T. WIEDEMANN & J. H. TEMPLIN.

METHOD OF PUMPING AIR OR OTHER FLUID.

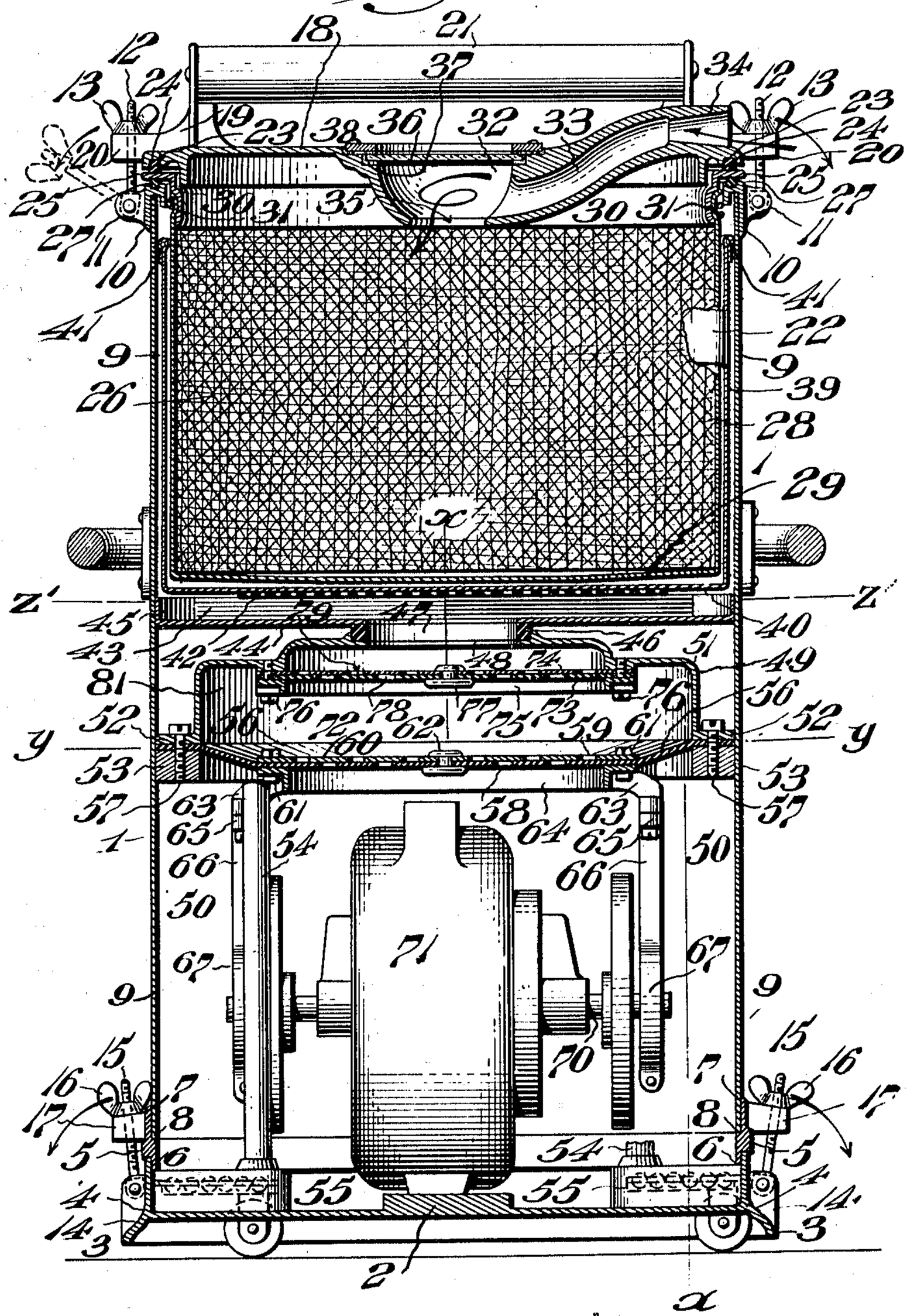
APPLICATION FILED SEPT. 9, 1909.

956,839.

Patented May 3, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

H. G. Dieterich

L. Douville.

INVENTORS

Theodore Wiedemann.

Joseph H. Templin.

BY Wiedersheim & Fairbanks

ATTORNEYS

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3 SHEETS—SHEET 2.

Fig. 2.

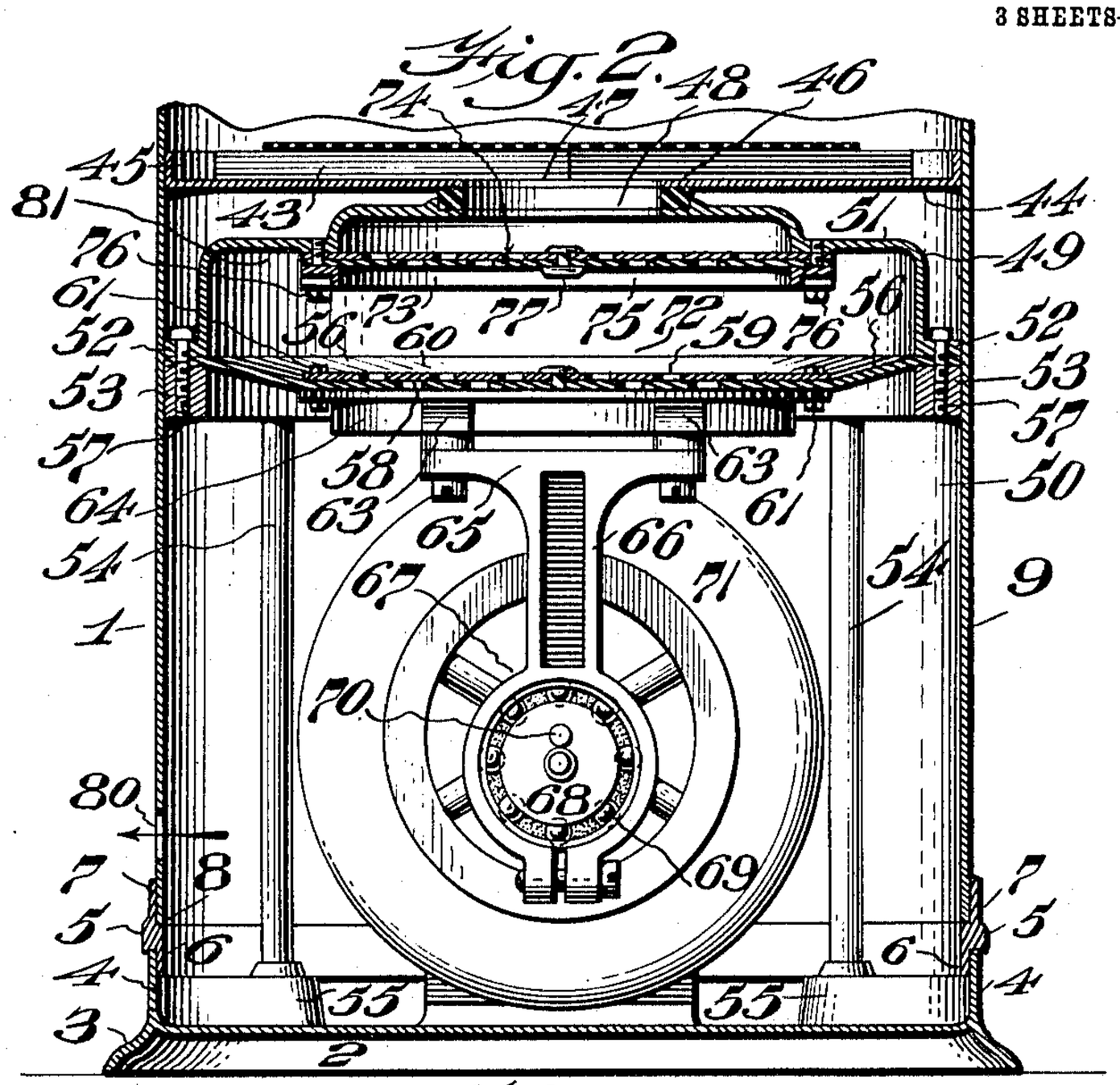

Fig. 3.

Fig. 4.

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L. Douville.

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BY

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3 SHEETS—SHEET 3.

Fig. 5.

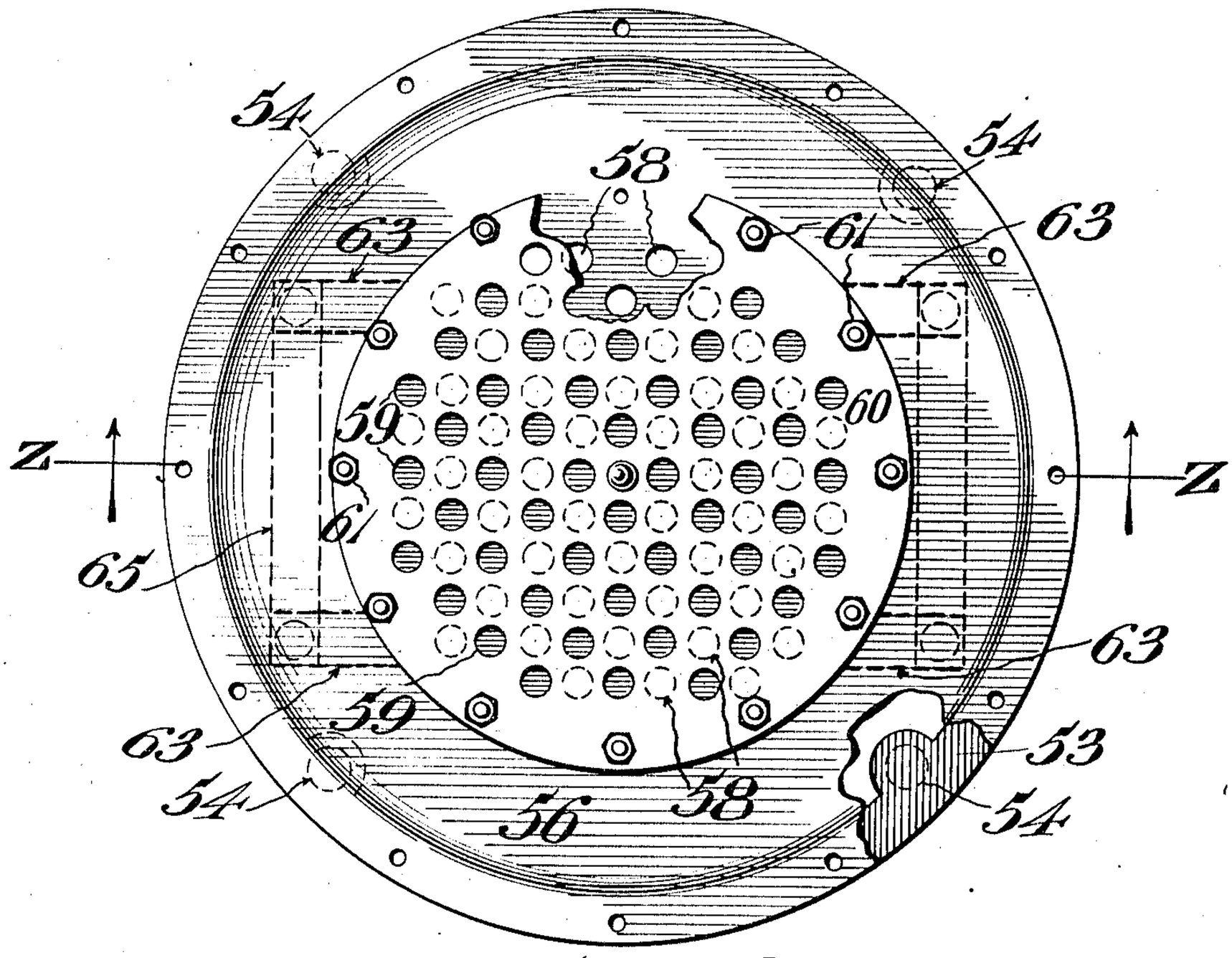

Fig. 6.

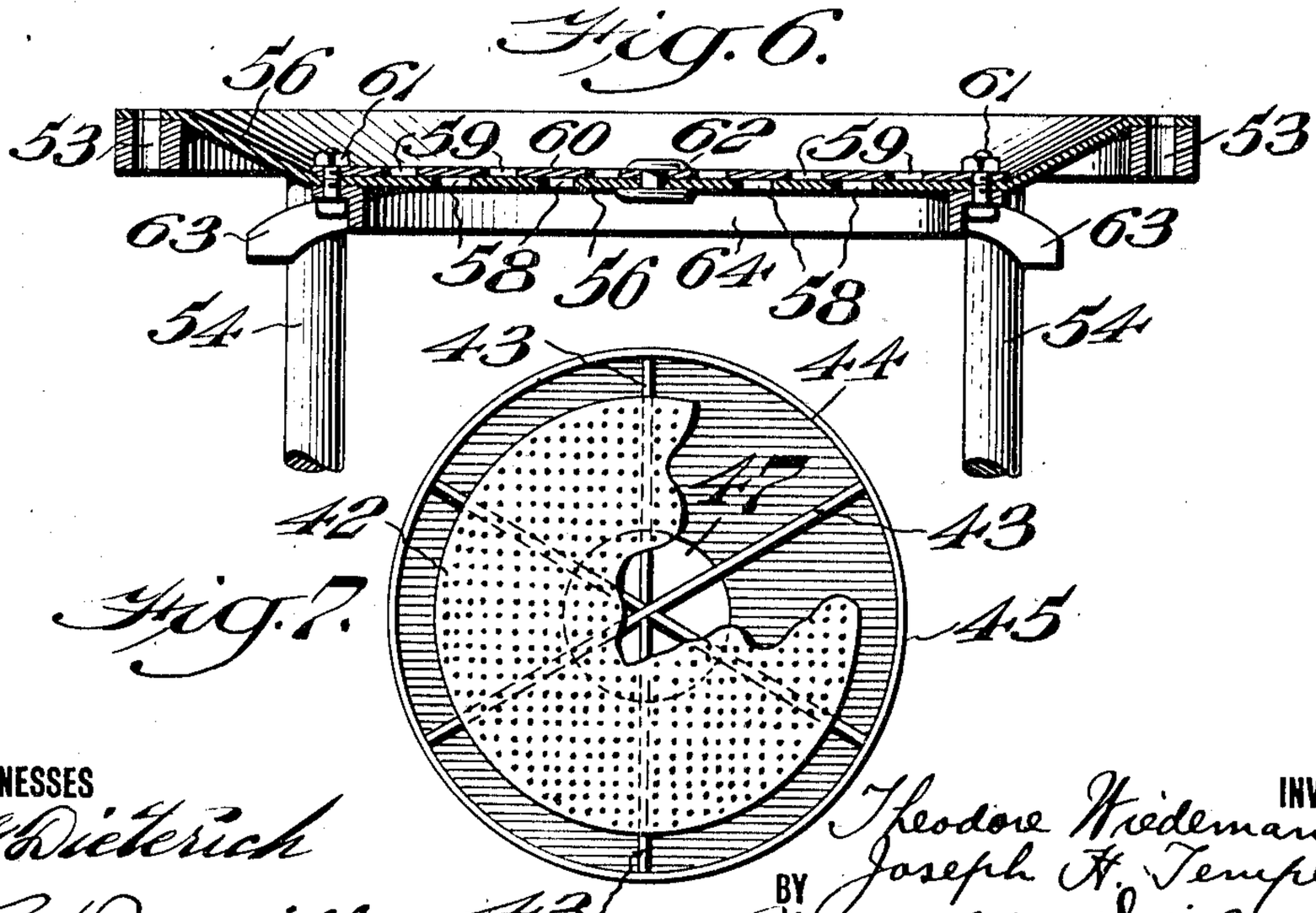

Fig. 7.

WITNESSES

H. G. Dieterich

L. Douville.

INVENTORS

Theodore Wiedemann.

Joseph H. Templin.

BY Wiedersheim & Fairbanks.

ATTORNEYS

UNITED STATES PATENT OFFICE.

THEODORE WIEDEMANN AND JOSEPH H. TEMPLIN, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO KELLER MANUFACTURING COMPANY, A CORPORATION OF DELAWARE.

METHOD OF PUMPING AIR OR OTHER FLUID.

956,839. Specification of Letters Patent. Patented May 3, 1910.

Application filed September 9, 1909. Serial No. 516,942.

To all whom it may concern:

Be it known that we, THEODORE WIEDEMANN and JOSEPH H. TEMPLIN, citizens of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Method of Pumping Air or other Fluid, of which the following is a specification.

Our present invention relates to a novel method of pumping air or other fluid which is especially adapted to be employed in conjunction with cleaning devices of the vacuum and other types, although as will be evident to those skilled in this art, it is not limited to use in conjunction with such devices but may be employed in connection with any suitable mechanism wherein a pumping mechanism is employed.

Our invention in its broad aspects consists of a novel method of pumping wherein the pump chamber is provided with an auxiliary or clearance chamber which, in carrying out our method, produces novel and very advantageous results and in order to show a construction in which our novel method can be advantageously carried out we have preferred to show the same in conjunction with a vacuum cleaning machine of the portable type which may be readily transported and which is well adapted for use in private houses and other places.

Our invention further consists of a novel method of pumping wherein an auxiliary chamber, which we have termed a clearance chamber, coöperates with the pumping chamber to automatically limit the maximum vacuum of the machine in order to prevent the machine from stalling when the vacuum becomes too high.

Our invention further consists of a novel method of pumping, wherein an auxiliary chamber coöperates with the pump to reduce the power required after a predetermined point in vacuum is reached, thereby decreasing the cost of power required to operate the pump, relieving the load on the motor, decreasing the tendency of the motor to heat, and permitting the continuous operation of the machine under all conditions arising in practice without stalling or overheating the motor, which is a very difficult thing to provide for in a small portable electric vacuum cleaner operating under varying conditions of load, since the suction nozzle communicating with the pump inlet is sometimes entirely closed, while at other times it is entirely open. By the employment of an auxiliary or clearance chamber coöperating with the pump, we are enabled to construct a portable vacuum cleaner which is readily attachable to an ordinary lamp socket and which will, when in operation, come within the limit in consumption of current as required by the insurance underwriters. If provision were not made for decreasing the consumption of electric current when the point of maximum vacuum is reached the consumption of electric current would be increased to such an extent that the limit set by the insurance underwriters would be greatly exceeded and the wiring system of the building and the building itself would be greatly damaged.

Our invention further consists of a novel method of pumping wherein an auxiliary chamber is provided which coöperates with the pumping chamber so that the maximum vacuum is automatically limited without the employment of an auxiliary device of any kind, thus providing a simple, sure and inexpensive method of insuring continuous operation of the machine.

Our invention further consists of a novel method of pumping wherein an auxiliary chamber coöperating with the pumping chamber is provided, so that the maximum vacuum is automatically limited at a predetermined pressure in such a manner that the point of vacuum, as fixed and determined at the factory, cannot afterward be modified or changed by those inexperienced in the use of the machine, thereby avoiding the usual trouble incidental to the abuse and misuse of auxiliary devices.

Our invention further consists of a novel method of pumping, wherein an auxiliary chamber coöperates with the pumping chamber to provide means for automatically limiting the maximum vacuum at a predetermined pressure without the use of auxiliary devices, thereby enabling us to provide a pumping chamber which in itself is adjustable to varying and irregular loads owing to the elasticity of the air contained in the auxiliary chamber and coöperating with the pumping chamber without subjecting the machine to irregular strains. Furthermore at the point of maximum vacuum the load on the motor is relieved and the machine operates with less consumption of electricity

and with less liability of overheating and the machine will operate continuously under conditions in which the suction nozzle is closed at the point of maximum vacuum for minimum consumption of current and load while by the use of any auxiliary devices the operation of the machine at all times without such conditions would be at maximum consumption and maximum load.

Our invention further consists of a novel method of pumping, wherein fluid is drawn into a vacuum chamber of relatively large area, thence to an auxiliary chamber cooperating with the pump chamber, then to the pumping chamber, thence to a pressure chamber of relatively large area, and thence discharged to the atmosphere.

Our invention further consists of a novel method of pumping wherein an auxiliary chamber is provided either within the pump cylinder itself or connected thereto in any desired manner so as to coöperate therewith.

Our invention further consists of a novel method of pumping wherein a relatively large vacuum with restricted port area is maintained on one side of the pumping mechanism and a relatively large pressure area under restricted port area is maintained on the other side of the pumping mechanism.

In our prior pending application, filed May 3, 1909, Serial No. 493,724, we have described and broadly claimed one form of an apparatus wherein our novel method may be carried out, although as is evident, our method is not limited to use in conjunction with such a construction but may be carried out in various other types of pumping mechanism.

For the purpose of illustrating our method we have shown a construction conforming to that shown in our pending application, since the same gives marked advantages in practice and has gone into extensive use.

Figure 1 represents a vertical sectional view of one type of a vacuum pump wherein our novel method may be advantageously carried out. Fig. 2 represents a section on substantially the line Z′—Z′, Fig. 1, showing the pumping mechanism and one side of the actuating mechanism therefor. Fig. 3 represents a section through the pumping mechanism showing the position that the lower or discharge valvular elements assume and through the upper section of the lower diaphragm and its adjuncts. Fig. 4 represents a sectional view of the pumping mechanism showing the position that the upper section or inlet valvular elements assume during the upward movement of the lower diaphragm and its adjuncts. Fig. 5 represents a section on line *y*—*y*, of Fig. 1. Fig. 6 represents a section on line *z*—*z*, of Fig. 5. Fig. 7 represents, on a reduced scale, partly broken away, a section on line *z′*—*z′*, Fig. 1.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings: In order to clearly set forth our novel method we will first describe in detail the construction shown in the drawing and then the manner in which our method is carried out.

1 designates a novel construction of a vacuum cleaner apparatus, the same comprising the base portion 2, the latter having the downwardly projecting or flaring flange 3 and the upwardly extending flange 4, upon which latter rests the top ring 5, the latter having the downwardly projecting portion 6 and the upper projecting member 7, which latter is provided with the shoulder 8 upon which rests the outer wall or casing 9, which latter in the present instance is preferably round or cylindrical.

10 designates a ring secured to the upper portion of the casing, said ring being provided with the slotted lugs 11 having the bolts 12 pivoted therein, the upper ends of said bolts being preferably apertured and provided with thumb nuts 13, it being understood that the rings 5 and 10 are in practice secured fast on the shell or casing 9 so as to be removed in unison therewith.

14 designates slotted lugs or ears secured in the present instance to the lower portion of the base or bed member 2, said lugs or ears being arranged preferably diagonally opposite each other and having pivoted therein the bolts 15, whose upper ends are threaded and provided with the thumb nuts 16, said bolts being adapted to pass through the slotted ears 17 which are preferably locked on the ring 5 so that by manipulating the thumb nut 16 the bolt 15 can be readily engaged with or disengaged from the lugs 17, it being apparent that by the employment of such fastening devices at the upper and lower portions of the casing the latter can be readily disconnected from its base according to requirements, while the upper portion of the casing can be readily disconnected from the top or cover 18, as is evident, the latter being provided with the angular brackets which terminate in the slotted ears 20 which are adapted for the reception of the bolts 12.

21 designates a handle which has its extremities preferably secured to the upwardly extending parts of the brackets 19, said handle being preferably of sufficient length so that when it is desired to transport the apparatus from one apartment or room to another the handle can be readily grasped by two people if necessary. In order that the upper compartment which we term the vacuum chamber or reservoir 22 may be made air and dust tight we place in the under side of the cover 18 a groove 23 in which is located an annular ring, packing or gasket 24, the latter being adapted to rest upon the

top of the flange 25 of the inner dust bag 26, the under side of said flange resting upon the annular ring, packing or gasket 27 which is mounted in a recess in the upper portion of the ring 10, whereupon it will be seen that when the thumb nuts 13 are tightened the flange 25 will be tightly held between said packing rings 24 and 27. The manner of removably mounting the cover 18 on the flange 25 of the inner dust bag and the top of the casing 9 is apparent from Fig. 1.

The inner dust bag 26 is constructed of any suitable fabric having sides 28, as indicated, and the bottom portions 29, the upper extremity of said sides 28 being secured to the annular portion 30 by means of the wire or other equivalent fastening devices 31.

The hose, to which the suction nozzle is secured, enters the machine through the conduit 33 for the dust laden air, which has its inlet opening 34 suitably adapted for the reception of one end of the suction hose, the current of dust-laden air passing from the passage 33 into the bowl or depression 32 in which the direction of the current of air is changed and which has an opening 35 therein through which the dust-laden current of air is drawn into contact with the inner bag or separator 26.

36 designates a plate of transparent material which is seated within the recess 37 and held in position by the ring or equivalent fastening device 38, the current of dust-laden air after passing through the outlet 35 and into the filtering device 36, whose construction and manner of removal has already been described, passing thence through the outer filtering bag 39 which is composed of sides and the bottom portion 40, the upper sides of said outer bags being connected to or reinforced by the ring 41, which has frictional engagement with the casing.

42 designates a perforated plate preferably of somewhat less diameter than the casing 9, said plate being mounted above or supported on the wings 43, the latter being contained in or resting upon the pan formed by the plate 44 and the upwardly extending flange 45, said plate 44 resting upon the ring or packing 46.

47 designates an opening in the plate 44 which communicates with the opening 48 leading to the pumping apparatus proper 49, it being noted that the latter is located between the vacuum reservoir 22 and what we term the pressure chamber 50.

The pumping apparatus 49 comprises a top plate 51 which terminates in the flanges 52 which rest upon the frame 53, which latter is supported in any suitable manner, in the present instance upon the upper extremities of the posts 54, the lower extremities of the latter being supported upon the bosses 55 or their equivalents which may be located on or in proximity to the base of the apparatus.

56 designates a diaphragm which has its outer periphery secured between the flanges 53 and 52, it being apparent that the same bolts or fastening devices 57 which serve to hold the flanges 53 and 52 in juxtaposition also hold the outer periphery of the diaphragm 56 in proper position, as will be more clearly understood by reference to Figs. 3 and 4 and also Figs. 2, 5 and 6. The diaphragm 56 is provided with a series of ports or openings 58 therethrough, which are arranged in staggered order with respect to the ports or openings 59 of the plate or diaphragm 60, which latter is located above said diaphragm 56 and is held in position with respect thereto by means of the bolts or equivalent devices 61 and the inner or central fastening devices 62.

63 designates arms which are secured to the ring or frame 64, the latter being secured to the diaphragms 56 and 60 by means of the fastening devices 61 before described, said arms 63 being secured to the heads 65 of the connecting rods 66, which latter terminate in the eccentric strap 67, it being noted that said eccentric strap, connecting rod and head are preferably made integral or in one piece.

68 designates an eccentric, by means of which the eccentric strap and connecting rod are actuated, suitable ball bearings being located between said strap and eccentric, the latter being rotated by the shaft 70 which is actuated by the motor 71. In the present instance we preferably employ an electric motor, since the same is readily capable of being attached to electric light fixtures of the usual construction.

It will be noted that we employ two eccentric straps, connecting rods and their adjuncts, as will be apparent from Fig. 1, although it is evident that a single eccentric strap and connecting rod may be employed, if desired. It will also be seen that we have a direct connection between each eccentric and the diaphragm 56.

As seen most clearly in Figs. 1 to 4 inclusive, a pumping chamber 72 of suitable area is formed between the plate or member 51 and the diaphragm 56, such chamber extending nearly across the casing of the apparatus, the upper portion of the pumping mechanism being provided with the upper diaphragms 73 and 74, whose outer peripheries are held in position by means of the rings or frames 75 having the fastening devices 76 passing therethrough, the center portions of said diaphragms being held in position by means of the fastening device 77. The lower diaphragm 73 is provided with ports or perforations 78 which are arranged in staggered order with respect to the ports or peripheries 79 of the upper diaphragm as will be clearly apparent from the drawings. The pressure chamber 50 is pro-

vided with an exhaust port 80 preferably of restricted area, as will be understood by reference to Fig. 2, in order that the machine may be used for blowing air and in order that the exhaust air may be employed to cool the motor.

81 designates an auxiliary or clearance chamber shown in the drawings as forming a part of the pumping chamber, although in many cases arising in practice the auxiliary chamber 81 is entirely separate from but connected with the pumping chamber.

In the operation, the motor is connected by means of a suitable conductor with an ordinary electric light fixture or other source of electricity, whereby the shaft 70 is rotated and the connecting rods 66 are rapidly reciprocated.

When the parts assume the position seen in Fig. 4 it will be seen that as the connecting rods move outwardly the diaphragm 56 will be lowered and the diaphragm 73 will be drawn downwardly, thereby causing the dust-laden air entering the suction nozzle to pass through the hose and the inlet 34 thence through the conduit 33 into the bowl 32, in which the condition of dust-laden air may be observed owing to the provision of the transparent cover 36 therefor. The dust-laden air then passes into the vacuum reservoir 22 in which a substantially constant vacuum is at all times maintained, whereby the pressure on opposite sides of the filtering devices will be substantially constant so that the air will be drawn through at a comparatively slow speed and all of the dust, dirt and foreign material carried by the air will be separated therefrom and the air in its purified condition will pass through the openings 47 and 48 and thence through the ports 79 and 78 into the auxiliary or clearance chamber 81, which coöperates with the pump chamber 72, in the present instance shown as forming a part thereof, although in practice the auxiliary chamber 81 may be, if desired, entirely separate from the pumping chamber 72. As the connecting rods 54 move upwardly from the position seen in Fig. 4 into the position seen in Fig. 3, it will be seen that the diaphragm 56 will assume the position seen in Fig. 3 whereupon air passes from the pumping chamber 72 through the ports 60 and 58 into the pressure chamber 50 and thence through the exhaust port 80 to the atmosphere or a desired point of utilization.

In practice motors of the character employed in our construction run at a very rapid rate, approximately fifteen hundred to two thousand revolutions per minute, and in some cases in practice very much higher, from which it will be seen that the rapid reciprocations of the diaphragm 56 will, when the auxiliary chamber 80 is properly proportioned with respect to the pumping chamber 72, through the co-action of the valves, cause a current of dust-laden air to be drawn into the inlet 34 and that the direction of the current will be changed by its contact with the walls of the chamber 32, so that the condition of the dust-laden air can be readily observed through the transparent member 36, the dust-laden air being freed from its impurities by the filtering mechanism comprising, in the illustration shown, the inner and outer filtering bag, it being apparent that the latter may be readily removed when desired by the simple removal of the cover 18.

The motor and the pumping mechanism are readily accessible for inspection when desired by actuating the thumb nut 16, whereupon the casing together with the filtering mechanism may be bodily removed.

In practice the casing is preferably provided with side handles and rollers or casters in order to facilitate its ready removal from one place to another.

In carrying out our novel method of pumping, an equilibrium of pressure is maintained in the pump, since when the pump has reduced the vacuum in the vacuum chamber to the point of equilibrium the clearance or auxiliary chamber maintains such equilibrium owing to the fact that when the point is reached where the air in the suction chamber and the air in the pump attains the same vacuum and the point of equilibrium the valves of the pump cease to operate and the clearance or auxiliary chamber of the pump chamber maintains the equilibrium. This condition arises in practice when the load at the inlet port varies so that in our novel device when the point of maximum vacuum for which the machine is designed has been reached in the vacuum chamber, the auxiliary or clearance chamber of the pump will maintain an equilibrium of pressure so that the motor will be automatically released at the point of maximum vacuum and a less amount of current will be consumed, since the moving parts of the pumping mechanism reciprocate against an elastic air cushion, thereby eliminating the liability of the motor becoming overheated or the machine stopping, owing to the increase in the load at the pumping inlet or the suction nozzle connected therewith.

It will thus be seen that in our novel method owing to the manner in which the auxiliary or clearance chamber coöperates with the pumping chamber, the maximum vacuum of the machine is automatically limited.

It is further to be noted that in our novel method of pumping a considerable vacuum space is maintained on one side of the pumping mechanism and a considerable pressure space is employed on the opposite side of the pumping chamber and an auxiliary

chamber is provided communicating with the vacuum space and the pumping chamber.

It is further to be noted that in our novel method of pumping the dirt, dust and foreign material are separated from the air in a very complete and reliable manner by employing in the vacuum reservoir a filtering device so that the pressure on the opposite sides of the filter is substantially the same, thereby devising a method of pumping and filtering, wherein the air passes through the filter at a very slow rate of speed, so that all of the impurities carried by the air in the shape of dust and foreign material is removed therefrom in such a manner that it can be readily removed from the machine and the air in its purified condition discharged into the room or place wherein the machine is being operated or the exhaust air employed for blowing or other desired purposes.

It will now be clear to those skilled in this art that when the pump inlet 34 is entirely open and the motor and the pump are operating, that a predetermined vacuum will be maintained in the vacuum chamber. As soon, however, as the pumping inlet is partially or wholly closed, due to variation of load at the suction nozzle which is operatively connected with the pump inlet, the vacuum within the vacuum chamber will gradually increase to the point of maximum vacuum for which the machine is designed, but the vacuum will never increase beyond the point of predetermined maximum vacuum, owing to the provision of the auxiliary chamber 81, which coöperates with the pumping chamber. If the pump inlet is wholly closed, as the movable member of the pumping mechanism reaches the end of its outer stroke, a balance of pressure will be maintained in the vacuum chamber and the auxiliary chamber at the point of maximum vacuum, since the air within the auxiliary chamber will be stretched to the point of maximum vacuum and on the return stroke of the movable member of the pumping mechanism the air in the auxiliary chamber will be returned to atmospheric pressure so that the valve intermediate the vacuum chamber and the auxiliary chamber will remain closed and the vacuum within the vacuum chamber will remain the same. It will thus be seen that when the point of maximum vacuum is reached the movable member of the pumping mechanism simply moves rearwardly against an elastic air cushion and the valves of the pumping mechanism will not open, thereby enabling us to devise a construction wherein the motor is relieved of its load at the point of maximum vacuum, and wherein it is impossible to increase the vacuum in the vacuum chamber above the predetermined maximum vacuum of the machine.

By the employment of our novel method the motor cannot become overheated and since we employ a vacuum chamber of relatively large volume, when the motor is first started there is no chance of overheating the same, since the motor will be running at full speed before it reaches the point of maximum load.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. The method of producing and maintaining a vacuum which is variable when the load varies, which consists in exhausting air from a vacuum space by producing alternately higher and lower pressure in a given space, and in limiting the lowest pressure in said given space by the amount of space it contains.

2. The method of producing and maintaining a variable vacuum, which consists in exhausting air from the vacuum space by producing alternately higher and lower pressure within a given space, separating the impurities from the air in the vacuum space, and in limiting the lowest pressure in said given space by the amount of space which it contains.

3. The method of pumping from a vacuum space to a pressure space, which consists in exhausting air from the vacuum space by means of a member having a to and fro motion, discharging said air into a confined pressure space to which said member is immediately and freely exposed, and then utilizing the pressure in said pressure space to aid in imparting to said member its return movement.

4. The method of producing and maintaining a vacuum varying in accordance with the load at the inlet to the vacuum space, which consists in exhausting air from the vacuum space by producing alternately higher and lower pressure within a given space, and in limiting the lowest pressure in said given space by the amount of space which it contains, and thereby unload the motive power for the air exhausting element at a point of predetermined load.

THEODORE WIEDEMANN.
JOSEPH H. TEMPLIN.

Witnesses:
H. S. FAIRBANKS,
C. D. MCVAY.