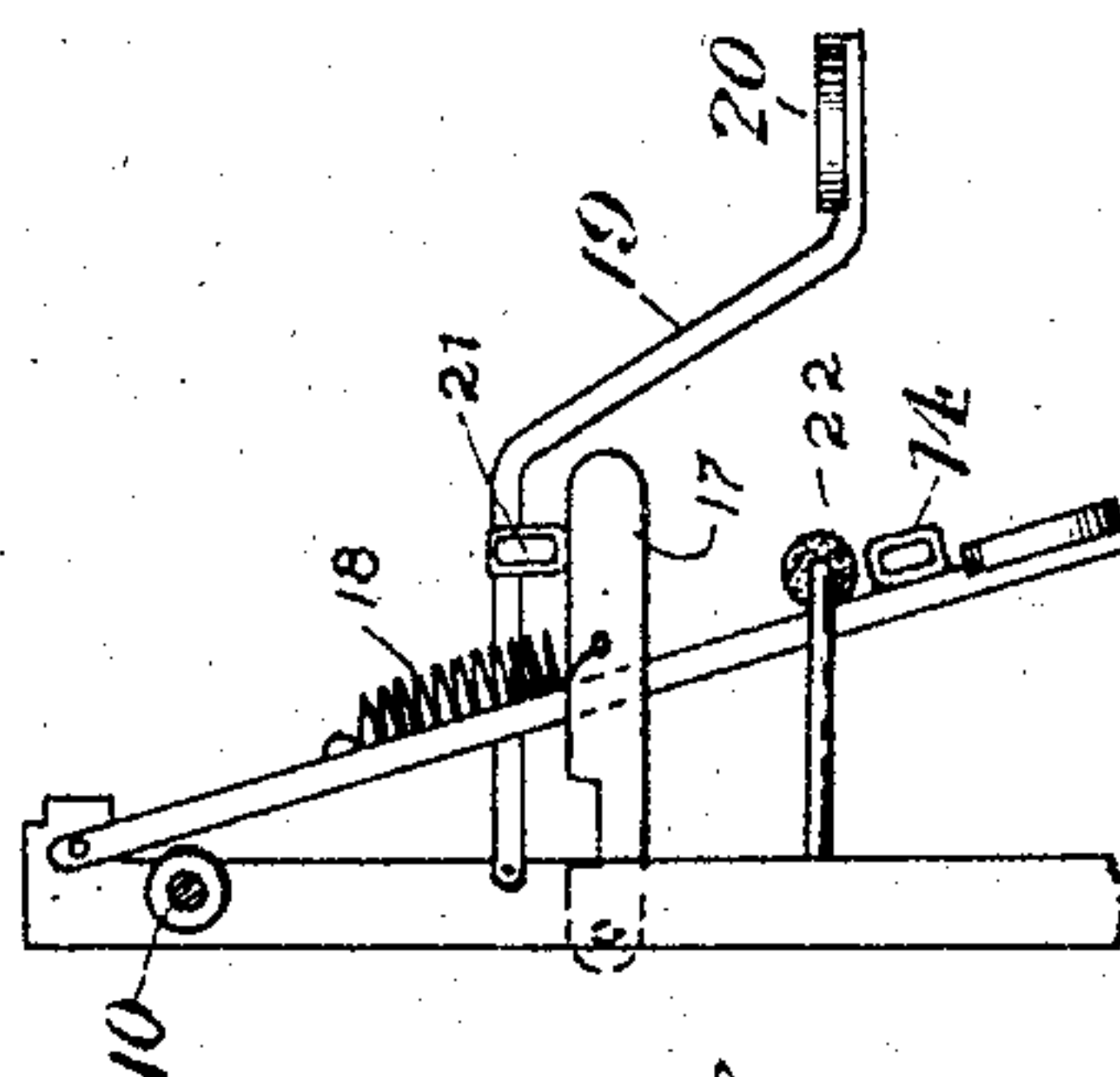


Fig. 1.

Witnesses

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by *Albert G. Davis*  
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# UNITED STATES PATENT OFFICE.

WILLIAM R. BURROWS, OF NEWARK, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## APPARATUS FOR PRODUCING HIGH VACUUMS.

SPECIFICATION forming part of Letters Patent No. 778,221, dated December 27, 1904.

Application filed April 8, 1901. Serial No. 54,861.

*To all whom it may concern:*

Be it known that I, WILLIAM R. BURROWS, a citizen of the United States, residing at Newark, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Apparatus for Producing High Vacua, of which the following is a specification.

This invention relates to improved apparatus for producing high vacua, and is designed to facilitate the operations connected with this procedure, to enable a larger output of exhausted vessels per operator to be produced than has been possible heretofore.

I provide a plurality of groups of lamps for management of each operator, either of which may be connected with either of two pumps, a preliminary pump by which the exhaustion is roughly effected and a final pump for carrying the exhaustion to a more perfect state, and provide cocks by which connection may be quickly made with either group. I provide also means for expediting the chemical exhaustion. I find that excellent results are produced by providing the apparatus with means for carrying on the exhaustion simultaneously in two groups of lamps, pump connections being provided by which either group may be instantly connected with the preliminary or final exhaust-pump.

The several features of novelty will be hereinafter more fully described and will be definitely indicated in the claims.

In the accompanying drawings, which illustrate an apparatus embodying my improvements, Figure 1 is a front view of an equipment designed to be cared for by a single operator. Fig. 2 is a detail of a heater to expedite chemical exhaustion, and Fig. 3 is a detail of a pinch-cock controlling pump connections.

1 represents a framework for supporting two groups of lamps, the exhaustion and sealing off of which are to be conducted by a single operator. On the front part of the bench are a series of pivoted levers 2, 3, 4, 5, 6, 7, 8, and 9, adapted to act as pinch-cocks for compressing a piece of soft-rubber pipe 10 10<sup>a</sup>, the opposite ends of which connect with the preliminary pump by means of pipes 11 11<sup>a</sup> and

with the final pump, by which the vacuum is finished, by means of a pipe 12<sup>a</sup>. The rubber pipes 10 10<sup>a</sup> have each a plurality of lateral connections, as 13 13<sup>a</sup>, one for each lamp of the group to be exhausted, which may be provided, as usual, with an elastic yielding nozzle into which the tubulature of the lamp may be fitted. I have shown the groups as composed each of three lamps, one set only being shown mounted. I find by experience that a group of three is sufficient to occupy the operator's entire time. More than this, however, may be used, if desired. The tubulature of each lamp is inserted in one of the lateral connections 13 13<sup>a</sup>, an air-tight joint with the pump being thus established. The pinch-cocks are arranged so that they may be quickly operated in groups to save time. Cocks 3, 4, and 5 may be simultaneously depressed by operating a finger-piece on the lever 4, the other two levers being carried down by a cross-bar 14, extending across them, which may be cushioned by a band of leather, as indicated at 15. Similarly, levers 6, 7, and 8 may be simultaneously closed. The pinch-cock 2, which controls communication with the preliminary pump, operates when depressed a rod 16, which forms part of a crank-shaft to trip a latch below described, holding the lever 5, controlling communication with the finishing-pump. Each pinch-cock when depressed is held in that position against the retractile force of the compressed rubber pipe 10 by a latch 17 17<sup>a</sup>, &c., projecting through a slot in the lever which operates the pinch-cock and provided with a notch, as clearly seen in Fig. 3, which locks the lever in closed position, a helical spring 18 18<sup>a</sup>, &c., connecting each latch with its corresponding lever. Thus any lever when depressed is held in the closed position by the latch. Connection with the preliminary pump may be established for all of the lamps by means of a pivoted lever 19, provided with a finger-piece 20 and a cross-bar 21, which spans the three latches corresponding to levers 2, 3, and 4. A cushioned stop comprising a bent rod secured to the bench and having a cushion of rubber, as shown at 22, arrests the



levers when released. On a vertical frame supported on top of the bench are pivoted swinging clips, as 23 23<sup>a</sup>, &c., counter-weighted or otherwise mounted so as to normally gravitate upward from the front of the bench. Each of these clips is provided with two insulated springs 24 24<sup>a</sup>, forming the terminals of a circuit, by which the lamp-filament may be raised to incandescence or by which a high-potential charge may be introduced to test the vacuum.

The circuit connections have not been shown, as they are of common adoption in the art and are well understood by those familiar with the construction of incandescent lamps.

In connecting the bulbs to the pump after the moisture has been driven off in any suitable manner the tubulatures are inserted in the sockets 13 13<sup>a</sup>, &c., as shown in Fig. 1, and the pivoted clips are drawn out, and the wire leads to the filament connected between the jaws of the spring-clips, the counter-weight giving a light tension on the leads. While one group of lamps is being finished another group is placed in the second group of sockets and connected up with the pumps. In front of the bench in convenient reach of the operator is a handle, (shown broken away at 27,) one for each group of lamps, by which a gas-burner containing three jets for each group of lamps may be drawn forward to heat the tubulature of the lamps, thus applying heat to the chemical in the tubulature and facilitating a more perfect vacuum. Each group of gas-jets may be controlled as an entirety by the operating-handle and shifted forward or back at pleasure, the handle shifting a crank 25, by which gas is fed to the burners 26. This handle and crank may also be arranged to draw the burners from a position where they do not affect the tubulatures of the lamp to a position close behind them, so that the flames play directly on the tubulatures, and it may also lower a deflector, which when the burners are in the back position is interposed between them and the tubulatures. The burner may be of any approved construction for furnishing a Bunsen flame to be shifted in operative relation to the tubulatures of the lamp, as indicated on the left side of Fig. 1, the burners on the right side being in the back position and the deflectors raised. In Fig. 2 is shown an end view of the burners as they appear in Fig. 1, those for the left group being drawn up in proximity to the tubulatures, in which position the gas is turned on, and those for the right group being shown in the back position with the deflector raised and the supply of gas lowered. By this means after the lamp has been exhausted by the pumps the burners may be drawn forward to warm the tubulatures of the entire group and as quickly withdrawn when desired. With an organization of this sort an operator after

placing a group of lamps in the sockets opens the pinch-cock 2 and closes pinch-cock 5, assuming that the group on the left is being put in connection with the pump. This throws on the preliminary pump, and while the lamps are being exhausted the operator may finish the chemical exhaustion and seal off the adjacent group on the right.

The cycle of operations in exhausting and sealing off is as follows: Suppose the left-hand group be on the final pump. Cock 2 is closed, 3, 4, and 5 open. 6, 7, and 8 are closed, and 9 open. The operator puts lamps in the right-hand side of the exhausting apparatus, connecting the wires in the clips at the top. He opens cocks 7 and 8, thus putting the preliminary pump on the right-hand group. He seals off the left-hand group and closes cocks 3, 4, and 5. He closes cock 9, which opens 6 and puts the final pump on the right-hand group. 6, 7, and 8 are open and 9 closed, leaving the final pump on the right-hand group. He then puts lamps in the left-hand side, opens cocks 2, 3, and 4, and closes 6, 7, and 8. He then closes cock 2, which opens 5, putting the final pump on the left-hand group, after which a fresh cycle of operations starts, as above described.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. Means for producing high vacua, comprising a group of vessels to be exhausted and two pumps either of which may be connected to the whole group, means by which disconnecting one pump from the vessels connects the other to them, and means for separately cutting off the pump connection of each individual vessel close to the vessel itself.

2. Means for producing high vacua, comprising a preliminary and a final pump, pipes connecting the same with a plurality of groups of vessels to be exhausted, cocks controlling the connections of either group with either pump, and means for opening and closing the cocks in groups to establish quick pump communication.

3. Means for exhausting incandescent lamps, comprising a preliminary and a final pump, pipes connecting the same with a plurality of groups of lamps, cocks for the several individual lamps, latches for locking them in a definite position against the tension of a retractile agency, and means for latching and unlatching them in groups to permit rapid connection with the pumps.

4. Means for exhausting incandescent lamps or other vessels, comprising pump connections to a plurality of groups of sockets for the lamps, and movable heating devices arranged in groups to correspond to the lamps adapted to be shifted to or from the lamp-tubulatures.

5. Means for exhausting incandescent lamps, comprising pump connections to a plurality of groups of sockets for the lamps, ranges



of gas-jets corresponding to said groups, and means for shifting said ranges to and from the lamp-tubulatures.

6. Means for producing high vacua, comprising a group of vessels to be exhausted, two pumps either of which may be connected to the whole group, and means by which disconnecting one pump from the vessels connects the other to them.

10 7. Means for producing high vacua, comprising two pumps, pipes connecting the same with a plurality of vessels to be exhausted, cocks controlling the connection of the ves-

sels with either pump, means for separately cutting off the pump connection of each individual vessel close to the vessel itself, and means for opening and closing the cocks in groups to establish quick pump communication. 15

In witness whereof I have hereunto set my hand this 30th day of March, 1901. 20

WILLIAM R. BURROWS.

Witnesses:

S. N. WHITEHEAD,

JOHN E. MITCHELL, Jr.