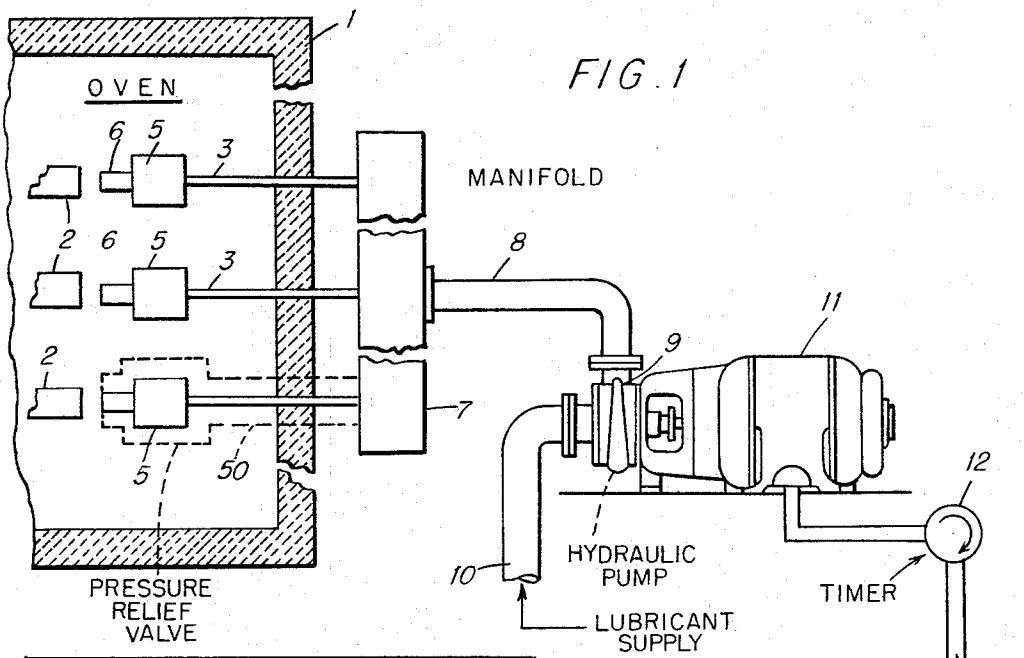
Sept. 27, 1966 R. J. HOLZINGER ETAL 3,275,102

HIGH TEMPERATURE LUBRICATION PROCESS

Filed Sept. 11, 1963

FIG. 1



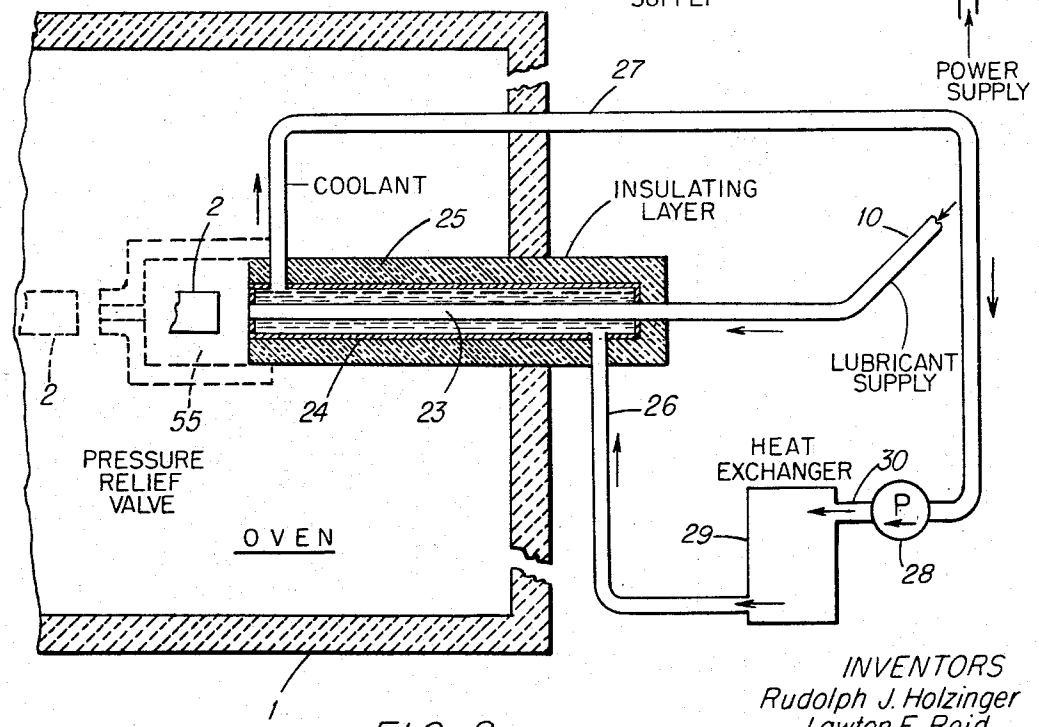


FIG. 2

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United States Patent Office 3,275,102
Patented Sept. 27, 1966

3,275,102

HIGH TEMPERATURE LUBRICATION PROCESS

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Filed Sept. 11, 1963, Ser. No. 308,273
8 Claims. (Cl. 184—1)

This invention is directed to the use of water-in-oil emulsions for lubricating equipment which must operate at ambient temperatures above 300° F. for extended periods of time and is particularly concerned with effective lubrication of oven conveyor chains.

In the manufacture of many products, there are involved various types of machinery which must operate at high temperatures. In commercial processes, such machinery is usually large and so expensive that continuous operation thereof is economically essential. Where there are moving parts exposed more or less continuously to the prevailing high temperatures, adequate lubrication with the proper lubricant is a prime requisite. In our application Serial No. 210,541, filed July 17, 1962, now Patent Number 3,213,024 of which this is a continuation-in-part, we have described lubricant compositions comprising emulsions of water in lubricating oil which have proved to be outstandingly successful for use on machines operating at high temperatures, e.g., 300–800° F. When such emulsion compositions are applied the oil surrounding the droplets of water is deposited on the areas where lubrication is desired. At the same time, the water in the emulsion is caused to flash off into steam due to the high temperatures of the machinery and the steam generated has a blasting effect which serves to remove carbon, dirt and similar deposits which tend to accumulate on the hot moving parts.

Giant ovens have been developed for continuously conveying materials therethrough which are generally about 100–300 ft. and up to 1000 ft. in length and which utilize continuous chains travelling over sprocket wheels to convey the articles through the heating zone. These ovens operate at approximately 300–800° F., depending upon the heat treating conditions required. The heat is supplied by heated air or gas which is circulated through the ovens by fans or blowers suitably located to maintain uniform temperature throughout the oven. The conveyor chains are continuous and usually contained substantially completely within the ovens. However, even such parts as may be outside the oven are not far removed therefrom and are still subjected to the high oven temperatures. The turbulence created by the circulating hot gas in the oven tends to carry in suspension fine particles of dust, dirt, dried stucco, board chips, fibers, and other particles from the product undergoing treatment which tend to deposit on the oil-wet chain links and rollers. Also, the oil used to lubricate the mechanism cracks at the high temperature of the oven producing carbonaceous deposits on the chains. Carbonaceous deposits likewise result from decomposition of organic materials, such as resinous binders, coatings and the like. The particles become embedded in the carbonaceous material which acts as a binder and these deposits seriously increase the chain load, requiring additional power to move the chain. These deposits can become so serious that they cause the chain links and rollers to "freeze" and may even cause the chain to buckle and break.

Current practice calls for application of lubricants to hot oven conveyors or the like by gravity feed. With the conventional type lubricants, this is generally unsatisfactory in that the oil may tend to vaporize prematurely and prevent adequate lubrication and/or cause carbon build-up on the conveyors. Even with the water-in-oil emulsion lubricants disclosed in our prior application, if gravity feed is used, care must be exercised to prevent excessive premature loss of water before the lubricant actually contacts the parts to be lubricated.

It is an object of this invention to provide a process for applying a water-in-oil emulsion lubricant to a hot surface to be lubricated.

It is a further object to apply a lubricant to equipment operating for sustained periods of time at temperatures of 300–800° F.

It is another object of this invention to lubricate conveyor chains and other moving elements in dusty ovens operating at temperatures of over 300° F.

It is yet another object to provide means for cleaning and lubricating moving elements while such elements are operating at high temperatures for sustained periods of time.

These and still other objects and advantages of the present invention will be more fully disclosed in the drawings annexed hereto and in the detailed description of the invention set forth hereinafter.

In the drawings:

FIGURE 1 represents a diagrammatic view, in elevation, of one form of the invention; and

FIGURE 2 represents a diagrammatic view, partly in elevation and partly in section, of another form of the invention.

In accordance with one aspect of this invention, moving mechanisms operating at ambient temperatures above 300° F. are effectively lubricated by applying a water-in-oil emulsion lubricant composition to the mechanisms while the lubricant is still in the form of an emulsion at the time of contact with the mechanisms, the lubricant emulsion having been maintained, prior to such contact, at a temperature and pressure sufficient to keep the water in the emulsion in liquid form. In the lubrication of moving parts in a high-temperature oven, for instance, the feed lines which carry the lubricant to the points of lubrication must, at least partially, be located inside the oven. Other parts of the lubricating system are in close proximity to the oven where temperatures tend to exceed the boiling point of water. As a consequence, water will be prematurely and undesirably lost from the water-in-oil lubricant emulsion and, in addition, vapor lock of the feed lines may be caused. The present invention serves to avoid these objectionable difficulties.

As shown in FIGURE 1, the invention is applied to an oven **1** with moving mechanisms **2**, to be lubricated. Passing through a wall of the oven, there is provided one or more lubricant feed lines **3** carrying presusre relief valves **5** and lubricating nozzles **6** at the oven ends of such feed lines **3**. The other ends of the feed lines are connected to manifold **7** which is supplied by feed line **8** from pump **9**. Lubricant from a suitable supply source is carried to pump **9** through line **10**. The pump is driven by a suitable power source such as electric motor **11**, driven by power supplied through timer switch **12**.

In operation, a water-in-oil emulsion lubricant is supplied, successively through line **10**, pump **9**, line **8**, manifold **7**, lines **3**, pressure relief valves **5** and nozzles **6** to mechanisms **2** in oven **1**, thereby lubricating such mechanisms. The pressure relief valves **5** are set for a pressure slightly higher than that necessary to maintain the water in the lubricant emulsion in liquid form at the temperatures encountered in the oven **1**. Thus, at an oven temperature of 450° F., the vapor pressure of water is 422.6 p.s.i.a., and the lubricant is maintained at a pressure slightly above that point, e.g., 450–500 p.s.i. Under these conditions, with relief valves **5** set for about 475 p.s.i., and

with pump 9 being capable of delivering the lubricant at about 500 p.s.i., timing device 12 is activated to operate motor 11 and connected pump 9 to deliver lubricant at periodic intervals under pressures of about 500 p.s.i., sufficient to overcome the setting of relief valves 5. This sequence of operations serves to supply the lubricant to the mechanisms in adequate quantities without premature loss of water from the lubricant emulsion. Of course, if desired, the pump 9 may be operated continuously to supply a steady stream of lubricant to the mechanisms.

In the preferred construction, nozzles 6 have somewhat larger inner diameters than those of feed lines 3. This serves to provide more effective relief of pressure than would otherwise be the case and jetting or spraying of the lubricant is avoided. It is also preferred that the lengths of nozzles 6 be kept to the minimum consonant with adequate lubrication without volatilization so that the lubricant is applied to the mechanisms in the form of a substantially uniform emulsion.

When using a pump to deliver the lubricant as shown in FIGURE 1, it may often be desirable to keep it running continuously rather than intermittently. This can be done by using a closed hydraulic circuit, with a valve (not shown) located in the high pressure leg and actuated by a timer which will release a fixed amount of lubricant at predetermined intervals into the manifold. Such an arrangement would also provide continuous homogenization of the emulsion if normal operation is interrupted.

It should also be noted that the feed lines and other elements in this lubricating system, which operate in the hot ovens or closely adjacent thereto, should be as short as possible to minimize heat transfer to the emulsion lubricant. If desired, the temperatures of these feed lines and the like, may be controlled by applying heat insulation thereto, by use of coolant in a surrounding jacket, or by combinations thereof, as indicated, diagrammatically in dotted lines by 50 in FIGURE 1, with respect to a single feed line. In practice, such expedients could be applied to all elements which require this protection from exposure to the extremely high temperatures prevailing. A system for such temperature control is shown in greater detail in FIGURE 2, wherein similar numbers represents parts similar to those shown in FIGURE 1.

As shown in FIGURE 2, oven 1 with moving mechanisms 2 therein, is provided with feed line 23 passing through a wall of the oven. Feed line 23 is surrounded by a cooling jacket 24 and outer layer or jacket 25 which may be in the form of high-temperature insulation or a closed jacket containing air or other inert heat insulating gas. Cooling jacket 24 is furnished with inlet conduit 26 and outlet conduit 27, which is attached to pump 28. A heat exchanger 29 is connected to pump 28 through conduit 30 and also to jacket 24 through conduit 26.

According to the modifications shown in FIGURE 2, a water-in-oil lubricant is supplied under relatively low pressure, static or pump, to feed conduit 23 passing through cooling jacket 24 and thence to mechanisms 2 which are lubricated thereby. Coolant fluid in jacket 24 keeps the temperature of the lubricant in line 23 from rising above the critical temperature of the water contained therein. The coolant fluid may be any one of the many available heat transfer fluids, preferably one that does not boil at the temperatures prevailing in the oven or the like since one may thus avoid the necessity for use of high pressure conduits which would otherwise be required to prevent rupture of the conduits in the event of failure of circulation. Coolant fluid passes through outlet conduit 27 and pump 28 to a heat exchanger 29 through conduit 30. Heat exchanger 29 lowers the temperature of the hot coolant fluid to the desired point and the cooled fluid is then returned to jacket 24 through feed conduit 26. The lubricant may be supplied to the system at pressures just sufficiently above atmospheric to ensure adequate flow to the point where lubrication is desired. Intermittent lubrication may be somewhat more effective than continuous lubrication. Suitable valves, pumps and the like, not shown, may be operated to give periodic feeding of the lubricant.

The temperature of the emulsion lubricant as applied to the mechanisms to be lubricated as in FIGURE 2, may be close to atmospheric and with adequate cooling, the pressure of the lubricant is not substantially above atmospheric. If it is desired to reduce the amount of cooling and operate at higher temperatures, slightly higher pressures should prevail in the lubricant feed lines in such event, one may use a pressure relief valve, indicated diagrammatically in dotted lines by 55, which operates in substantially the same manner as similar valves 5 in FIGURE 1. More specifically, the lubricant can be maintained at an intermediate temperature of 250° F. by proper control of the coolant fluid temperature. At 250° F., a lubricant system pressure of 30 p.s.i.a. would contain the water within the emulsion. The pressure relief valve 55 set to operate at pressures slightly above 30 p.s.i.a. would be effective. Whether or not a relief valve is used, it remains desirable to apply the lubricant to the mechanisms as soon as possible after its issuance from the point of temperature and pressure control. As pointed out in connection with FIGURE 1, it is desirable to prevent jet or spray discharge of the lubricant. As a further modification of the system shown in FIGURE 2, the lubricant before being fed into the supply conduit 23, may be refrigerated by any suitable means and the need for cooling would be accordingly reduced, particularly if the feed lines are efficiently insulated. Prerefrigeration of the lubricant supply to the pump 9 in FIGURE 1 would also be effective in reducing the pressures required for maintenance of the water in liquid form.

As described above, according to the present invention, the pressure and temperature of the lubricant are controlled so that the emulsion can reach the surfaces to be lubricated without substantial loss of water. Thus, the lubricant is applied as a liquid rather than a mist permitting it to penetrate in unaltered form. Subsequent intimate contact with hot metal, in addition to providing lubrication, provides steam cleaning action to control deposits originating from the material being processed or decomposition of the lubricant, or both. Because the water is vaporized on contact, the steam acts as a "snuffer" and stack fires are eliminated. Use of our lubrication method with our novel lubricants greatly minimizes formation of carbon or other deposits. Such deposits as may be formed contain numerous small gas pockets caused by the expanding steam, imparting a friable consistency to such deposits so that they are easily dislodged, frequently by the action of the moving mechanisms itself, without need of other means of removal. These results serve to increase the life and usefulness of the lubricated mechanisms while at the same time decrease power requirements significantly.

The water-in-oil emulsions used in the present invention are described in great detail in our application Serial No. 210,541. Broadly, these emulsion lubricants comprise about 0.1 to 5.0 percent, by weight, sufficient to emulsify the water and oil, of an emulsifier, about 0.1 to 5.0 percent, by weight, of a high-temperature stabilizer for said emulsion, the combined emulsifier and stabilizer having an HLB (hydrophilic-lipophilic balance) number of about 2–8, the oil portion of said emulsion being a hydrocarbon oil of from about 50–1000 SUS viscosity at 100° F. in the amount of about 85–30 percent, by weight, the water content of said emulsion being 15–70 percent, by weight, and about 0.05 to 5.0 percent, by weight, of a solid lubricant in finely divided form. It is obvious that any of the lubricants set forth in that application may be used under the present invention.

Various modifications and changes other than those set forth above may be resorted to without departing

from the spirit and scope of the invention. Such variations and modifications are considered to be within the scope of the appended claims.

What is claimed is:

1. In a process for applying water-in-oil emulsion lubricants to hot moving mechanisms operating within a heated zone at ambient temperatures above about 300° F., the steps comprising:

(1) conveying the emulsion lubricant to and into the said heated zone;

(2) maintaining the said emulsion lubricant in an emulsified state under such temperature and pressure conditions as to prevent conversion of the water in the emulsion lubricant into steam prior to its application; and

(3) directing said emulsion lubricant in an exposed steam through said heated zone toward the hot moving mechanism, contact therewith causing the water to evaporate on the surface of the said mechanism, whereby the said evaporation cools and cleans the surface of the said mechanism and leaves a deposit of oil on the said surface.

2. The process of claim 1 in which the emulsion lubricant is maintained at a pressure slightly above atmospheric and at a temperature below the critical temperature of water at that pressure.

3. The process of claim 1 wherein the ambient temperatures in the heated zone range from about 300° to about 800° F.

4. The process of claim 1 wherein the pressure temperature of the heated zone is about 450° F. and the

lubricant in step 2 is maintained at a pressure of about 450 to 500 p.s.i.a.

5. The process of claim 1 in which the lubricant is maintained at a temperature of about 250° F. and at a pressure of about 30 p.s.i.a. until it is applied to the mechanism.

6. The process of claim 1 wherein the heated zone is an oven.

7. The process of claim 1 wherein the hot moving mechanism is an oven conveyor mechanism.

8. The process of claim 1 wherein the emulsion lubricant contains by weight of total emulsion: from about 0.1% to about 5% of an emulsifier, from about 0.1% to about 5% of a high temperature stabilizer for said emulsion, the combined emulsifier and stabilizer having a hydrophilic-lipophilic balance number of from about 2 to about 8; about 85% to about 30% of a hydrocarbon oil having an SUS viscosity at 100° F. of about 50 to 1000, and about 15% to about 70% of water and about 0.05% to about 5.% of a solid lubricant in finely divided form.

References Cited by the Examiner

UNITED STATES PATENTS

2,664,173	12/1953	Korig	184—104
2,794,681	6/1957	Suess	239—132
3,074,648	1/1963	Stone	239—132

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