

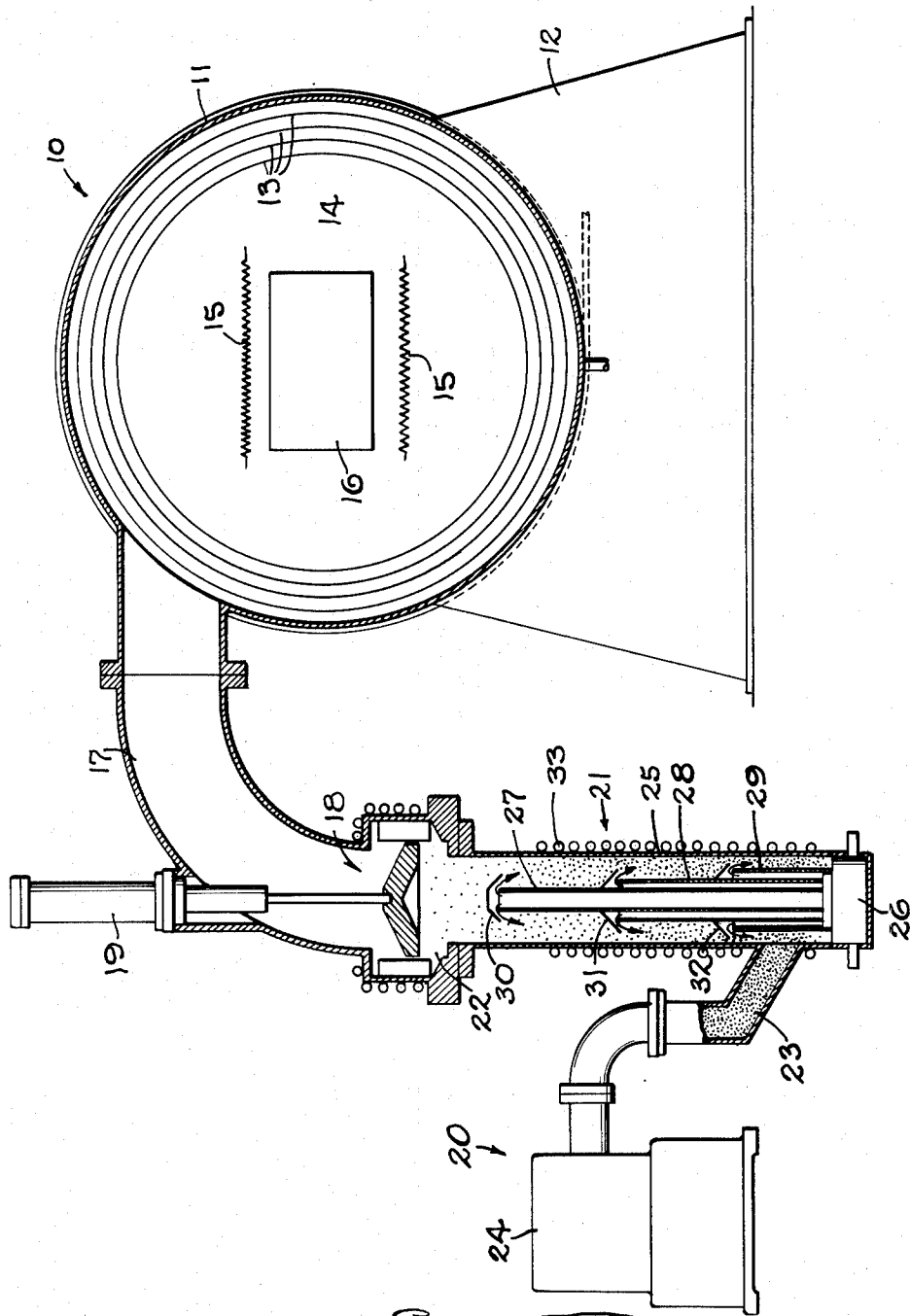
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METHOD OF EVACUATING TREATING CHAMBERS

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METHOD OF EVACUATING TREATING CHAMBERS

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2 Claims. (Cl. 230-45)

This invention relates to apparatus, such as heat treating furnaces, in which workpieces are treated in an evacuated chamber and, more particularly, to an apparatus in which the treating chamber is evacuated to an absolute pressure on the order of 10 microns of mercury. In such an apparatus, the rough evacuation usually is effected mechanically while the final evacuation is achieved through the use of an oil diffusion vapor pump cooperating with a mechanical pump.

The general object of the invention is to evacuate an apparatus of the above character by a novel method which eliminates the need for expensive valving and piping heretofore used and which requires only a single mechanical pump.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawing, in which

The single figure is a schematic view of a heat treating furnace and the system for evacuating the furnace according to the method of the present invention, parts being broken away and shown in section.

As shown in the drawing for purposes of illustration, the invention is shown embodied in a system for evacuating a chamber such as the interior of a heat treating furnace 10. The latter comprises a horizontally disposed cylindrical casing 11 supported by a base 12 and lined with a series of cylindrical heat reflecting members 13. The furnace chamber 14 is brought to the desired temperature by heating elements, shown schematically at 15, and the work 16 is supported in the center of the chamber. The latter is evacuated through a conduit 17 which is controlled by a valve 18 actuated by a hydraulic motor 19 and which connects the chamber with an evacuating system 20.

In prior arrangements of this type, the furnace chamber 14 is evacuated initially by a mechanical pump which reduces the absolute pressure within the chamber to about 100 microns of mercury. Thereafter, an oil diffusion vapor pump cooperating with a mechanical pump further reduces the absolute pressure to the desired operating value, usually on the order of 1 to 10 microns of mercury. Heretofore, such systems have required comparatively elaborate piping and valving systems and, in many instances, have used two separate mechanical pumps, one for the roughing operation and the other for use with the diffusion pump.

The present invention contemplates the provision of a novel method for evacuating the chamber 14 which method requires no valving beyond the usual vacuum valve 18 and uses only a diffusion pump and a single mechanical pump with a simple connection between them. Generally stated, this method comprises the steps of mechanically drawing the gas out of the chamber 14 through a diffusion pump 21 while initiating operation of the diffusion pump so that the rough evacuation is effected mechanically while the diffusion pump is heating and then, when the oil in the latter begins to vaporize, the diffusion pump automatically assists in and completes the evacuation.

To carry out the novel method, the inlet end 22 of the diffusion pump is connected directly to the conduit 17 on the downstream side of the vacuum valve 18 and the outlet 23 of the diffusion pump is connected to the inlet of

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a mechanical pump 24. The latter is a positive acting pump and may be of the gas ballast, rotary piston type. Preferably, the mechanical pump is capable of efficiently reducing the pressure in the chamber 14 to at least 10 microns of mercury.

The diffusion pump 21 herein comprises a vertical tubular casing 25 connected at its upper end to the conduit 17 and provided at its lower end with a boiler 26 which vaporizes the oil. Within the casing are three concentric chimneys 27, 28 and 29 with the inner chimney 27 extending above the intermediate chimney 28 which, in turn, is taller than the outer chimney 29. At the tops of the chimneys are deflectors 30, 31 and 32 respectively so that the oil vaporized in the boiler 26 first rises through the chimneys and then is deflected downwardly toward the outlet 23 which communicates with the interior of the casing 25 near the lower end thereof. The casing is suitably cooled as by a water jacket 33 to condense the oil vapor and the condensed oil runs back to the boiler.

As the molecules of the gas in the chamber 14 enter the casing 25 by random thermal motion, they collide with molecules of vaporized oil issuing as a downwardly directed jet stream from the top of the inner chimney 27. As a result of these collisions, the gas molecules are impelled toward the outlet 23 and similarly are given additional velocity by the vapor jets issuing from the chimneys 28 and 29. In this way, the gas is compressed to a pressure at which it may be pumped by the mechanical pump 24.

With the foregoing arrangement, the chamber 14 is evacuated by opening the valve 18 and starting the mechanical pump 24. At the same time, the boiler 26 of the diffusion pump 21 is started and begins to heat the oil. While the oil is being heated and before it vaporizes, the mechanical pump performs the roughing operation, reducing the pressure in the chamber to about 100 microns of mercury. At that time, the temperature of the oil has reached the boiling point, for example, about 400 degrees F., and the oil begins to vaporize. The jets of vaporized oil compress the gas so that it may continue to be pumped by the mechanical pump 24.

When the chamber 14 has been evacuated, the work 16 is heat treated. During this operation, the temperature within the boiler 26 is reduced to maintain the oil substantially below the boiling point, such as at 275 degrees F. When the heat treating is completed, the work is removed from the chamber. As a result, the chamber is exposed to atmospheric pressure and must again be evacuated. This is achieved simply by opening the valve 18, starting the mechanical pump 24 and simultaneously increasing the input to the boiler 26 to begin raising the temperature of the oil to the boiling point. The evacuation then takes place as described above.

It will be seen that, with the method of the present invention, the equipment is quite simple and requires only one mechanical pump and no valves beyond the usual vacuum valve 18. Moreover, even though all of the gas is pumped through the diffusion pump, there is no loss of oil due to the vaporized oil being subjected to atmospheric pressure since the mechanical pump has reduced the pressure well below this value before the oil begins to vaporize. In addition, after starting the system in operation no mechanical steps need to be performed since the diffusion pump automatically becomes effective when the oil begins vaporizing.

I claim as my invention:

1. The method of repeatedly evacuating a chamber using a mechanical pump and an oil diffusion vapor pump in the latter of which oil is heated to vaporize and the oil vapor issues in jet streams to impel gas molecules away from the chamber, said pumps being connected in series with the diffusion pump communicating directly

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with the chamber, said method comprising the steps of initiating operation of said mechanical pump to draw gas out of the chamber through said oil diffusion vapor pump while the temperature of the oil is substantially below its boiling point, simultaneously heating the oil in said vapor pump whereby initial evacuation of the chamber is effected by the mechanical pump through the diffusion pump until the oil begins to vaporize and thereafter the vapor pump assists the mechanical pump in the final evacuation of the chamber, and then cooling the oil to a temperature substantially below its boiling point before again initiating operation of said mechanical pump to re-evacuate said chamber.

2. The method of repeatedly evacuating a chamber using a mechanical pump and an oil diffusion pump in the latter of which oil is heated in a boiler to vaporize the oil and issue the vapor in jet streams to impel gas molecules away from the chamber, said pumps being connected in series with the mechanical pump exhausting said chamber through the diffusion pump, said method comprising the steps of, initiating operation of said me-

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chanical pump to draw gas out of said chamber while the temperature of the oil in said diffusion pump is substantially below its boiling point whereby said mechanical pump performs the rough evacuation of said chamber through the diffusion pump without drawing oil vapor from the latter, activating the boiler to heat said oil during said rough evacuation and to begin vaporization of the oil only after rough evacuation of the chamber is substantially complete whereby said diffusion pump assists the mechanical pump in the final evacuation of the chamber, and then reducing the energization of said boiler to cool the oil to a temperature substantially below its boiling point before repeating the cycle.

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