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PUMPING OR COMPRESSING OF GASES

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This invention relates to a lubricant for gas handling pumps, gas compressors, gas meters, etc., and especially to a lubricant that does not form explosive mixtures with gases and which may be safely employed in the pumping of gases intended for medicinal uses. This invention relates more particularly to the use of organic esters of phosphoric acid for the purpose of reducing friction of moving parts on machinery adapted for handling gases.

An object of the invention is to effectively and safely lubricate gas handling devices. Another object of the invention is the method of compressing or pumping oxygen under such conditions that the formation of explosive mixtures of gases and lubricant is obviated. A still further object of the invention is the compression of gases into cylinders in such a manner that the compressed gas is in a purer state than has heretofore been possible. Other objects of the invention will appear from the following detailed description.

Relatively pure gases are compressed in containers, which containers may or may not contain absorbent material, for distribution to consumers. The problem of compressing these gases into the containers has involved, prior to the present invention, serious difficulties. One of the major difficulties was the lubrication of pumps and compressors. Many of the ordinary lubricants, when employed in compressors and pumps which attain an elevated temperature, tend to volatilize and are carried along with the gases into the containers, thus producing impure products. Other lubricants tend to volatilize under the heat and pressure of pumping action and when handling gases containing oxygen they form explosive mixtures. For example, mineral oils, when used on pumps handling oxygen, formed explosive mixtures. Such mineral oil lubricants were therefore replaced by water, water and glycerine, and water containing soap or soap and glycerine. These aqueous lubricants obviously caused very serious difficulties in the packing of the pumps and compressors and in operation thereof. Moreover, at the temperature and pressure at which the pumps and compressors are operated, these aqueous lubricants were particularly unsatisfactory since the water, constituents of the soap, and oftentimes the glycerine evaporated into the stream of gas and were carried into the storage cylinder. The adulterants contained in the gas often gave to the gas an offensive odor. Furthermore, the presence of water or other reactive compounds in containers con-

taining oxygen often caused the gas to react corrosively with the material of walls of the container making them weak and dangerous to handle.

I have now found that the lubricants heretofore employed in gas handling devices may be replaced by an organic phosphate. These aryl phosphates, particularly the aryl type, have a low vapor pressure, are odorless and non-reactive. They, therefore, have the advantage over prior lubricants in that there is relatively no volatilization of the same and the small quantities that may be carried into the gas do not give rise to corrosion of containers or offensive odors. Furthermore, the aryl phosphates are substances having an oily quality and their lubricative value is equivalent to that of mineral oil. They have a high wetting property which causes them to always maintain a film on the surface of the parts to be lubricated. Due to the presence of the film the pumps, compressors, etc., are always sealed against leaks.

By employing this invention, massive and clumsy sealing means need not be employed in pumps and compressors as was necessary when water formed the chief lubricant. This invention permits of the use of a more simple design of pump, compressor, etc., thus reducing greatly the overhead cost of plants adapted to handle gases. The life of the machinery is also greatly increased when employing the aryl phosphate as the lubricant as it forms a film over the metal parts preventing rust and corrosion, whether the pumps are in use or not. For the purpose of describing this invention and in the appended claims, the term "pumping machines" are intended to cover suction pumps, compressor pumps, meters or other types of gas handling devices which employ moving parts which require lubrication.

In accordance with my invention, I pump, compress or otherwise handle gases in devices employing moving parts, which moving parts are lubricated and sealed against gas leakage with an organic phosphate. In this manner I am able to compress gas into cylinders or other storage chambers, which gas is free of contaminating gas formerly found therein due to volatilization of the lubricants employed in the machines. Also, in accordance with my invention, I pump gases containing oxygen in such a manner that no explosive mixtures are formed.

This invention is applicable to the pumping of such gases as sulphur dioxide, carbon dioxide, carbon monoxide, methyl chloride, anhydrous

ammonia gas, oxygen, hydrogen, methane, ethane, ethylene, acetic acid vapors, acetone vapors, etc. Other types of gases and also vapors may be pumped in accordance with this invention. For the purpose of condensing, reclaiming and during the manufacture of such liquids as acetone, acetic acid and the like, the lubricant of this invention may be employed in the machinery handling the substances in the vapor stage.

Any suitable aryl phosphate may be employed as the lubricant. For medicinal purposes, that is, for gases to be used for human consumption or in or around foods intended for human consumption, it is advisable to employ as the aryl phosphate a tricresyl phosphate prepared in the manner described in application S. No. 708,475 filed January 26, 1934, or application S. No. 718,436 filed March 31, 1934. Although tricresyl phosphate as described in the above applications is preferable where the compressed gas is to be employed for medicinal or human consumption, other aryl phosphates may be employed where the gas is to be used for industrial purposes. Any of the aryl phosphates named in and prepared in the manner described in U. S. applications S. Nos. 706,360, filed January 12, 1934; 717,954, filed March 29, 1934; 720,448, filed April 13, 1934; and 50,714, filed November 20, 1935, may be employed.

While I prefer to employ those esters of phosphoric acid which are relatively non-volatile and non-inflammable, such as tricresyl phosphate (various isomers and mixtures of same), triphenyl phosphate, mixed cresyl and phenyl phosphate, trixylenyl phosphate (various isomers and mixtures of same), trinaphthyl phosphates, etc., it is to be understood that other organic phosphate esters may be employed which are somewhat more volatile and inflammable than those listed above. For example, in some compressors which operate at very low temperatures a mixture of alcohol and glycerine has been used as the lubricant. Glycerine is objectionable because it aids corrosion, is water soluble and becomes gummy. For these compressors a mixture of alcohol and tricresyl phosphate may be employed in accordance with this invention.

While the aryl phosphates are preferred, I may employ alkyl phosphate esters or mixtures of these with aryl phosphate. Examples of alkyl phosphate esters are triethyl phosphate, trimethoxy ethyl phosphate, tributyl phosphate,

esters described in U. S. Patent No. 1,982,903 and in Patent No. 1,994,530. The chlorinated phosphate esters may also be employed in accordance with my invention, such as tricresyl phosphate chlorinated to various degrees. Also the phosphite esters, such as tricresyl phosphite and triphenyl phosphite or the thiophosphates may be employed alone or in combination with any of the other esters listed above.

In certain types of compressors it may be advantageous to mix with the phosphate ester small quantities of mineral oil of the paraffin series or other lubricants, such as dichlormethyl stearate. The combination of aryl phosphates with chlorinated diphenyls and chlorinated naphthalenes are also comprised within the scope of this invention. Oxygen inhibitors may also be added to the lubricant such as small quantities, say .001%, of alpha or beta naphthol.

The aryl phosphate may be employed in a manner similar to mineral oil, and, if desired, may be thickened with soaps, greases, etc., for use in devices requiring a composited lubricant. By employing this invention, oxygen and other explosive gases may be handled with apparatus normally employed in the compression of air, and no expensive devices need be employed for maintaining the moving parts lubricated. The pumps, compressors, etc., employed may be water cooled or where the pump is acting as a suction pump, the pumps may be warmed by any suitable means, such as jackets surrounding the pumps wherein suitable medium may be circulated.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. Method of lubricating bearings of meters, without corrosion of bearing metals over periods of time, comprising applying to such bearings a lubricant consisting essentially of a non-volatile ester of phosphoric acid.

2. Method of lubricating bearings of meters, without corrosion of bearing metals over periods of time, comprising applying to such bearings a lubricant consisting essentially of tricresyl phosphate.

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