Feb. 20, 1951 C. T. DE GROAT 2,542,636

GAS CHARGING APPARATUS WITH GAS PRESSURE REDUCING VALVE

Filed Dec. 8, 1947

Fig. 1.

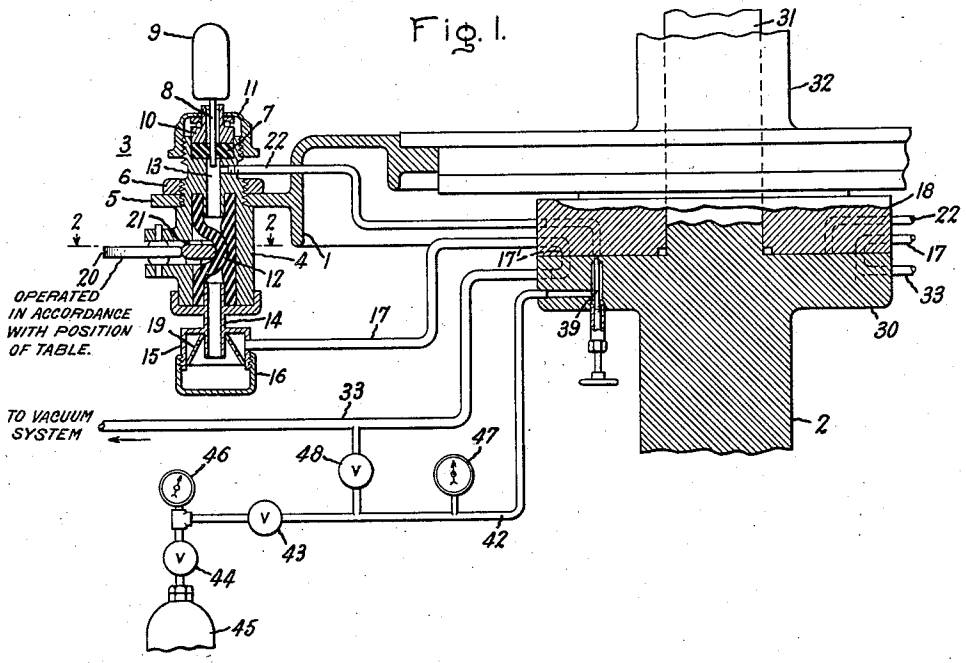


Fig. 4.

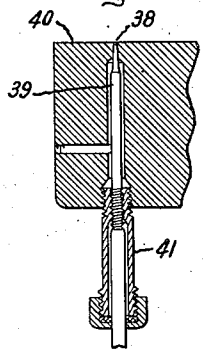


Fig. 3.

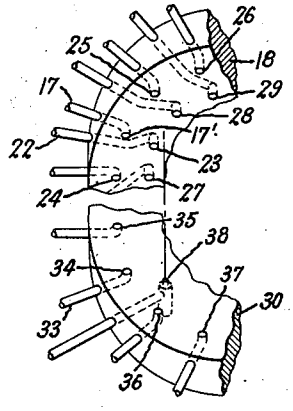
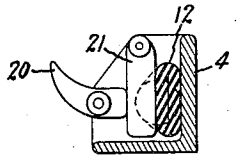


Fig. 2.



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GAS CHARGING APPARATUS WITH GAS PRESSURE REDUCING VALVE

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4 Claims. (Cl. 226—20.1)

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My invention relates to improved evacuating and gas charging apparatus of a type which is particularly adapted for the automatic manufacture of evacuated devices, such as electric discharge devices.

In making gas filled electric discharge devices, for example, considerable difficulty has been experienced in providing machinery for introducing the gas into the evacuated envelope of the devices at a pressure lower than atmospheric, without wasting a volume of gas, which is large compared with that actually introduced into the device. Also considerable difficulty has been experienced as a result of contamination of the gas in the charging system as a result of a defective or leaking tube on the machine. In accordance with important aspects of my invention, I provide an improved automatic evacuating and gas charging apparatus which overcomes both of the difficulties mentioned above and offers a commercially practical way of automatically charging evacuated devices with expensive gases, such as Xenon.

It is an object of my invention to provide a new and improved evacuating and gas charging apparatus.

It is another object of my invention to provide automatic gas charging apparatus for the manufacture of evacuated devices in which the amount of gas wasted is kept to a reasonably small volume.

It is still a further object of my invention to provide an improved evacuating and gas charging apparatus which avoids contamination of the supply of gas when a leaking device is charged with gas.

My invention will be better understood as the following description proceeds, reference being had to the accompanying drawing, and its scope will be pointed out in the appended claims. In the drawing, Figure 1 is an elevational view, partially in section, illustrating an automatic exhaust and gas charging apparatus embodying my invention; Figure 2 is a sectional view taken along the line 2—2 of Figure 1; Figure 3 is a view illustrating the operative relationship of certain parts of the machine illustrated in Figure 1, and Figure 4 is an enlarged sectional view of a portion of the machine shown in Figure 2.

Referring now to Figure 1 of the drawing, I have shown my invention embodied in an automatic exhausting and gas charging machine for electric discharge devices including a plurality of identical stations supported on a movable support or turntable 1 which is rotatably mounted on a stationary support 2. In a practical machine embodying my invention sixteen movable stations, identical with the one illustrated in the drawing, are provided at equally spaced points around the movable support 1. In the interest of simplification of the drawing, only one station has been illustrated. It will be appreciated that the movable table is moved intermittently by a suitable indexing system, not shown. This station includes a compression fitting designated generally by the numeral 3 and including a body member 4 supported from a flange 5 extending outwardly from the turntable 1. The body 4 is provided with a threaded portion which is received within an opening in the flange 5 and engaged by a nut 6. The upper end of the body is recessed to receive a body 7 of resilient material, such as synthetic rubber, which has a central opening for the reception of the tubulation 8 of a discharge device or other hollow member 9 to be evacuated and charged with gas. The material 7 is compressed by a bearing member 10 which is urged downwardly into the body member 4 by a threaded cap 11 which engages the threaded upper end of the body 4.

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The lower end of the body is provided with a cylindrical recess which houses a flexible connection 12 connecting a passage 13, communicating with the exhaust tubulation of the device 9, with a fitting 14 which frictionally engages the lower end of the housing to provide a well or trap for collecting any foreign matter, such as broken exhaust tubulations, which may drop from the compression fitting. The well is defined by a cylindrical member 15 closed by a cap 16 to provide a cylindrical enclosure which communicates through a conduit 17 with a port 17' on the face of a rotatable valve member or plate 18 which moves with the table 1 of the machine. A strainer in the form of a perforated sheet metal cone 19 is located in the well to prevent foreign matter from being drawn into the vacuum system.

Communication between the conduit 17 and the passage 13 of the compression fitting 3 is controlled in accordance with the position of the table 1 of the machine by a cam lever 20 which compresses the flexible connection 12 through an intermediate pivoted member 21 as illustrated in detail in Fig. 2. The cam 20 is operated in accordance with the position of the turntable by any suitable means which may, for example, be a combination of fixed and movable stops of the type commonly employed in lamp making machinery.

In addition to the vacuum conduit 17, there

is at each movable station a conduit 22 which communicates at one end with the passage 13 in the compression fitting at a point between the device 9 to be evacuated and the flexible shut-off connector 12. As illustrated clearly in Fig. 3, conduit 22 communicates with a port 23 on the face of the rotary valve plate 18. As will be described later in the specification, this conduit is for supplying gas to the device 9 during gas charging operation of the machine.

Referring particularly to Fig. 3, the upper or rotary valve plate 18 is provided with two ports for each movable station, one for the vacuum conduit corresponding to the conduit 17 of the station illustrated in Fig. 1 and one for the gas charging conduit corresponding to the conduit 22 of Fig. 1. There are illustrated in Fig. 3 the valve ports corresponding to three stations in addition to the station illustrated in Fig. 1. The vacuum ports have been designated by numerals 24, 25, 26 and the gas charging ports by numerals 27, 28, 29. It will be noted that both the vacuum and gas charging ports for each station are positioned on the same radius.

The stationary or base part 2 of the machine includes a valve plate 30 on which the table 1 and particularly the movable valve plate 18 is supported. The base 2 is also provided with an upwardly extending shaft 31 which is received within a hub 32 of the turntable 1. As illustrated in Fig. 3, a stationary vacuum conduit 33 communicates with a port 34 in the face of the stationary valve 30 which, in the illustrated position of the machine, lines up with the port 17'. In a similar way stationary vacuum conduits are provided at equally spaced positions around the machine and terminate in ports such as those designated by numerals 35, 36, 37 which are adapted to register with the vacuum ports of the various stations of the movable valve plate 18. As indicated in Fig. 1, the conduit 33 is connected with a vacuum system which is provided either independently for each station or by a single vacuum manifold which is evacuated by a single vacuum pumping system. As is common in the art the vacuum pumping system may be mounted either on or off the machine.

The apparatus described thus far is duplicated at each movable and fixed position of the machine. At the position of the machine illustrated, there is, in addition, a supply of gas and a novel arrangement for introducing the gas at reduced pressure to the various gas charging conduits 22 of the movable stations. As illustrated in Figs. 1 and 3, the stationary valve plate 30 is provided with a port 38 terminating on the face of the valve plate at the same radial distance as the gas charging ports 23, 27, 28, and 29 of the movable valve plate 18. The port is, however, circumferentially spaced with respect to the gas charging ports of the stationary valve plate in any stationary operative position of the machine so that registry between the gas charging ports takes place only as the machine indexes from one position to another. The effective size of the port 38 is controlled by a needle valve 39 which is adjusted with respect to a valve seat 40 as a result of the threaded connection between the valve spindle and the sleeve 41. Suitable means for effecting very accurate adjustment of the valve member 39 are preferably provided. In order that the control and reduction in pressure of the gas be affected as near to the contacting faces of the valve plates 18 and 30 as possible, the valve member 39 is positioned to clear the movable valve face 18 by only a few thousands of an inch when it is in closed position. The port 38 is connected with a gas supply conduit 42 which is connected through valves 43 and 44 to a gas supply 45. The valves 43 and 44 permit release of a predetermined amount of gas into the conduit section lying between the valves 43 and 44 which may then be released to the machine after valve 44 has been closed by the opening of valve 43. Pressure gauges 46 and 47 are provided to indicate respectively the pressure of the gas in the container 45 and the pressure of the gas remaining in the gas supply conduit 42. A manually operable valve 48 connects the gas supply conduit 42 and the vacuum conduit 33 for the purpose of thoroughly evacuating the gas charging system before the machine is placed in operation. It will be appreciated that the valve 48 is closed once the evacuation has been completed and is not operated again until after the machine has been shut down.

The features and advantages which characterize my invention will be more readily understood by a brief consideration of the operation of the machine which has been described in detail. At one of the positions of the movable part of the machine designated the "loading position," a device to be evacuated is inserted into the compression fitting 10 and the cap 11 tightened, either manually or automatically as the machine indexes to a second position. The cam 20 operating the flexible shut-off 12 is also in the closed position in the loading position of the machine and is moved to the open position, either manually or preferably automatically by suitable stop means carried by the stationary part of the machine. As the machine indexes from one position to another the device is evacuated and baked out in accordance with the normal procedure in exhausting electric discharge devices. Since the gas charging ports, such as port 23 has not, in these positions of the machine, registered with the gas supply port 38 which is provided at only one position of the machine, the gas charging equipment has not been effective. A device 9 in normal operation of the machine is completely exhausted and is ready for gas charging as the illustrated movable station moves from registry with the vacuum conduit 34 to the vacuum conduit 36. During the first part of this movement, the cam 20 is operated to close off the flexible connector 12 and effectively isolate the device 9 from the vacuum system. The gas charging port 23 connected with conduit 22 passes momentarily over the gas charging port 38 of the stationary valve plate and with proper adjustment of the valve member 39 relative to the speed of movement of the rotary part of the machine, a predetermined supply of gas passes into the conduit 22 and the device 9 to be charged. In succeeding positions of the movable part of the machine the charged device may be sealed off and the tubulation removed from the fitting 3. The station is again ready for loading of a new device 9 to be evacuated and charged with gas.

It will be apparent from the foregoing description that the only gas volume not used for charging the device is that which lies within the conduit 22 and the passage 13 of the compression fitting. It will be apparent that this represents a small volume of gas since the devices are usually charged to a pressure of a few hundred microns while the pressure in the supply container may be in the order of 45 pounds per

square inch when the container is full. It is an important feature of the present invention that the reduction in pressure of the supply of charging gas takes place as closely as possible to the contacting faces of the stationary and rotary valve plates. In this way all of the gas in the stationary system is at relatively high pressure and there is no tendency for any contamination of the gas supply to take place as a result of leakage in the movable part of the machine and particularly through the compression fitting in the event that the device 9 is a leaker or that an improper seal is made between the exhaust tubulation and the fitting.

While I have shown and described particular embodiments of my invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention in its broader aspects, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. Evacuating and gas charging apparatus comprising, a pair of relatively movable valve members having cooperating valve surfaces, a conduit system for connection with a device to be evacuated and charged with gas including a conduit terminating in a port on the valve surface of one of said members, a second conduit terminating at one end in a second port on the valve surface of said one valve member and connected to said first conduit through a valve, a conduit for connection with a vacuum system terminating in a port on the valve surface of the other of said valve members and positioned to register in a predetermined relative position of said members with said second port of said one member, a second port on said other valve member, a passage in said other valve member terminating in said second port on said other valve member and a pressure reducing valve means in said passage.

2. Evacuating and gas charging apparatus including relatively movable valve members each having a valve surface and a valve port therein which register with each other in a predetermined relative position of said valve members, a fitting for supporting a device to be evacuated, a conduit connected between the port on one of said members and said fitting, a second conduit connected with said one valve member and including a port opening on the valve surface of said one member, said second conduit being connected with said fitting, a conduit connected with the port in the other of said valve members and adapted to be connected with a vacuum system, a second conduit connected with the other of said valve members including a portion extending within the other of said members and

terminating in a port on the valve surface of the other of said members, a pressure reducing valve in said second conduit and within said other of said valve members, and a valve for closing said first-mentioned conduit connected with said one member.

3. Evacuating and gas charging apparatus comprising, a stationary support including a stationary valve plate having a plurality of circumferentially spaced ports for connection with a vacuum system, a movable support including a second valve plate rotatably supported with respect to said stationary valve plate and including a plurality of circumferential spaced ports which register respectively with the ports of said stationary plate in each of a plurality of different relative positions of said stationary and second valve plates, a fitting for supporting a device to be evacuated at each of a plurality of positions on said movable support, means connecting each of said fittings with one of the ports of said second valve plate, a second conduit connecting each of said fittings with a port in said second valve plate, a gas supply conduit connected with said stationary valve plate, said last-mentioned conduit including a portion within said stationary valve plate and terminating in a port on the face of said stationary valve plate, and a pressure reducing valve in said gas supply conduit and within said stationary valve plate.

4. Apparatus for charging an evacuated device with gas comprising relatively movable valve members having cooperating valve surfaces, a conduit for connection with a device to be charged and including a port on the valve surface of one of the said members, a conduit for connection with a supply of gas under pressure extending through a portion of the other of said valve members and terminating in a port on the face of the other of said members, said ports being positioned to register in a predetermined position of said relatively movable members and a pressure reducing valve in the portion of said second conduit within said other of said members.

CHARLES T. DE GROAT.

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