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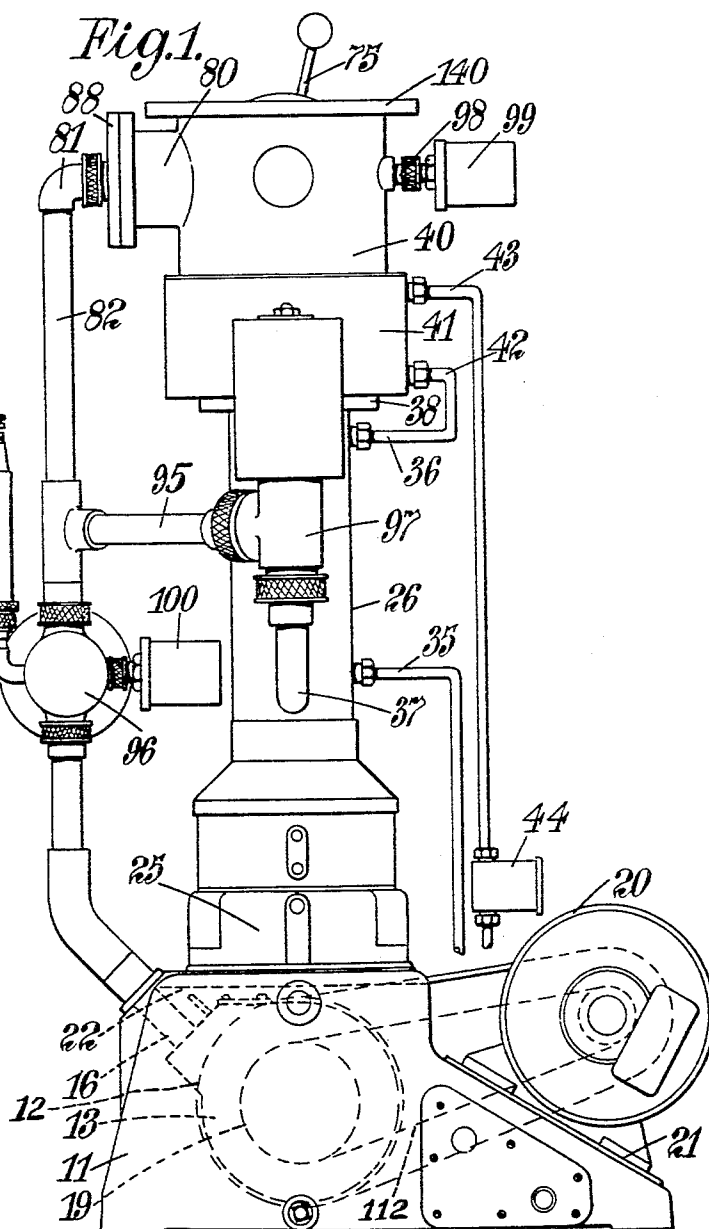
P. SADLER

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VACUUM PUMPING APPARATUS

Filed Dec. 10, 1956

4 Sheets-Sheet 1



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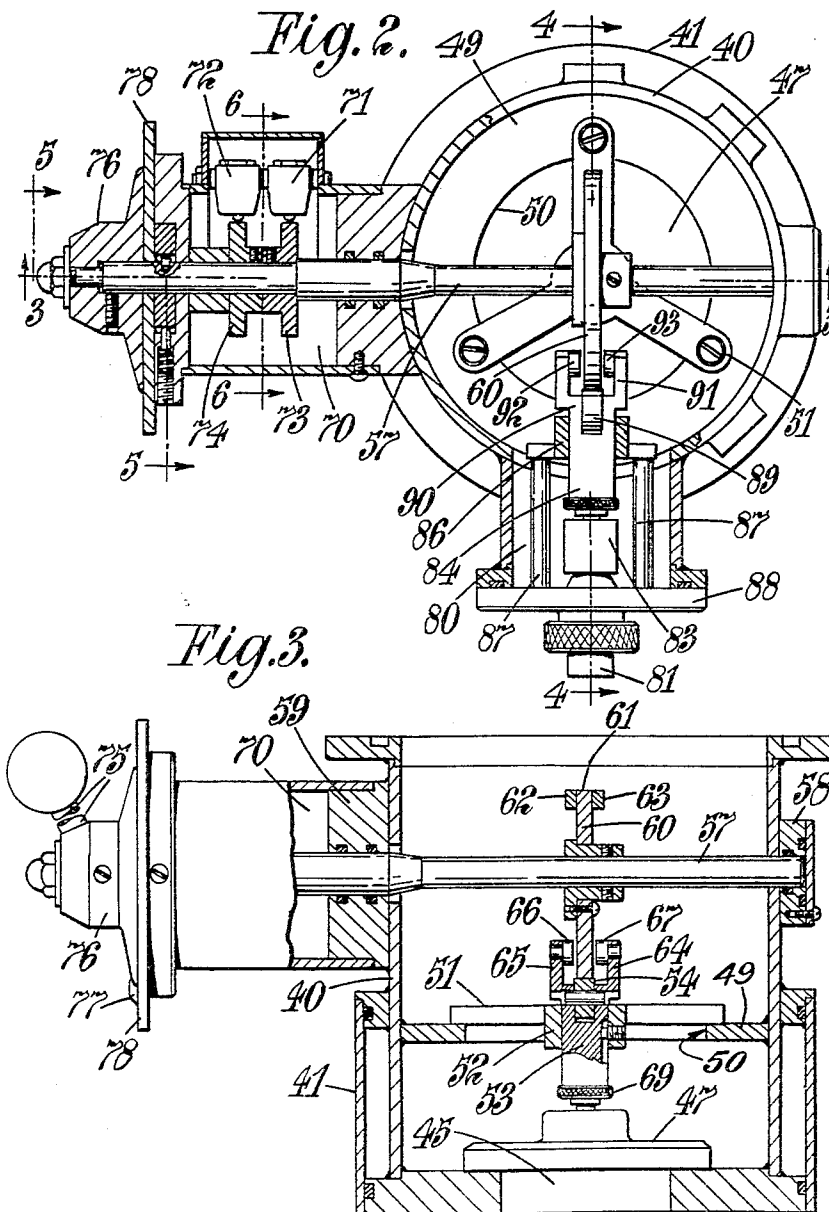
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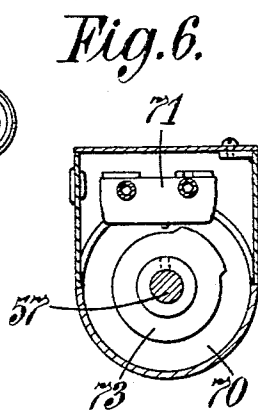
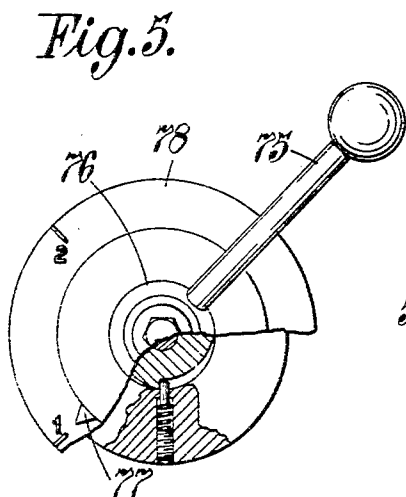
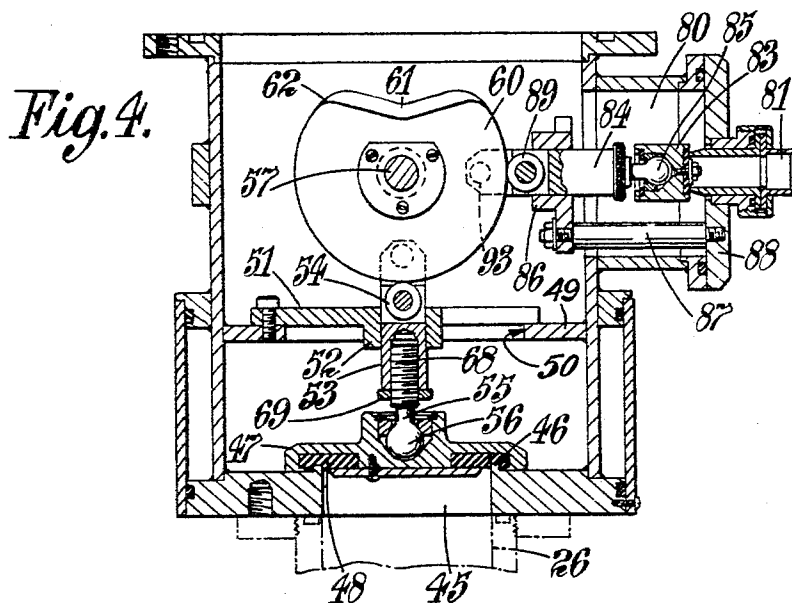
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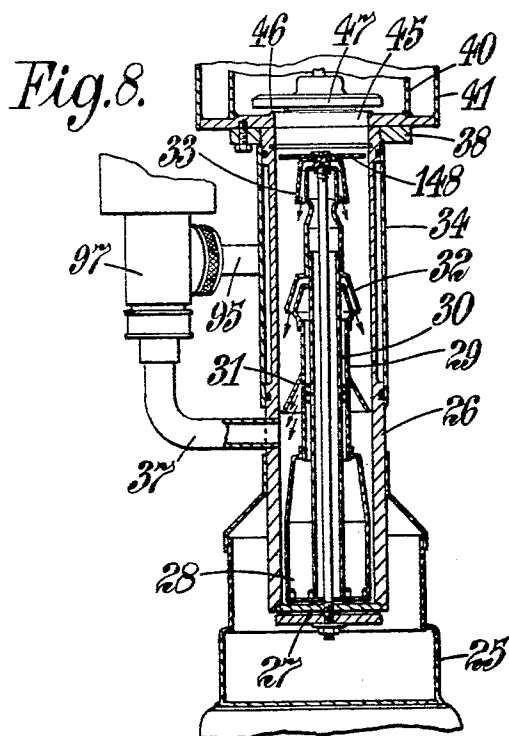
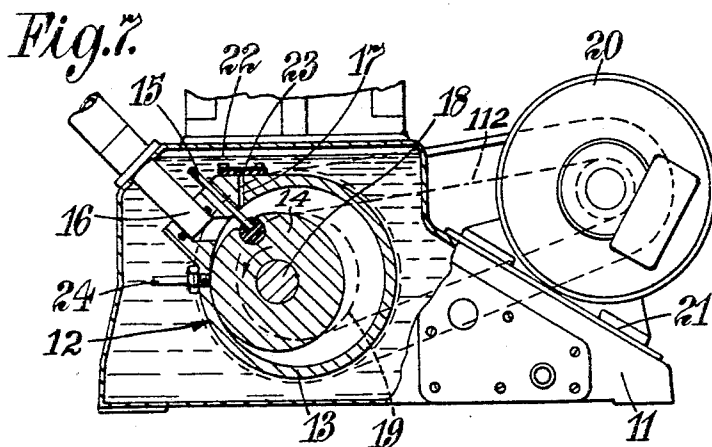
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2,935,243

VACUUM PUMPING APPARATUS

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Application December 10, 1956, Serial No. 627,479

Claims priority, application Great Britain December 9, 1955

4 Claims. (Cl. 230—45)

This invention comprises improvements in or relating to vacuum pumping apparatus.

It is well known to make vacuum pumping apparatus which comprises both a diffusion-pump and a mechanical pump to which the diffusion-pump delivers. These are normally connected up by pipework and hand-operated valves so that the mechanical suction-pump can be made to first evacuate the apparatus to which it is connected and thereafter the connections can be changed so that the diffusion-pump is brought into operation in series with the mechanical suction-pump to bring about complete evacuation. It is an object of the present invention to provide an apparatus of this kind in which the construction of the parts and the control of the operations is simplified.

The present invention comprises, in a vacuum pumping apparatus, the combination of a mechanical suction-pump, a diffusion-pump, an inlet valve to the diffusion-pump, a valve-operating member therefor, and valved by-pass means also operated by the valve-operating member to connect the mechanical suction-pump direct to the inlet when desired.

Preferably, the inlet valve to the diffusion-pump, the valve-operating member and a by-pass valve forming part of the by-pass means, are located in an inlet valve-casing attached to the inlet of the diffusion-pump and are actuated from the exterior by a single actuating-spindle having a sealed joint with the walls of the casing. The use of a single actuating spindle reduces risk of leakages as well as involving simplicity of operation.

In the construction hereinafter described by way of example, the mechanical suction-pump is located in an oil bath forming the base of the apparatus, the diffusion-pump is mounted directly upon the said base and the inlet valve casing is mounted upon the diffusion-pump, the whole constituting a self-supporting unit. In such a construction the upper part of the diffusion-pump and the lower part of the valve casing may have interconnected cooling jackets.

Preferably the mechanical suction pump is motor driven by an electric motor mounted directly upon the oil bath base of the unit. In this way, framing for the apparatus such as is usually employed can be totally obviated, the control and pipework is simplified and the efficiency is increased.

The following is a description by way of example of one construction in accordance with the invention.

In the accompanying drawings:

Figure 1 is a side elevation of the apparatus;

Figure 2 is a plan of the valve gear, with cover plate removed and partly in section;

Figure 3 is a vertical section upon the line 3—3 of Figure 2;

Figure 4 is a section upon the line 4—4 of Figure 2;

Figure 5 is a detail, partly in section upon the line 5—5 of Figure 2; and

Figure 6 is a section on line 6—6 of Figure 2.

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Figure 7 shows the interior of the base.

Figure 8 is a vertical section of the diffusion pump mounted on the base.

The apparatus comprises a light-alloy base 11 which forms an oil vessel and contains a mechanical suction pump 12 of the type indicated in Figure 7, comprising a circular casing 13 in which works a circular eccentrically mounted displacer 14 in contact with a sliding vane 15 on one side of which is an inlet 16 and on the other an outlet port 17. The displacer is operated by a crank pin 18 from a shaft which enters the casing at one side and which extends outside the casing and carries a pulley 19. The pulley is driven by a V-belt 112 from an electric motor 20 mounted on an inclined face 21 which forms one side of the base of the apparatus. The suction-pump works flooded in oil 22 and carries a delivery valve 23 which is beneath the oil surface. It has an adjustable oil inlet 24 on the suction side and the oil which finds its way into the pump is delivered with the air at the outlet valve, for example as described in my copending application No. 569,005, filed March 2, 1956.

The cast alloy base 11 has a flat top on which is bolted the base 25 of a diffusion-pump shown in Figure 8 in section and constructed as described in my copending application No. 627,449, filed December 10, 1956, now Patent No. 2,899,126. This pump comprises a stout cylindrical metal body 26 which is closed at the bottom by a removable plate and is supported so that its lower end is suspended within the heating chamber. An electric heating unit 27 is secured to the bottom of the pump body 26 within the heating chamber, and within the pump body there is an oil chamber 28 where oil is heated by the heating unit and from which rise two concentric vapour tubes 29, 30 carrying diffusion hoods, 31, 32, 33 one above the other. The upper part of the pump body is turned to a smaller diameter than the lower part so that the walls are thinner and over this reduced portion there is slid a tubular water jacket casing 34 having an outlet 35 at the bottom and an inlet 36 at the top (see Fig. 1). Below the water jacket, which extends as far as the lowermost of the three hoods, there is a lateral outlet 37 from the pump body.

The top of the pump body 26 is flanged at 38 and on to the flange there is bolted a control valve casing 40, the lower part of which is water jacketed as shown at 41, having an outlet 42 at the bottom which is connected to the inlet 36 of the diffusion-pump jacket and an inlet 43 which is connected to an automatically-operated water-flow relay 44. The outlet 35 of the diffusion-pump body jacket is connected to drain. The top of the control casing 40 has a flange 140 for bolting to the underside of any apparatus which is to be evacuated.

The control valve casing 40 contains in its lower portion where it is bolted on to the flange 38 of the diffusion-pump, a large circular port 45 (Figures 3, 4 and 8) equal in diameter to the interior of the diffusion-pump and surrounded by a circular upstanding seating 46. On the seating there seats a disc-valve 47 faced on its underside with a renewable facing 48 of synthetic rubber such as that sold under the trade name "Nygon." The disc-valve not only serves to control the inlet to the diffusion-pump, but when lifted acts as a baffle to hinder the creeping back into the evacuated space of mists of condensed oil vapours. The top of the diffusion-pump vapour tube assembly also carries a baffle disc 148 (Figure 8) and the baffle disc and the disc-valve, both being located in a water-jacketed portion of the pump, are effective in increasing the efficiency of the apparatus. Above the disc-valve by the upper end of the cooling jacket 41 of the valve casing there is a diaphragm 49 with a central

passage 50 for the gas which is being evacuated. This passage is spanned by a spider 51 (see Figure 2) in the centre of which is a guide 52 (Figures 3 and 4). The guide serves to guide a cylindrical cam-follower 53, which above the guide carries a cam-roller 54. The cam-follower extends below the guide and carries at its lower end the stem 55 of a ball member 56 which is held in a suitable socket on the back of the disc-valve 47. Thus, raising and lowering of the cam-follower will open and close the disc-valve.

Across the valve casing above the cam-follower there extends a valve-actuating spindle 57, which has a sealed bearing 58 on the casing at one side and passes out of the casing through a seal 59 on the other side. In the centre of the spindle is a valve-operating cam 60 which over the greater part of its periphery is circular and concentric with the spindle, but which at one side has a depression 61 bordered by two flanges 62, 63 projecting laterally from the cam surface on each side. The cam-follower 53 of the disc-valve 47 engages the underside of the cam surface and it carries two lateral arms 64, 65 (Figure 3) which extend upwardly one on each side of the valve-operating cam 60 and which carry cam-rollers 66, 67 projecting inwardly from the arms toward the side surfaces of the valve-operating cam 60. These cam-rollers are adapted to engage the inner faces of the flanges 62, 63 which border the depression 61 in the cam and when the spindle is rotated so that the depression comes to the underside of the cam spindle 57, the two cam-rollers on the arms engage the flanges and the disc-valve 47 is lifted off its seat. At all other times, constituting about three-quarters of the circumference of the cam the disc-valve 47 is held firmly closed. The ball stem on the valve-operating member is adjustable by screwed stem 68 and lock nut 69 to ensure this.

The actuating spindle 57, outside the valve body 40, after it has passed through the seal 59, enters a switch-operating chamber 70 which contains two micro switches 71, 72 and cams 73, 74 upon the spindle for actuating them. The spindle passes on through the switch-operating chamber to the exterior thereof where it carries an operating handle 75 having a hub 76 and a pointer 77 moving over an engraved disc 78 which shows the position of the internal parts.

At one side of the actuating spindle 57 there is a lateral extension 80 to the valve chamber on the end of which is secured an inlet 81 to a by-pass pipe 82. The by-pass pipe 82 is controlled by a by-pass disc-valve 83 (Figures 2 and 4) mounted on a ball stem 85 carried by a cam-follower 84 in a guide 86 in a similar way to the cam-follower 53 and guide 52 of the disc-valve 47 which controls the inlet to the diffusion pump. The guide 86 is supported on posts 87 carried by a flanged closure 88 for the extension 80. The cam-follower 84 similarly has a roller 89 to engage the periphery of the cam 60 and lateral arms 90—91 with inwardly directed cam-rollers 92, 93 to engage behind the flanges 62, 63 of the cam depression 61. Therefore, if the actuating spindle 57 is rotated through 90° from the point at which the inlet 45 to the diffusion-pump is open, the diffusion-pump inlet disc-valve 47 will be closed and the by-pass disc-valve 83 will be opened. If the spindle is rotated through a further 90°, both valves will be closed.

The by-pass pipe 82 from the control valve casing 40 is led downwardly towards the suction inlet 16 of the mechanical pump. On its way it is joined by a horizontal pipe 95 which is connected to the outlet 37 of the diffusion-pump and below this connection it is provided with a moisture trap 96 before it enters the cast base casting 11 of the apparatus and is connected to the inlet 16 of the suction-pump.

The outlet 37 from the diffusion-pump is connected to the by-pass pipe 82 through an electro-magnetically-operated backing-valve 97. There are also provided on the control valve casing 40 an air inlet 98 closed by an

electro-magnetically-operated air admission valve 99 and on the side of the trap 96 a further electro-magnetically-operated air admission valve 100. The electro-magnetically-operated valves 97, 99, 100 are of standard known type and are connected to the micro switches 71, 72 in the switch-operating chamber.

In operation, when the handle 75 of the actuating spindle 57 is moved to the position where both the by-pass valve 83 and the inlet disc-valve 47 are closed, the electro-magnetic air admission valves 99, 100 are opened and the pump can be started on no load. On moving the spindle 90° clockwise from the position of Figure 4 the point is reached at which the by-pass valve 83 is opened and the electro-magnetic air admission valves 99—100 are closed, and the mechanical suction-pump 13 in the base of the apparatus directly evacuates the apparatus above flange 140 to which the pump is connected. When an adequate vacuum has been reached to operate the diffusion-pump, by rotating the same operating handle 75 through a further quadrant of its movement the valve 83 of by-pass 82 can be closed and the diffusion-pump 26 is brought into use; in this position the valve 83 of the by-pass 82 is closed and the disc-valve 47 in the inlet 45 to the diffusion-pump is opened, the backing valve 97 of the diffusion-pump is also opened by the operation of one of the micro switches 71, 72. On rotating the handle 75 through a further quadrant of its movement all the valves are closed.

The electric motor 20 which works the suction pump is started by a separate switch, and the air-admittance valve 100 to the moisture trap 96 and the magnetic valve 97 between the diffusion-pump and the rotary pump are operated from the same switch as the motor. This protects the plant if the motor is stopped as it isolates the diffusion-pump by closing the backing valve 97 and at the same time by allowing the air admission valve 100 (opened when de-energized) to automatically admit air to the suction side of the rotary pump. The effect is to raise the pressure to atmospheric and prevent oil being sucked into the system from casing 11 if the motor 20 is stopped.

The water-flow relay 44 actuates contacts which are in series with the supply of the current heater 27 of the diffusion-pump. Should the water-flow through the diffusion-pump be at substantially any different rate from that for which the water-flow relay is set, the relay 44 separates such contacts and disconnects the electrical supply from the diffusion-pump heater 27.

I claim:

1. Vacuum pumping apparatus comprising in combination a base, a mechanical suction pump having an inlet and an outlet, and being located in an oil bath in the base, an electric motor for driving the mechanical suction pump and in operative connection therewith, a diffusion pump on the base said diffusion pump having an inlet and an outlet, a conduit between the diffusion pump outlet and mechanical pump inlet, a valve-casing above the diffusion pump having a valve casing inlet port to the diffusion pump and a valve casing by-pass port, a by-pass from the valve casing by-pass port to the mechanical pump inlet, inlet and by-pass valves for said valve casing ports, valve-operating means on said valve casing in operative connection with the inlet and by-pass valves for opening the inlet valve and the by-pass valve alternatively, an electromagnetically actuated backing valve in the conduit between the diffusion pump and mechanical pump, switch-means actuated by the valve-operating means on the valve casing, said switch means closing said backing valve when the by-pass valve is opened, an electro-magnetically actuated air admission valve to the conduit between the diffusion pump and mechanical pump, and a connection from said air admission valve to the circuit controlling the electric motor, the arrangement being such that if the motor is stopped the air-admission

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valve is opened, the whole constituting a self-supporting unit.

2. A vacuum pumping apparatus as claimed in claim 1, wherein the upper part of the diffusion pump and the lower part of the valve casing having interconnected cooling jackets.

3. Vacuum pumping apparatus comprising in combination a base, a mechanical suction pump located in an oil chamber in the base, a motor in operative connection with the mechanical suction pump for driving the same, a diffusion-pump secured to the base said diffusion pump having an inlet and an outlet, a valve casing on the inlet to the diffusion-pump having a diffusion inlet port communicating with the pump and a by-pass port at an angle thereto, an inlet lift-valve for the inlet port, a by-pass valve for the by-pass port, a rotatable valve spindle extending transversely to said valves and carrying a cam to operate the same, a by-pass extending from the by-pass port to the mechanical pump inlet, a conduit connecting the delivery of the diffusion pump to the by-pass, an electro-magnetically-actuated backing valve in said conduit, a switch to control said valve located on said valve-casing and a switch-operating member on said backing valve spindle to operate the switch.

4. Vacuum pumping apparatus as claimed in claim 3

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wherein an electromagnetically-operated air-inlet valve is located on the by-pass, a second switch is located in relation to the said valve spindle, the valve spindle carries a second switch-operating member to operate the same, the second switch being connected in a circuit including the air-inlet valve and a connection to the motor circuit, so that the air valve is opened whenever the valve spindle is placed in an initial position for starting the motor and whenever the supply to the motor fails.

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