SAFETY ARRANGEMENTS FOR ELECTRICALLY OPERATED EQUIPMENT IN SURGERY OR ANESTHESIA ROOMS

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ABSTRACT OF THE DISCLOSURE

Apparatus for purging surgical equipment of explosive anesthetic gases with fresh air provided by existing operating room ventilation systems and remote from the equipment to the vicinity of a ceiling ventilation outlet. A blower at the base of the inlet tube pressurizes the cabinet containing the equipment. An exhaust tube, coaxial with the inlet tube, exhausting the air to the room at a substantial distance above the floor. A pressure sensing device is also provided in the cabinet to prevent energization of the equipment until the required pressure is built up within the cabinet.

This invention refers to safety arrangements and techniques for surgery rooms and anesthesia rooms, for example in hospitals, where electrically-operated equipment is employed in the presence of inflammable or explosive anesthetic vapors. It is, therefore, an object of the invention to simplify the installation and maintenance of such rooms without sacrificing the high-level safety factor under operating conditions.

It is well known that the presence of inflammable or explosive vapors in surgery and anesthesia rooms results in the danger of explosions. Consequently, rules and regulations have been set up, frequently by official authorities, in order to reduce the danger of ignition of anesthetic vapor-air mixtures. By way of example, such regulations may provide that medical equipment operated in the danger zone must be designed in such a manner that, under normal circumstances of use, the mixture of anesthetic vapor with air surrounding the equipment may not be ignited. Apparatus and equipment falling within the scope of this category are, for example, illumination equipment, X-ray apparatus and auxiliary components, equipment for monitoring the process of the application of anesthetics, blood circulation monitoring equipment, as well as high-frequency operated surgical instruments.

The explosive danger has been minimized by removing anesthetic vapor-air mixtures from the interior of the equipment prior to starting operation thereof, and preventing subsequent entry of such mixtures during operation. This was accomplished by purging the interior of the equipment with a shielding flow of air or protective gas, under conditions of pressure excess. The pressure excess within the equipment must be at least 0.3 torr, in accordance with some of the above-mentioned official regulations. The pressure excess must be maintained even though the air or protective gas may escape through apertures, such as the inlets for cables, which are always present since they are necessary for the operation of the equipment.

In order to assure a maximum of safety, it is necessary that electrical equipment of the type mentioned before air flow is made ready for operation, or actually energized, only under the condition that the prescribed minimum pressure excess has been reached and that it has been ascertained that the interior has been purged by the substitution of a volume of fresh air or protective gas at least ten times the volume of the equipment. In order to fulfill these requirements, the equipment must be provided with a safety device controlled by the difference of pressures within the equipment and outside, permitting energization of the equipment only when the required threshold value of excess pressure has been reached.

There exists in the prior art another solution to this problem, whereby the equipment is designed in such a manner that the excess pressure is maintained permanently within the equipment even after de-energization, i.e. when not operated. However, this alternative is only of practical value in connection with switches or lamps, because of the excessive cost and complexity involved in the provision of air-tight housings required to maintain the pressure excess beyond atmospheric pressure.

Anesthetic gases are generally considerably heavier than air. Therefore, the zones or areas in surgery and anesthetic rooms which normally may be filled with inflammable or explosive vapor-air mixtures and constitute zones of danger, are assumed to include spherical zones with radii of one meter above the head of a patient, or above the equipment to be protected during a surgical operation. Consequently, the zone of danger generally reaches to a height of at least two meters above the floor of the operating room in the vicinity of the anesthetic equipment, and somewhat lower elsewhere in the room.

The present invention is based on the officially required provision of a fresh air supply into surgery and anesthetic rooms from or through the ceiling. Such fresh air supply basically consists of a unidirectional, generally downward directed, flow of fresh air offsetting a change of air eight to ten times per hour. With this fresh air supply, it is intended to continuously purge the surgery and/or anesthesia room and the equipment positioned in the zone of danger with fresh air. As a result of this arrangement, installation and upkeep of contemporary surgery and anesthesia rooms require significantly higher expenditures.

In accordance with one of the more important features of the present invention, fresh air, as supplied to the upper zone of a room in which anesthetic vapors are present, is used for feeding a shielding air flow into electrical equipment operated in the lower zone of the same room.

Other features of the invention include the provision of air ducts extending upwardly from, and supported by, the electrical equipment to be shielded, with the ducts being preferably telescoping tubular structures. One of the ducts is the inlet duct which, when extended, reaches into the upper zone of the room filled with fresh air, while another duct may be the outlet, terminating below the fresh air zone. Also, several units of equipment may be operated with a common fresh air supply, with a common outlet duct, or both.

In the following, the invention will be described in connection with the single figure of the drawing which schematically illustrates conditions in a surgery room, wherein one embodiment of a device in accordance with the present invention is shown.

The dashed line 10 is assumed to be the boundary between the lower portion 12 of the room, defined as the zone of danger, and the upper portion 14 of the room into which fresh air is continuously introduced by a standard equipment, schematically indicated by a perforated pipe 16. In many instances, the fresh air supply is built into the ceiling and fed from a central system, as is conventional with contemporary design of hospitals. A volume of air equal to that supplied from above continuously leaves the portion 13 of the room and surgery equipment 20, 22 are shown disposed within the zone of danger 12. At least one of these equipment
units, for example that designated by numeral 26, is provided with a compressor or blower, for example a centrifugal pump 24, which is connected to the equipment 20 and escapes through an outlet duct 34. The outlet duct preferably does not terminate in the vicinity of the floor 36 of the room, but rather in the upper area, for example at location 38 of equipment 20. Alternatively, as indicated by dashed lines, the outlet duct 34 may continue upward as an outlet tubing 49 concentrically surrounding the inlet tubing 26, but it still terminates within the zone of danger 12, i.e. below boundary 10 and a significant distance below the upper opening of inlet tubing 26. As shown in the drawing, both tubings 26 and 40 are telescoping tubular structures so that they may be retracted to permit easy passage through doors, and for facilitating storage and transportation. Also, when stored away, the inlet and outlet tubings are less cumbersome when in their retracted positions.

Additional units of equipment, such as that designated 22, with outlet tubing 32, may be connected through a length of hose 42 to the equipment including compressor 24. Alternatively, unit 22 may be provided with an individual compressor connected to the inlet tubing 26. The outlet air from the additional unit 22 of the equipment escapes through hose 44.

Thus, the present invention eliminates the necessity of providing inlet pipes or hoses for supplying air to blower or compressor 24 by connection to locations outside the surgery room. Were it intended to accomplish this, a multiplex cable composed of hoses and pipes would be necessary. Rather, the present invention is based on the fact that fresh air is continuously supplied into the room from above, so that the danger zone does not reach up to the ceiling of the room. Thus, the fresh air constantly at disposal in a zone above the zone of danger in cooperation with the inlet tubing 26 provides the air flow for shielding the equipment.

Then, the compressor or blower 24 feeds fresh air into the equipment and, if properly designed, it sustains the required excess pressure of 0.3 torr above the surrounding pressure. Consequently, inflammable vapor-air mixtures are prevented from ignition, as they cannot reach the demonstrated fire hazard. Instead of the outlet duct 34, 40, the air flow may be permitted to escape through locations of the electrical equipment which are not entirely air-tight, or the equipment may be provided with an appropriate outlet tube of any other design.

The nature of the safety device 30 and its mode of operation in accordance with which it renders the equipment explosion-proof by preventing energization unless the required pressure excess has been reached and ten times the critical volume of air has been supplied, need no further detailed description herein, because they form part of the prior art.

Each one of the units of electrical equipment operating in the zone of danger may be provided with an individual, upwardly extending inlet tubing 26 for supplying fresh air to its compressor or blower 24. Alternatively, a common inlet tubing may be provided for several compressors or blowers; or a common blower or compressor may be used to supply fresh air to every equipment unit operating in one room. It may be found appropriate to combine a single, common blower, or a single, common inlet tubing, or both, with one unit of equipment which is of a type used under any circumstances such as the equipment employed for supporting the most important surgical instruments and some of the control equipment. This type of unit is conventionally provided with a tubular supporting structure which may effectively be used as the air inlet tubing. Alternatively, supporting structures of other equipment, such as light, sound, or surgery tubings may be used as the inlet tubing for blowing air into electrical equipment.

Then, individual lengths of hose may connect the common inlet tubing with the individual inlets to the blowers of other equipments. In the case a common blower is used in connection with other units, the outlet of the common blower is connected by means of lengths of hose with the interior of the other units to be protected, such as unit 22. Although several hose connections 42 will be required, the expenditure and the inconvenience caused thereby are greatly reduced as compared to an arrangement in which an air duct must be provided from each one of the units to a location outside the room.

In the case that the equipment to be protected is intended to be provided with an outlet tubing, it is desirable to avoid discharge of the exhaust air in proximity to the floor of the room. Such arrangement could easily lead to air turbulence so that dust and germs could be introduced into the atmosphere of the room. Accordingly, and in accordance with the invention, the equipment unit may be provided with the pair of concentrically arranged tubing sections 36 and 48, described above, disposed in a concentric space left between one and the other. Then, suitably, the internal tubing section 26 operates as the inlet, while the external tubing section 40 conducts the outlet air upwardly. This external tubing 40 which conducts the outlet air should terminate at a location between fifty centimeters and one meter below the inlet opening of the inlet tubing 26 so that the outlet air is conducted to a location 46 within the upper portion of the zone of danger 12 without the risk that the outstreaming air disturbs the fresh air intake into the equipment. Obviously, several units, or several blowers, may be provided with a common outlet tubing.

As a result of the present invention, the cumbersome arrangements and excessive cost otherwise necessary for providing air flows around electrical equipment are greatly reduced. In addition, objectionable hose connections laid out over the floor of the room which would connect locations outside the room with the equipment units are avoided. The use of the equipments units themselves is simplified because connecting and disconnecting air ducts becomes unnecessary, at least for those equipment units which are provided with individual inlet tubings 26 and compressors or blowers 24. Furthermore, the telescope type structure of the inlet and of the outlet tubings permits transportation of the units through doors without any difficulty.

Having thus described the invention, it is obvious that numerous modifications and departures may be made by those skilled in the art; thus the invention is to be construed as being limited only by the spirit and scope of the appended claims.

What is claimed is:

1. Apparatus for using fresh air supplied to the upper zone of a room wherein anesthetic vapors are present to supply a protective air flow into electrical equipment in the lower zone of the room, comprising: an inlet duct in the form of a telescoping tubular structure extending from, and supported by, the electrical equipment;

blower means connected to the duct for forcing air from a zone above the equipment through the equipment to thereby cause and maintain the pressure of air forced into the equipment;

means responsive to pressure within the equipment for de-energizing the electrical equipment unless the pressure exceeds a predetermined threshold value; an upwardly directed outlet duct for the air, the duct opening into the room at a level within the lower
zone, sufficiently high to avoid turbulence in the vicinity of the floor of the room, and sufficiently low to avoid disturbing the fresh air intake by the inlet duct; and means for temporarily connecting the duct of pressurized air with at least one additional unit of equipment.

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MEYER PERLIN, Primary Examiner.