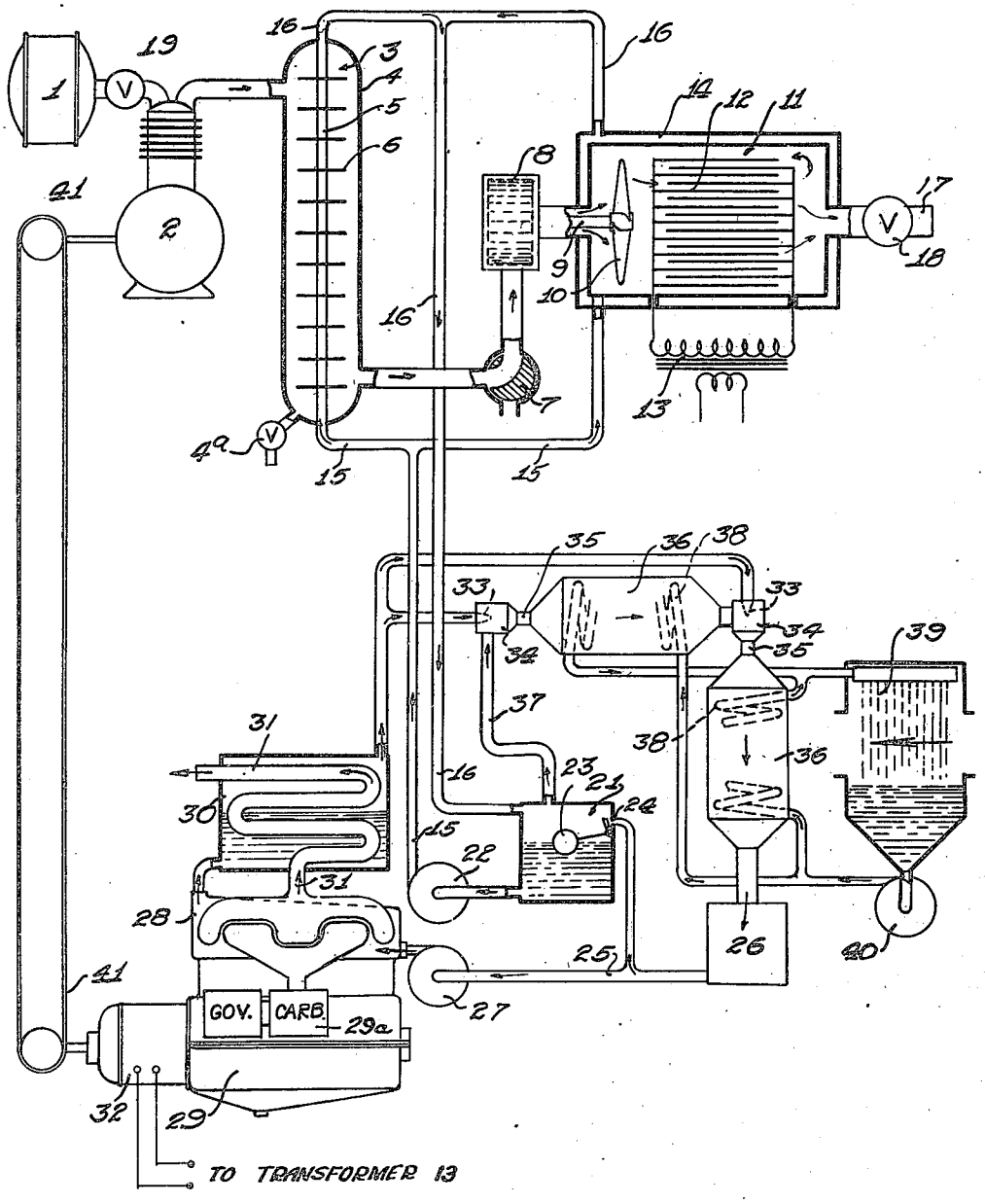
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APPARATUS FOR PRODUCING OZONE

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APPARATUS FOR PRODUCING OZONE

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3 Claims. (Cl. 204—314)

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My invention relates to an apparatus for producing ozone, and among the objects of my invention are:

First, to provide an apparatus for producing ozone wherein the air to be treated is compressed and then subjected to refrigeration to remove moisture, as well as lower its temperature prior to introduction into the ozone chamber;

Second, to provide an apparatus of this character which employs a novel refrigerating system operated on energy otherwise wasted, thereby increasing the over-all efficiency;

Third, to provide an apparatus of this character wherein the amount of refrigeration automatically changes in response to changes in demand of ozone; and

Fourth, to provide an apparatus for producing ozone which is inherently capable of being formed into a compact, portable self-contained unit and which is particularly designed for the treatment of water.

The figure is a diagrammatical view of my apparatus for producing ozone.

Air to be treated in order to form ozone is drawn through a filter 1 by a compressor 2. The air is compressed and passed through a refrigerating unit or heat exchanger 3 which may remove not only the heat generated during compression but lower the temperature below that of the incoming air, and in cooling the air remove therefrom a large percentage of water which may be drained off by a drain valve 4a. The heat exchanger may comprise a shell 4 with a suitable refrigerating coil 5 therein, and may incorporate baffles 6 to insure proper heat transfer. The compressed and refrigerated air passes through a bleeder valve 7 to an air motor 8. The bleeder valve is a three-way valve providing connection between the refrigerator unit and the motor, or permitting discharge of the compressed air to atmosphere so as to by-pass the ozone generator, to be described hereinafter, during an initial "warming up" period.

The air motor drives a shaft 9 and propeller 10. The propeller 10 is mounted within an ozonizer chamber 11 which contains ozone generating elements 12. These may comprise sets of plates divided into two groups separated by dielectric material and connected to the secondary of a high voltage transformer 13. The ozonizer chamber 11 is provided with a jacket 14. The refrigerating unit and the jacket of the ozonizer chamber are connected to a refrigerant supply pipe 15 and to a refrigerant return pipe 16,

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through which a refrigerant circulates; the refrigerant of course being isolated from the air.

The air from the air motor exhausts into the ozonizer chamber and circulates therein by means of the propeller and is drawn from the ozonizer chamber as needed through a discharge line 17 controlled by a valve 18. Another control valve 19 may be interposed between the filter 1 and compressor 2.

The supply pipe and return pipes 15 and 16 are connected, respectively, to the lower and upper ends of an evaporator 21. A pump 22 is interposed in the supply pipe 15 so as to move liquid from the evaporator 21. Various refrigerants may be used; ordinary water may be employed. The evaporator 21 is maintained at a sub-atmospheric pressure as will be described hereinafter. A float 23 which controls a valve 24 regulates the height of liquid in the evaporator, fluid being supplied from a branch of a supply line 25 connected with a sump or reservoir 26. The supply line also leads to a pump 27 which withdraws a refrigerant from the sump and delivers it to the jacket 28 of the internal combustion engine 29 which serves as a preheater, the engine 29 being provided with a governor controlled carburetor 29a, as shown. The heated refrigerant passes from the jacket to a boiler 30. In addition, the exhaust pipe 31 of the internal combustion engine is coiled in the boiler 30. The internal combustion engine drives an electric generator 32 for supplying current to drive the motors connected with the several pumps 22 and 27, as well as the compressor 2 and transformer 13.

Heated refrigerant in the gaseous phase is discharged through jets 33 extending into vacuum chambers 34. The refrigerant is drawn through Venturi tubes 35 into condensers 36. The condensers are connected in series with the discharge end of the first condenser connecting with the vacuum chamber of the second jet. A vacuum line 37 communicates between the evaporator 21 and the chamber 34 of the first or high vacuum jet. One, two, three or more jets may be employed to produce the required sub-atmospheric pressure. Each of the condensers is provided with heat exchanger coils 38 which are connected to an evaporative cooler 39; a pump 40 maintains circulation. The last of the series of condensers 36 discharges into the sump 26, from which it is withdrawn for recycling, part of the refrigerant being heated by the otherwise wasted heat from the internal combustion engine and the other part circulating in the cold circuit of the refrigerating

system, that is, through the supply and return pipes 15 and 16.

By utilizing the otherwise wasted heat of the internal combustion engine it is possible to so cool the air that the ozonizer operates at maximum efficiency. It should be noted that the process of ozonizing the air tends to heat it and that the amount of ozone that can be generated diminishes as the temperature of the air increases, so that it is of utmost pratical importance to maintain the air at as low a temperature as possible. It is also mandatory that the cost per unit of ozone produced be as low as possible. All of these desirable goals are attained by utilizing the wasted heat of the internal combustion engine which supplies the power for the different parts of the apparatus either by mechanical connection, as by the belt and pulley arrangement 41 between engine and compressor, or through the generator and electrical motors supplied by the generator and connected to the parts to be operated.

A further important advantage is gained, namely, the demands on the internal combustion engine are, of course, proportional to the load on the compressor and the transformer. When the quantity of ozone being drawn off is lowered the power requirements are lowered and therefore the heat generated by the internal combustion engine is lowered. As a consequence, the amount of refrigeration is reduced.

While the internal combustion engine has ample capacity for heating the refrigerant for the purpose of cooling the air to be ozonized, it is of course possible to provide a jacket on the compressor and absorb heat from this source as well.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention.

I claim:

1. An apparatus for producing ozone comprising an air compressor, a refrigerating unit for chilling air compressed by said compressor, an ozonizing chamber having electrical means associated therewith, means for conducting chilled air from said unit to said chamber for ozonization by said electrical means, means for varying the amount of ozonized air withdrawn from said chamber thereby varying the load on said compressor and electrical means, and means for supplying a refrigerant to said refrigerating unit and for automatically regulating the refrigerating effect thereof in accordance with variations in the amount of ozonized air withdrawn from the chamber, comprising a heat responsive refrigerating system including said refrigerating unit, an electrical generator for energizing said electrical means, an internal combustion engine drivably connected with said compressor and generator, the power output of said engine then varying in proportion to the load on the compressor and electrical means and hence varying in accordance with the variations in the amount of ozonized air withdrawn, and means to transmit heat generated incidental to operation of the engine to said heat responsive refrigerating system.

2. An apparatus for producing ozone comprising an air compressor, an air motor, and an ozonizing chamber, means to conduct compressed air from said compressor to said motor to drive the same and from the motor to said chamber, electrical discharge means within said chamber for ozonizing the air conducted thereto, a fan drivably connected with the air motor and positioned within the chamber for circulating air over said discharge means, means for varying the amount of ozonized air withdrawn from said chamber thereby varying the load on said compressor and electrical discharge means, and means for supplying a refrigerant to the exterior of the chamber and for automatically regulating the refrigerating effect thereof in accordance with variations in the amount of ozonized air withdrawn from the chamber, comprising a heat responsive refrigerating system including said refrigerant supply means, an electrical generator for energizing said electrical means, an internal combustion engine drivably connected with the cmopressor and generator, the power output of the engine then varying in proportion to the load on the compressor and electrical means and hence varying in accordance with the variations in the amount of ozonized air withdrawn from said chamber, and means to transmit heat generated incidental to the operation of the engine to said heat responsive refrigerating system.

3. An apparatus for producing ozone comprising an air compressor, an air motor, and an ozonizing chamber, means to conduct compressed air from said compressor to said motor to drive the same and from the latter to said chamber, a refrigerating unit for cooling the air conducted from the compressor to the motor, a second refrigerating unit for cooling said chamber, electrical discharge means within the chamber for ozonizing the air conducted thereto, a fan drivably connected with the air motor and positioned within the chamber for circulating air over said discharge means, means for varying the amount of ozonized air withdrawn from said chamber thereby varying the load on said compressor and electrical discharge means, and means for supplying a refrigerant to both said refrigerating units and for automatically regulating the refrigerating effect thereof in accordance with variations in the amount of ozonized air withdrawn from the chamber, comprising a heat responsive refrigerating system including both said refrigerating units, an electrical generator for energizing said electrical means, an internal combustion engine drivably connected with the compressor and generator, the power output of the engine then varying in proportion to the load on the compressor and electrical means and hence varying in accordance with the variations in the amount of ozonized air withdrawn from said chamber and means to transmit heat generated incidental to the operation of the engine to said heat responsive refrigerating system.

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