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PROCESS OF COMPRESSING GASES

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7 Claims. (Cl. 230—1)

This invention relates to a process of compressing gases containing corrosive constituents. More particularly it relates to a process for compressing gases containing condensable and corrosive vapors in the absence of any organic lubricant in a reciprocating type compressor. More particularly it relates to a process of compressing, to a high degree, gases containing vapors of nitric acid and oxides of nitrogen, such as those produced by the catalytic oxidation of ammonia, in which a reciprocating type of compressor is used to obtain high pressures and without the use of organic lubricants or corrosion of the compressor materials.

In many cases, it is desirable to compress to a high degree gases containing corrosive vapors, which can not be allowed to come in contact with the ordinary organic lubricants. For instance in the production of nitric acid, it is desirable to compress gases containing oxides of nitrogen, nitric acid, and some water vapor. Such gases can not be allowed to come in contact with organic lubricants because rapid deterioration of the lubricant will occur and dangerously explosive mixtures may also be formed with the organic materials. Heretofore, gases of this nature have had to be compressed in turbine type compressors which are not as efficient in the sizes desired as the reciprocating type; also they can not be used to obtain the high pressures desired. In the sizes desired and for the higher pressures the reciprocating type compressor is much the most efficient.

The use of flake graphite, graphite piston rings, or other graphite wearing surfaces in reciprocating type compressors has been suggested to avoid the use of organic lubricants, but the above gases usually contain some moisture, or, at least, are saturated. Considerable heat is generated in the compression of gases and to prevent an undue rise in temperature with resulting increased power consumption and damage to the machine it is necessary to cool the cylinders of a reciprocating compressor by circulating a cooling medium around them. Also the dew point of a gas is raised as the pressure is increased. Thus in the ordinary manner of operation of such a compressor liquid will be deposited in contact with the graphite and metal of the compressor. Then with such an electrolyte and two dissimilar materials in contact serious electrolytic corrosion of the metal of the compressor will occur.

The object of this invention is to provide an economical method of compressing these gases to pressures higher than has heretofore been economically possible. A further object is a method which will avoid contact with organic or liquid lubricating agents. A still further object is a method of eliminating corrosion.

These objects are accomplished by utilizing for the compression of these gases a reciprocating type compressor, in which one of the wearing surfaces is of a metallic composition and as smooth as possible, and the other is constructed, at least in part, of a graphite composition, and in which these surfaces are maintained, at least where the two dissimilar materials will come in contact with each other, at a temperature above the dew point of the gas in contact therewith. This is to avoid any danger of the formation of a liquid film in contact with the two dissimilar materials. For example, in the compressing of gases resulting from the catalytic oxidation of ammonia, a reciprocating type compressor is used, constructed for the most part either of iron or of a chromium-iron alloy. The cylinder and piston rod are made exceedingly smooth and the piston rings and piston rod packing are of a graphite composition. The gases, before entering the compressor, are passed through an entrainment separator to remove any mechanical entrainment, and may then be heated to a temperature above their dew point. In a multi-stage compressor this may of course be done between stages, each stage being considered a separate compressor. The cylinder and the compressor parts then instead of being surrounded by a cooling medium, are surrounded by a temperature regulating medium to maintain the temperature of the rubbing surfaces above the dew point of the gas in contact therewith. As the dew point of the gas is increased by increase of pressure, it is necessary that this temperature regulating medium be above the dew point of the gas at its highest pressure. For example, hot water will be circulating through the ordinary cylinder jackets, or what is more advantageous, the cylinder will be surrounded with a body of water maintained at its boiling point.

While I have described this method of operation to be particularly adaptable to gases containing moisture and oxides of nitrogen, it is adaptable to gases containing other corrosive constituents, particularly where the dew point is in the range of atmospheric temperatures. Gases such as, for instance, those containing moisture and chlorine or moist carbon dioxide may be advantageously handled in this way. While it is advantageous to construct the main

parts of the compressor, in contact with the gases, of a corrosion-resistant alloy, such for instance as a chrome-iron alloy, where gases containing oxides of nitrogen are being handled, this is not essential, and ordinary cast iron or iron alloys may be used, if the proper temperatures are maintained. While I have specifically mentioned the use of graphite piston rings or graphite wearing blocks carrying the piston, rings or wearing blocks of other compositions may be used. For instance, various special alloys or bearing metals which also have some self-lubricating properties or fiber or moulded compositions may be capable of use in my invention provided they fulfil the requirements set forth in the foregoing.

As many variations of this invention may be practiced without departing from the spirit thereof, I do not intend to limit my invention except as indicated in the following patent claims.

I claim:

1. The process of compressing gases containing oxides of nitrogen and water vapor and which condense at a temperature below the dew point to form a corrosive condensate, which process comprises compressing said gases in a reciprocating type compressor, the moving, frictional parts of which are constructed of two dissimilar materials, one of which is a metal and the other of which consists, at least in part, of graphite, and maintaining the temperature of said gases, while undergoing compression and in contact with said dissimilar frictional parts, at a temperature above the condensation point of said gases to prevent the electrolytically induced corrosion of said metal by reason of contact with any corrosive condensate.

2. The process of compressing gases containing a corrosive vapor including oxides of nitrogen, which process comprises removing from the gases substantially all entrained mist, heating the gases above the dew point of the corrosive vapor, compressing the gases while maintaining the gases above the temperature at which corrosive condensate can form, the gases thus maintained being compressed, in the absence of liquid organic lubricant, in a compressor, the frictionally moving and gas-contacting surfaces of which are comprised of at least two dissimilar materials, including a metal and graphite, whereby the electrolytically induced corrosive effect of said condensate on the compressor parts is substantially prevented.

3. The process of claim 2, in which said gases are compressed in a reciprocating type compressor.

4. The process of compressing gases containing oxides of nitrogen and water vapor and which condense at a temperature below the dew point to form a corrosive condensate, which process comprises removing from the gases substantially all entrained mist, compressing said gases in a reciprocating type compressor, the moving, frictional parts of which are constructed of two dissimilar materials, one of which is a metal and the other of which consists, at least in part, of graphite, and maintaining the temperature of said gases, while undergoing compression and in contact with said dissimilar frictional parts, at a temperature above the condensation point of said gases to prevent the electrolytically induced corrosion of said metal by reason of contact with any corrosive condensate.

5. The process of compressing gases containing oxides of nitrogen and water vapor and which condense at a temperature below the dew point to form a corrosive condensate, which process comprises heating the gases above the dew point of the corrosive vapor, compressing said gases in a reciprocating type compressor, the moving, frictional parts of which are constructed of two dissimilar materials, one of which is a metal and the other of which consists, at least in part, of graphite, and maintaining the temperature of said gases, while undergoing compression and in contact with said dissimilar frictional parts, at a temperature above the condensation point of said gases to prevent the electrolytically induced corrosion of said metal by reason of contact with any corrosive condensate.

6. The process of compressing gases containing oxides of nitrogen and water vapor and which condense at a temperature below the dew point to form a corrosive condensate, which process comprises removing from the gases substantially all entrained mist, heating the gases above the dew point of the corrosive vapor, compressing said gases in a reciprocating type compressor, the moving, frictional parts of which are constructed of two dissimilar materials, one of which is a metal and the other of which consists, at least in part, of graphite, and maintaining the temperature of said gases, while undergoing compression and in contact with said dissimilar frictional parts, at a temperature above the condensation point of said gases to prevent the electrolytically induced corrosion of said metal by reason of contact with any corrosive condensate.

7. The process of claim 1, in which the compression is carried out in the absence of a lubricant that forms hazardous mixtures with oxides of nitrogen within the compressor.

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