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VACUUM SYSTEM APPARATUS

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FIG. 1.

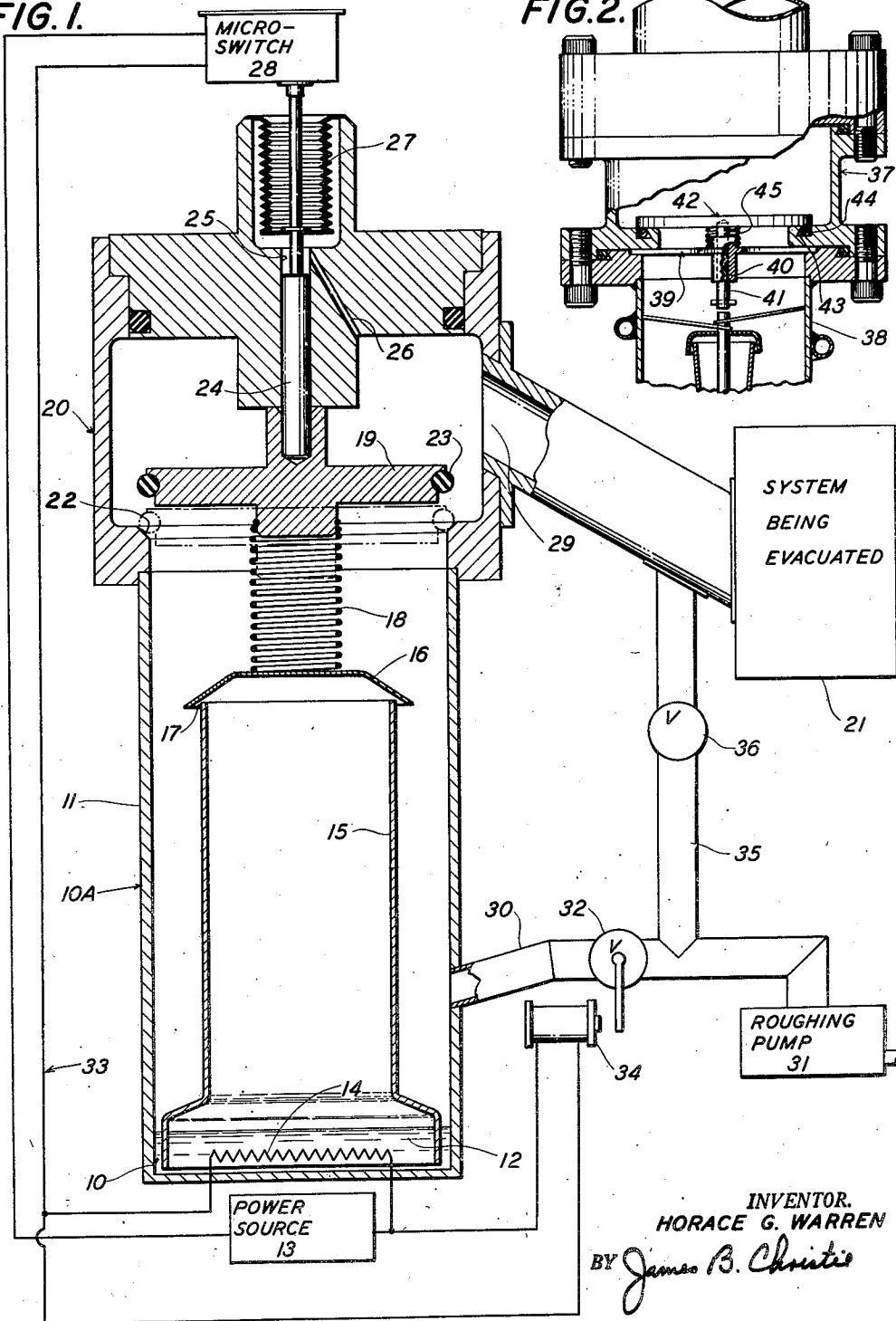
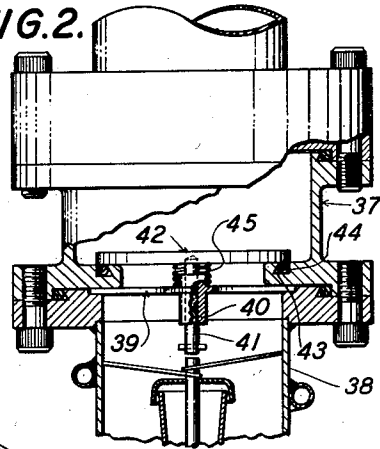


FIG. 2.



SYSTEM
BEING
EVACUATED

ROUGHING
PUMP
31

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VACUUM SYSTEM APPARATUS

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3 Claims. (Cl. 230—101)

This invention relates to diffusion pumps for producing high vacuum and in which baffles are used to prevent the migration of pump fluid vapor from a high pressure area to a low pressure area. More specifically, this invention relates to apparatus for increasing the utility of such baffles in diffusion pumps.

In the production of good vacua, diffusion pumps are generally used since they make possible high pumping speeds at pressures less than 0.001 mm. In general, a diffusion pump operates to evacuate a closed system as follows: The pump fluid, either oil or mercury, is evaporated rapidly from an electrically heated boiler located at one end of a closed casing. The pump fluid vapor streams up a chimney positioned coaxially within the casing, with one end submerged in the pump fluid in the boiler. A jet at the top of the chimney reverses the direction of flow of the vapor and directs it into the annular space between the casing and the chimney. Thus, the annular space between the casing and the chimney is filled with vapor molecules moving with high velocities in a direction countercurrent to that of the vapor molecules leaving the boiler. A conduit attached to the end of the casing away from the boiler connects the casing to the system being evacuated. The wall of the casing is cooled and as the vapor strikes the wall, it condenses and returns to the boiler. Gas molecules which are to be evacuated from the system enter the annular space from the conduit by diffusion and are forced along in the direction of flow of the pump vapor stream in the annular space.

Generally speaking, the nature of operation of a diffusion pump is such that another type of vacuum pump must be provided in series on the downstream side of the diffusion pump in order for it to operate. This additional pump is commonly referred to as a mechanical pump, and it is used to produce and maintain a sufficiently low pressure on the downstream side of the diffusion pump so that efficient operation of the diffusion pump is assured.

Although diffusion pumps are designed to direct the vapor stream of the pumping fluid away from the system being evacuated, molecules of the vaporized pump fluid tend to diffuse from the diffusion pump into the system being evacuated. In order to reduce this tendency for the pumping fluid vapor to diffuse out of the diffusion pump, a baffle or series of baffles is provided within the conduit connecting the diffusion pump casing to the system being evacuated. The baffles are rigidly mounted and serve no purpose other than to impede the diffusion of pump vapor out of the diffusion pump. In accordance with my invention, at least one of the baffles is movable, and serves not only to impede the diffusion of pump vapor into the system being evacuated, but also as a safety device to protect the diffusion pump.

As indicated above, for a diffusion pump to be operative, the pressure within the pump must first be reduced to a low value and the pump fluid must be heated to a relatively high temperature. If for any reason during the operation of the diffusion pump there should be a

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failure, such as a fracture of the system being evacuated, air would rush into the diffusion pump and mix with the boiling pump fluid. Practically all pumping fluids contain materials which are readily oxidized when exposed to air at the operating temperatures involved. Oxidation of the pumping fluid is undesirable because it brings about the loss of the pumping fluid which is often an expensive material, and it also contaminates the diffusion pump with oxidation products which interfere with future pump operation and require considerable work and expense to remove.

The baffles used at present in diffusion pumps do not provide any means for protecting the pump fluid from the oxidizing effects of a sudden inrush of air should a failure occur in the system being evacuated. My invention provides a movable baffle which protects the diffusion pump in the event of such a failure.

Broadly, my invention contemplates a diffusion pump having a casing, a conduit attached to the casing for connecting the casing to a system being evacuated, a boiler for vaporizing a pump fluid and a jetting means for forcing the vaporized pump fluid into the casing to entrain gaseous molecules migrating into the casing from the system through the conduit, a movable baffle disposed in the conduit transverse to the general direction of gas flow through the conduit, an annular seat for the baffle near the juncture of the conduit and the casing, and springing means for holding the baffle away from the seat when the differential pressure between the system being evacuated and the casing is relatively low, but which permits the baffle to move into engagement with the seat and seal the conduit from the casing when the differential pressure is relatively high, for example—upon fracture of the system being evacuated.

In the preferred form of my invention a switch is provided. This is actuated by movement of the baffle to turn off the heat to the boiler of the diffusion pump and thus prevent damage to the pump and its fluid. A switch actuated by the baffle movement may also be employed to control a valve in the system to bring about further isolation of the diffusion pump in the event of failure of the work.

The foregoing and other aspects of the invention will be clear in the light of the following detailed description, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a view taken partly in vertical section showing the preferred arrangement of the invention assembled for use with a vertical diffusion pump; and

Fig. 2 is another embodiment of the invention showing in partial vertical section a movable baffle mounted over a vertical diffusion pump.

Referring to Fig. 1, a boiler 10 of a vertical diffusion pump 10A is located at the bottom of a vertical casing 11 and contains a pump fluid 12. An electrical power supply 13 provides power for an electrical heater 14 which is used to boil the pump fluid. A chimney 15, with its lower end submerged in the pump fluid, is positioned coaxially within the casing. A top 16 on the upper end of the chimney forms a jet opening 17. A compression spring 18 is mounted on the top of the chimney and coaxially within the casing. A movable baffle 19 of circular cross-section rests on the spring and extends across the top of the casing. A conduit 20 attached to the top of the casing connects the casing to a system 21 to be evacuated. An annular seat 22 is provided in the conduit near its juncture with the casing. A gasket 23 is positioned around the periphery of the movable baffle and is adapted to fit in the seat. A guide shaft 24 mounted transverse to the baffle and on the opposite side of the baffle from the compression spring is adapted to slide in a recess 25 in the wall of the conduit. A degassing

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channel 26 connects the inner portion of the recess with the surface of the conduit wall to facilitate degassing the recess. The shaft is attached to a spring bellows 27 in the wall of the conduit which actuates a microswitch 23 positioned external to the conduit. The spring bellows is placed under a tension when the system is evacuated which balances the differential pressure produced across the bellows and thus permits easy movement of the bellows by the shaft when the baffle is moved. An opening 29 in the conduit leads to the system being evacuated. An exhaust tube 30 extends through the wall of the casing and connects the downstream side of the diffusion pump with a mechanical pump 31 through a control valve 32. An electrical control circuit 33 connects the microswitch with the power supply for the heater and with a relay 34 for sounding an alarm (not shown). A by-pass line 35 connects the roughing pump directly to the system being evacuated, by-passing the diffusion pump. A by-pass valve 36 in the by-pass line is ordinarily kept in a closed position and isolates the roughing pump from the system being evacuated.

The apparatus shown in Fig. 1 operates as follows: The conduit is attached to the system or work to be evacuated and initial pumping is started with the roughing pump. The entire system is originally at atmospheric pressure, but the roughing pump soon removes sufficient gas from the system being evacuated through the conduit, casing, and exhaust tube to reduce the pressure sufficiently within the diffusion pump to permit its efficient operation. It should be noted that the rate at which the roughing pump draws gas past the movable baffle is insufficient to overcome the compression spring and does not cause the baffle to move down and seal the conduit from the casing. On the attainment of a sufficiently low pressure within the diffusion pump, the electrical heater in the boiler is turned on. The pump fluid is vaporized and the vapor streams up the chimney where it is directed by the jet at the top of the chimney downward into the annular space between the chimney and the casing. The movable baffle above the jet reduces the tendency for the vapor to diffuse from the casing to the system being evacuated. Gas molecules diffuse from the system being evacuated into the annular space and are forced by the jet stream of pump fluid vapor down to the exhaust tube where they are removed by the roughing pump. The wall of the casing is cool so that the pump fluid condenses on the casing wall and flows back into the boiler. As in the case when the roughing pump was first turned on, the gas flow past the movable baffle is insufficient to overcome the spring and does not cause the baffle to move down and seal the conduit from the casing. If during the course of the evacuation of the work, say a cathode ray tube, the tube should happen to break, a relatively large amount of air will tend to rush into the conduit past the movable baffle and into the pump casing. If this were permitted, the air would come into intimate contact with the boiling pump fluid and spoil it by oxidation. However, this is prevented by the movable baffle because a sudden inrush of air such as that occurring from an implosion of the tube being evacuated, overcomes the spring and forces the movable baffle down to seal the conduit from the casing before an appreciable amount of air can find its way into the diffusion pump. The baffle is held tightly in sealing position as long as relatively large pressure differential exists between the conduit and the pump casing.

My invention also provides for the operation of the electrical switch when the baffle is moved into sealing position. One manner in which this is accomplished is shown in Fig. 1 where the guide shaft for the movable baffle is attached to the bellows mounted in the conduit wall. Movement of the guide shaft is transmitted by the bellows to the switch, which when operated, serves to turn off the power supply for the electrical heater and automatically sound an alarm or perform other operations. Thus, on the failure of the system being evacuated, the hot pump

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fluid is protected from oxidation and is automatically allowed to cool so that it can safely be exposed to air if necessary when the pumping operation is resumed after the system being evacuated has been repaired.

With the arrangement shown in Fig. 1, the diffusion pump can be placed back into operation following an implosion of the system being evacuated as follows: The damaged equipment, a cathode ray tube for example, is removed and new equipment is installed in the system to be evacuated. The valve in the exhaust tube is opened. The by-pass valve is opened and the roughing pump reduces the pressure in the system to be evacuated to a sufficiently low value that the compression spring is able to overcome the pressure differential between the conduit and the casing and raise the baffle from the sealing position to the open position. After the mechanical pump reduces the pressure in the system sufficiently to permit operation of the diffusion pump, the by-pass valve is closed, the valve in the exhaust tube is opened, the heater is turned on, the control valve is opened to permit evacuation of the system as before the implosion.

Similar results can be achieved with the arrangement shown in Fig. 2, in which one end of a conduit 37 is attached to the top of a diffusion pump casing 38. A spider 39 is mounted near the juncture of the casing and the conduit and extends across the casing. A guide hole 40 coaxial with the casing is provided in the center of the spider. A guide shaft 41 is adapted to move in the guide hole and is attached transversely to a movable baffle 42 mounted above the spider. An annular seat 43 is provided in the conduit near its juncture with the casing and a gasket 44 is adapted to fit within the seat. A compression spring 45 mounted between the spider and the baffle holds the baffle up off the gasket. The operation of this embodiment is the same as that described for the device shown in Fig. 1. As in the device shown in Fig. 1, means can be provided for actuating an electrical switch when the movable baffle is forced into sealing position.

Although the foregoing description deals with vertical diffusion pumps, it should be clear that my invention is equally applicable to any type of diffusion pump which employs baffles to prevent the migration of pump fluid vapor from a low pressure area to a high pressure area.

Similarly, the electric switch need not be mounted exterior to the conduit, but can also be mounted within the conduit, having vacuum-tight electrical leads extending through the conduit wall to provide for external electrical contact.

I claim:

1. A diffusion pump which includes an electrical heating element, a conduit for connecting the pump to a system from which gas is to be evacuated, a baffle movably supported in the conduit transversely to gas flow through the conduit, an annular seat for the baffle in the conduit, springing means engaging the baffle for holding the baffle away from the seat against a predetermined differential pressure between the system and the pump and permitting the baffle to move into sealing engagement with the seat and seal the conduit from the pump when the predetermined differential pressure is exceeded, an electric switch connected to the heating element, and means responsive to the movement of the baffle to the sealed position to operate the switch and inactivate the electrical heating element.

2. A diffusion pump which includes an electrical heating element, a conduit for connecting the pump to a system from which gas is to be evacuated, a baffle movably supported in the conduit transversely to gas flow through the conduit, an annular seat for the baffle in the conduit, springing means engaging the baffle for holding the baffle away from the seat against a predetermined differential pressure between the system and the pump and permitting the baffle to move into sealing engagement with the seat and seal the conduit from the pump when the predetermined differential pressure is exceeded, a guide shaft

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attached to the baffle and adapted to slide in a recess in the wall of the conduit, an electric switch connected to the heating element, and means responsive to the movement of the baffle to the sealed position to operate the switch and inactivate the electrical heating element.

3. A diffusion pump which includes an electrical heating element, a conduit for connecting the pump to a system from which gas is to be evacuated, a baffle movably supported in the conduit transversely to a gas flow through the conduit, an annular seat for the baffle in the conduit, 10 springing means engaging the baffle for holding the baffle away from the seat against a predetermined differential pressure between the system and the pump and permitting the baffle to move into sealing engagement with the seat and seal the conduit from the pump when the prede- 15

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termined differential pressure is exceeded, a bellows mounted in the conduit wall with the baffle attached thereto, an electric switch connected to the heating element, and means responsive to the movement of the bellows when the baffle moves to the sealed position to operate the switch and inactivate the electrical heating element.

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