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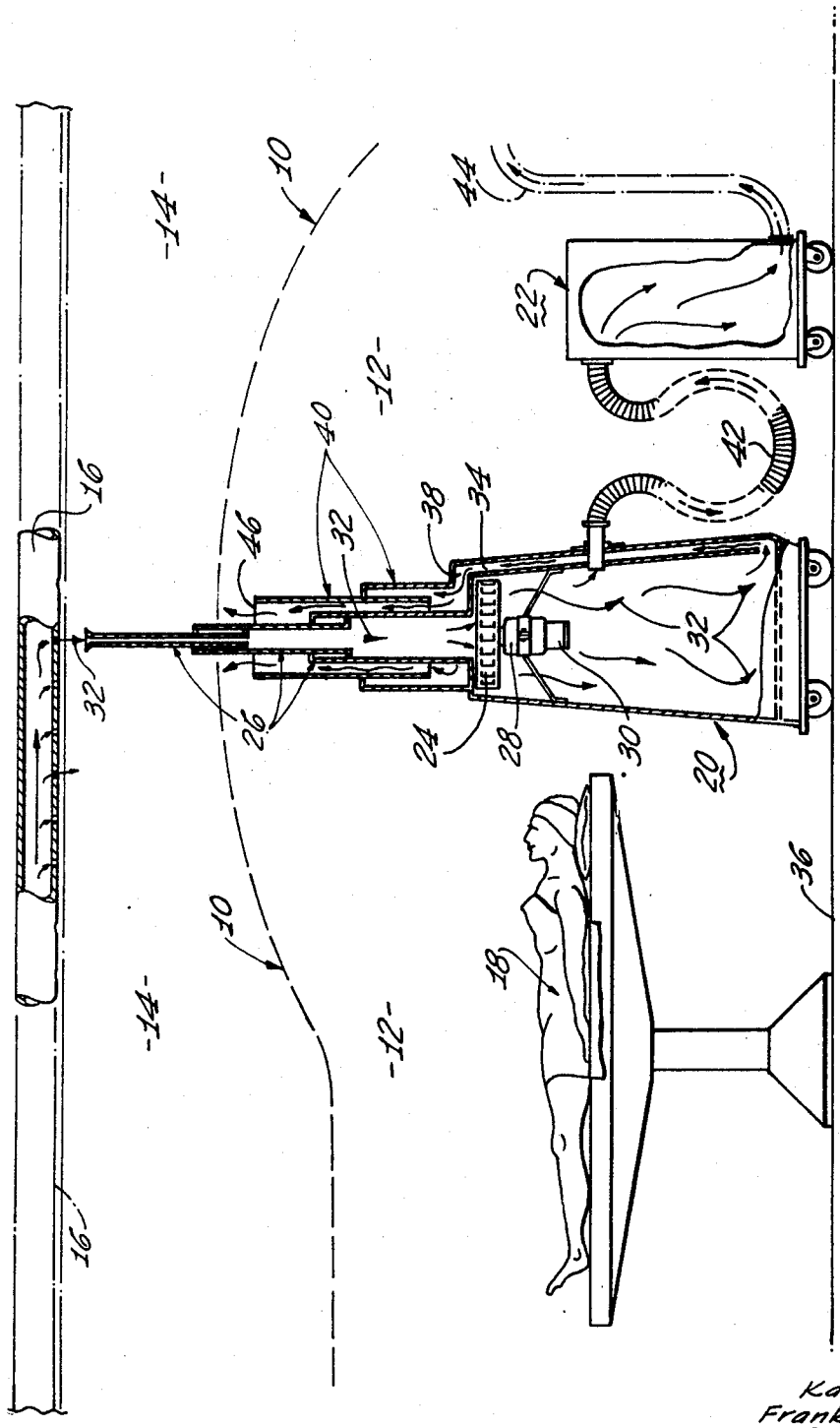

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SAFETY ARRANGEMENTS FOR ELECTRICALLY-OPERATED EQUIPMENT IN SURGERY OR ANESTHESIA ROOMS

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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. A telescoping inlet tube extends from the equipment to the vicinity of a ceiling ventilation system outlet. A blower at the base of the inlet tube pressurizes the cabinet containing the equipment. An exhaust tube, coaxial with the inlet tube, exhausts air to the room a substantial distance above the floor. A pressure sensing device is also provided in the equipment 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 anethetic 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 anethesia 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 regulation may provide that electromedical 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.

In the past, the explosion danger has been minimized by removing anethetic 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 shielded by 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 anesthesia 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 anesthesia rooms from or through the ceiling. Such fresh air supply basically consists of a unidirectional, generally vertically downward directed, flow of fresh humidified air effecting 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 **12** of the room. A patient **18** 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 **20**, is provided with a compressor or blower, for example a centrifugal pump **24**, having an inlet tubing **26** extending vertically upward and into the upper portion **14** of the room. The blower **24** is driven by a motor **28** and a safety device **30** is provided for inhibiting energization of equipment **20** unless the threshold value of excess pressure has been reached, as is shown in the prior art. The air flow, as represented by arrows **32**, is forced through 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 upwardly as an outlet tubing **40** 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**, which might be required for surgery, 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 main 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 multiple 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 equipment.

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 circumstance, such as that 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 sources for surgery rooms, 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 several units as shown in the drawing, 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 turbulences 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 **26** and **40**, described above, with some concentrical 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 persent 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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