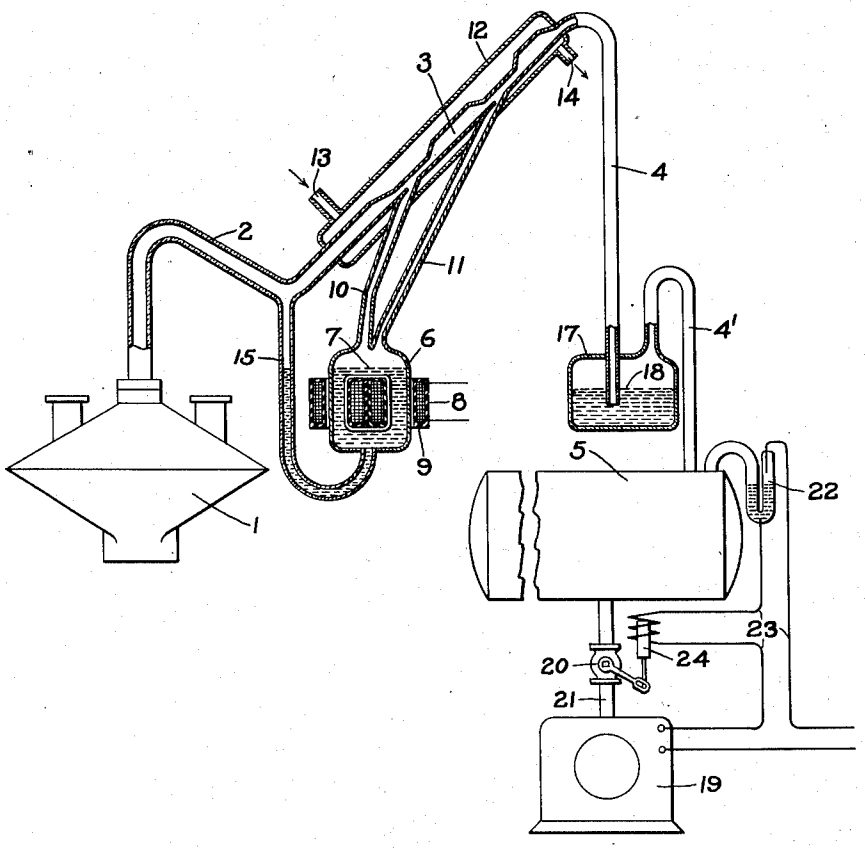
Sept. 9, 1930. C. KRÄMER 1,775,531

VACUUM APPARATUS

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Inventor:
Christian Krämer,
by Alexander S. Lent.
His Attorney.

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UNITED STATES PATENT OFFICE

CHRISTIAN KRÄMER, OF PANKOW, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

VACUUM APPARATUS

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The present invention relates to the maintenance of a desired pressure in a device, such as a mercury arc rectifier, for example, in which small amounts of gas are evolved continuously during operation.

A mercury arc rectifier preferably should be operated with a gas pressure less than about 0.005 to 0.01 m. m. of mercury. Large power rectifiers which usually require large metal receptacles and relatively large electrode masses are apt to give off gas gradually during operation so that the vacuum becomes progressively poorer. When the gas pressure exceeds a permissible value the vacuum pump again must be put into operation in order to reduce the gas pressure to the required value. As there are no reliable automatically operating devices which are responsive to such small gas pressures, the state of the vacuum of a power rectifier must be continuously supervised by an attendant. Obviously this necessity for continuous supervision of the rectifier is disadvantageous and contrasts unfavorably with the operation of other electrical devices, such as transformers, in the station in which the rectifier is employed.

It is the object of my present invention to reduce the supervision required for the operation of large rectifiers, that is, to provide an arrangement whereby automatic serviceless operation for relatively long periods of time is secured.

In accordance with my invention, the device in which a good vacuum is to be maintained is continuously exhausted by an exhaust means having no moving mechanism, and hence requiring no supervision, and the gas removed by this means is received by an exhausted space of relatively large capacity, thereby permitting operation for relatively long periods before the pressure in the large capacity space becomes too high to permit of further operation.

The accompanying drawing illustrates somewhat diagrammatically an installation for carrying out my invention. In the drawing a mercury arc rectifier 1 is connected by a conduit 2 to the exhaust tube 3 of a vapor jet pump which in turn is connected to a conduit 4, 4′ whereby the exhausted gases are conducted to a container 5 having a materially larger cubical capacity than the mercury arc rectifier 1.

The vapor exhaust device may assume various forms and may be constituted of a single pump or several pumps used in combination. The drawing shows a pump which comprises a receptacle 6 containing a body of mercury 7 which is heated by any convenient means, as for example, by electrical induction from a primary winding 8. This primary winding is inductively interlinked with the mercury, constituting the secondary, by a magnetic core 9 as indicated. Communicating with the receptacle 6 are two ducts 10 and 11 which communicate at the opposite ends with the exhaust tube 3. In the drawing which is merely diagrammatic these ducts terminate at the lower inclined surface of the tube 3 but, of course, they may be of any other advantageous construction. Surrounding the exhaust tube 3 is a suitable cooling means, such as the water jacket 12, which is provided with an inlet tube 13 and an outlet tube 14 as indicated. When the mercury is heated and vapor rises through the ducts 10 and 11, gas is drawn from the device 1 through the conduit 2 and accumulated in the conduit 4 in accordance with the now well understood method of operation of vapor or condensation pumps. Mercury vapor is condensed during this operation and the globules of condensed mercury are returned to the receptacle 6 by a conduit 15. The duct 10 will convey gas taken from the conduit 2 in a relatively good vacuum and deliver it to the exhaust tube near the terminal of the duct 11 at a pressure of about 0.2 m. m. where it is further raised to a pressure of about 30 to 50 m. m.

Included in the conduit 4, 4′ is a valve constituted by a receptacle 17 containing a quantity of mercury 18 into which the end of the tube 4 dips. When the gaseous pressure in the conduit 4 has become high enough to overcome the pressure of the mercury surrounding the lower end of this conduit, the mercury will be displaced and some of the

gas will flow into the large vacuum container 5.

The mercury vapor pump requires no supervision and will operate continuously to exhaust small amounts of gas given off by the rectifier 1 during operation. These gases are accumulated at a higher pressure in the conduit 4 as already described and fed intermittently into the tank 5 until the pressure in the tank becomes so high that no more gas can escape from the conduit 4. In other words the system will operate until the pressure in the conduit 4 becomes high enough to be in equilibrium with the pressure which is delivered by the vapor pump, without being relieved by escape into the tank 5. It then becomes necessary to again exhaust the tank 5, for example by starting into operation a vacuum pump 19 and opening a valve 20 in the conduit 21 which connects the pump 19 with the tank 5. When the tank has been re-evacuated, the valve 20 is closed and the pump 19 is stopped. In the drawing the valve 20 has been shown as being operated electromagnetically but, of course, in some cases manual operation may be preferred, the operating magnet then being omitted.

An automatic contact manometer 22 has been diagrammatically indicated, whereby the exhaust pump may be automatically put into operation when the gas pressure in the tank 5 has risen to a predetermined value. The mercury column in the manometer then will complete an electric supply circuit 23, thereby opening the valve 20 by a magnet 24 and starting the electrically driven pump 19. Suitable relay devices, of course, may be used as well understood in the art.

As the size of the tank 5 can be made relatively large as compared with the size of the rectifier 1, (as indicated by its being shown as broken), the system will operate for a relatively long period without supervision.

When the tube 4 is made of barometric height, that is, at least 760 m. m. then in case the tank 5 is opened, or for any reason loses its vacuum, no air still can reach the rectifier as the mercury cannot rise higher than 760 m. m. in the tube 4.

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

1. A vacuum apparatus comprising the combination of a receptacle in which a high vacuum is to be maintained and in which small amounts of gas are apt to be evolved, means for continuously exhausting gas from said receptacle, a container of larger capacity than said receptacle connected to receive gas from said exhaust means and a valve for preventing the back flow of gas from said container.

2. The combination of a mercury arc device, means for continuously exhausting gas therefrom, a container of larger capacity than said receptacle connected to receive gas from said exhaust means, and means for preventing the back flow of gas from said container to said arc device.

3. The combination of a mercury vapor rectifier, a condensation pump connected thereto, a tank having a larger volume content than said rectifier and connected to receive gas from said condensation pump, a mechanical pump for evacuating said tank and a mercury seal located between said condensation pump and said tank permitting the flow of gas to said tank but preventing flow of gas in a reverse direction.

4. The combination of a vapor condensation pump, a mechanical pump, a container connected between said pump, a mercury seal arranged to permit the flow of gas only in one direction between said condensation pump and said container, and means arranged to open the connection between said container and said mechanical pump when the pressure within said container has attained a predetermined value.

In witness whereof, I have hereunto set my hand this 31st day of May, 1924.

CHRISTIAN KRÄMER.