Title: METHOD AND APPARATUS FOR IMPROVING THE DELIVERY OF OIL OF A WICK LUBRICATION SYSTEM FOR A LOCOMOTIVE TRACTION MOTOR SUPPORT BEARING

Abstract: An improved wick-holder for mounting a felt lubricating wick of a lubricating system for lubricating the axle journal surface supported in a support bearing of a traction motor used in a locomotive is provided with a plurality of oil-reservoir louver pockets or splash-cups molded or pressed into the wick holder which store oil from the time that the oil reservoir was full or near its maximum height and which store splashed oil during normal operational use, and delay the runoff of the oil to increase the oil saturation of the wick housed within the wick holder. The oil reservoir pockets are located above the minimum serviceable oil level, and are designed to improve and increase oil saturation of the wick. As a result of the increased oil saturation, the wick are, therefore, capable of delivering increased amounts of oil to the axle journal area. Each reservoir pocket or splash cup is preferably louver-shaped, whereby during normal locomotive operating service, the splashing of oil in the bearing housing oil reservoir is collected and delivered to the lubricating wick. In a second embodiment, the reservoir pockets or splash cups are provided on a separate splash sleeve. In another version, improved lubrication is achieved by means of a passive inertia-activated pump mounted for submersion in the axle-cap lubricant-reservoir at a level that ensures that for all levels of the reservoir, the pump inlet is submerged in the lubricant of the reservoir, and the output of the passive inertia-activated pump is directed to the surface-inter face between the felt wick and the axle journal surface area to increase the lubrication thereof over and above that which normally ensues owing to the conventional capillary action of the felt wick. In a modification of the first embodiment, the pump is mounted to the splash sleeve forming part of the wick-holder.
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METHOD AND APPARATUS FOR IMPROVING THE DELIVERY OF OIL OF A
WICK LUBRICATING SYSTEM FOR A LOCOMOTIVE TRACTION MOTOR
SUPPORT BEARING

BACKGROUND OF THE INVENTION

The present invention is directed to an improved wick holder used in a lubricating system for lubricating the axle-journal surface mounted in a support bearing of a locomotive traction motor. The wick holder supports and mounts a central lubricating wick having a lower end portion or section received in an oil reservoir, which oil, via capillary action, is delivered by the wick to the axle-journal surface by means of a window formed in the shell of the traction motor support bearing. The other, upper wick-face section of the wick is received in the window for contact against the axle-journal surface, to thereby provide the proper lubrication.

Examples of this lubricating system are disclosed in the U.S. Patent Nos.: 2,980,472; 3,827,769; 3,905,659; 4,229,056; and 5,082,089. One such prior-art system is also shown in Fig. 1, and is indicated generally by reference numeral 10, and includes an oil reservoir 12 for storing lubricant, and a carrier assembly 14 connected to the axle cap 16 of a friction support bearing 18 used for mounting a locomotive traction motor to the wheel axle assembly. The carrier assembly 14 has a spring 22, such as a coil or torsion spring, that biases a wick-holder unit 34 toward a window 26 formed in the shell of the friction support bearing 18, through which window oil is delivered to the axle-journal surface 37 mounted in the friction support bearing.
The wick-holder unit consists of a slide bracket element or member 32 which is mounted for sliding movement in the carrier assembly 14, a wick holder member 34 of arcuate shape that is connected to the slide bracket element 32, and a felt wick 36 having an upper section of similar arcuate shape mounted in the wick holder 34.

The above-described wick lubricator assembly of the prior art, however, has serious shortcomings. Specifically, these prior art oil-lubricating delivery systems have decreasing ability to deliver a continuous amount of oil to the axle-journal surface area as the oil level in the journal box is consumed over time, as the oil level in the oil reservoir decreases, even though the wick had initially absorbed oil to saturation.

When a new traction motor/axle wheel set of a locomotive is placed into service, it has approximately twelve pints of journal oil added to the bearing oil reservoir. Capillary-oil lift is typically less than two inches. During normal operation, the oil is consumed and the oil level in the reservoir continues to drop, resulting in reduced oil-saturation of the felt wick. As a result, the oil delivery-rate is reduced in inverse proportion to the increased required oil-wicking height. The result of this reduced oil delivery can be a repetitive cycle of reduction in the load bearing capacity of the journal and an increase in the operating temperature of the bearing each time the locomotive accumulates mileage between normal servicing. As a result of this reduction of lubrication delivered to the journal, the margin of excess bearing capacity can be reduced such that a condition is created that can end in a failure of the bearing and axle.

It would, therefore, be advantageous to provide an improved wick-lubricating delivery system for an axle-journal surface supported by a friction bearing of a locomotive traction motor that diminishes the adverse effect of oil depletion in the journal box and oil reservoir, in order to continue to supply the requisite lubricating oil to the axle-journal, thereby reducing railroad
operating expenses by improving reliability and length of service of the existing traction motor/axle-wheel set combination.

SUMMARY OF THE INVENTION

It is, therefore, the primary objective of the present invention to provide a supplemental lubricant-delivery system for enhancing the lubrication of the axle-journal surface-area by optimizing the amount of oil delivered to the face of the wick lubricator and, therefore, to the axle journal surface-area.

It is, also, the primary objective of the present invention to provide an improved wick-holder for a wick lubricating system for the axle-journal surface supported by a friction support bearing of a locomotive traction motor which delivers a greater amount of oil even as oil is depleted from the oil reservoir.

In accordance with the present invention, an improved wick-holder for mounting a felt lubricating wick is provided with a plurality of oil-reservoir pockets or cups molded or pressed into the wick holder which store oil from the time that the oil reservoir was full or near its maximum height. These reservoir pockets also collect oil that has been splashed or sloshed within the oil reservoir during normal locomotive operation, thereby delaying the run off of the oil and to increase the oil saturation of the wick housed within the wick holder. These oil reservoir pockets are located above the minimum serviceable oil level, and are designed to improve and increase oil saturation of the wick. As a result of the increased oil saturation, the wick is, therefore, capable of delivering increased amounts of oil to the axle-journal surface. This increased amount of oil saturation provides better protection against axle-journal bearing failure in the event that a locomotive is operated with insufficient or diminished oil levels. It also provides reduced wicking height. Felt wicks exhibit an ability to be saturated with liquids and lift
the liquids above the level of the liquid in a reservoir. This ability is called "wicking height" and is measured in linear graduations after a given period of time while the viscosity of the liquid is maintained at a standard value. The higher the wick is sampled above the reservoir, the smaller the percent of saturation is encountered. In accordance with the improved wick holder of the invention, when lubricant is artificially introduced via the collection reservoir pockets during splashing of oil in the oil reservoir, the percent saturation above these locations will be increased and, in turn, the lubricant available at the delivery wick-face will be increased. The increased oil saturation at an intermediate height of the wick will reduce the required wicking height of the wick, therefore allowing a greater amount of oil lubrication at the axle journal. The increased wick saturation and delivery rate act to reduce wick-face temperatures and extend the life of the wicks. The increased amount of oil saturation and reduced wicking height provide increased protection against traction motor support-bearing failure if a locomotive is used with axle-journal oil levels near the recommended minimum oil levels. In addition, the increased saturation may increase time interval between scheduled wick replacements.

The reservoir pockets are preferably shaped as louvers, whereby during normal locomotive operating service, with the traction motor being subject to significant "g" force acceleration, "oil sloshing" and "oil splash" in the bearing-housing oil reservoir occur, whereby these louver-shaped splash cups or pockets of the wick holder of the present invention capture or collect oil as it sloshes or splashes during locomotive service. The captured oil is immediately absorbed into the wick's felt material and then transferred to the axle-journal surface area by capillary action.

In another embodiment of the invention, a splash sleeve made of metal or elastomeric material is provided that slides over the tail or lower end section of the existing felt wick
lubricator. This splash sleeve is used to encase the lower end portion of the wick below the existing wick support holder. The splash sleeve preserves the maximum possible exposure of the felt wick to lubrication oil, while introducing splash louvers on each side of the lubricator pad. The splash sleeve is preferably held in place by, for example, a retaining pin that passes through the sleeve and between the two felt layers of the felt wick, and rests upon the main bodies of the two rivets which clamp these two felt layers together.

In accordance with another version of the invention, an improved lubricating system for use with a wick-holder mounting a felt lubricating wick is provided with a passive inertia-activated pump mounted for at least partial submersion in the axle-cap lubricant-reservoir whereby at least the pump inlet is submerged in the lubricant of the reservoir. In a one embodiment thereof, the passive inertia-activated pump takes the form of a piston-type pump, while in another embodiment, the passive inertia-activated pump takes the form of a diaphragm pump. In either embodiment, the inlet of the passive inertia-activated pump is submersed in the lubricant-reservoir, and the output of the passive inertia-activated pump is directed to the surface-interface between the felt wick and the axle journal surface-area to increase the lubrication thereof over and above that which normally ensues from that owing to the conventional capillary action of the felt wick. In a modification, the passive inertia-activated piston pump is mounted to the splash sleeve forming part of the wick-holder which is telescopingly received over the free end of the felt wick, with the output of the pump delivering the lubricant to the surface-interface between the felt wick and the axle journal surface-area interiorly via the hollow interior-volume of the splash sleeve and wick holder proper.
In another embodiment, the passive inertia-activated pump of the invention entirely replaces the prior-art wick-lubricating system, to be the only delivery source of lubricant to the surface-interface between the support bearing and axe journal.

**BRIEF DESCRIPTION OF THE DRAWING**

Reference is had to the drawings, wherein:

Figure 1 is a partial vertical cross-sectional view of a prior-art locomotive traction support bearing and axle cap, and showing the prior-art lubricating system;

Figure 2A is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap, and showing a first embodiment of the improved lubricating system of the invention;

Figure 2B is a side elevational view of the first embodiment of Fig. 2A showing the wick holder in isolation, incorporating the louver-shaped reservoir pockets of the invention;

Figure 2C is a partial cross-sectional rear view of the wick holder of Fig. 2B, showing the louver-shaped reservoir pocket of the invention which had been formed by punching out material from the wick holder itself;

Figure 3 is a first isometric view of a second embodiment of the invention where a splash sleeve incorporating louvers which in combination with the wick form reservoir pockets is used for attachment over the bottom or lower portions of a wick lubricator;

Figure 4 is a second isometric view of the second embodiment of the invention of Fig. 3;

Figure 5 is a plan development view of a metal forming the splash sleeve of Fig. 3, prior to forming the sides thereof;

Figure 6 is an end view thereof;
Figure 7 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap, and showing the splash sleeve of the second embodiment of the invention mounted in place over a lubricating wick;

Figure 8A is a side elevational view of the second embodiment of Fig. 3 showing the wick holder incorporating the splash sleeve of the second embodiment;

Figure 8B is a plan view of a retaining pin for fastening the splash sleeve of the second embodiment to the felt wick;

Figure 9 is a side elevational view similar to Figs. 2B and 8A of a third embodiment of the invention which is a combination of the first embodiment of Fig. 2A and the second embodiment of Fig. 4;

Figure 10A is a rear, plan view of a fourth embodiment of the invention similar to the first embodiment of Fig. 2A but incorporating only one reservoir pocket of the invention, on the interior, or bearing-facing, surface of the wick-holder;

Figure 10B is a partial side elevational of the fourth embodiment of Fig. 10A;

Figure 11A is a rear, plan view of a fifth embodiment of the invention similar to the first embodiment of Fig. 2A where the wick holder is extended downwardly in the interior, or bearing-facing, surface for providing additional reservoir pockets or compartments facing interiorly toward the bearing surface;

Figure 11B is a partial side elevational of the fifth embodiment of Fig. 11A;

Figure 12A is a front, plan view of a sixth embodiment of the invention similar to the fifth embodiment of Fig. 11A but where the wick holder is extended downwardly in the exterior, or outwardly-facing, surface thereof for providing additional reservoir pockets or compartments facing the exteriorly away from the bearing surface;
Figure 12B is a partial side elevational of the sixth embodiment of Fig. 12A; and

Figure 13 is an isometric view similar to Fig. 4 but showing the retaining pin in place for securing the splash sleeve of Fig. 4 on the lower end of the lubricating wick;

Figure 14 is an end view thereof;

Figure 15 is a side view thereof; and

Figure 16 is a graph showing the improved oil delivery rate of the wick lubricator according to the invention versus the prior art;

Figure 17 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap similar to Fig. 1, but showing the lubricating system of a seventh embodiment of the present invention that incorporates a passive, inertia-activated slosh pump of the invention for enhancing oil flow to the face of the central wick lubricator;

Figure 18 is a side view, in partial cross section, showing the slosh pump of Fig. 17;

Figure 19 is an end view thereof;

Figure 20 a vertical cross-sectional view of the inlet of the slosh pump of Fig. 18;

Figure 21 a vertical cross-sectional of the outlet of the slosh pump of Fig. 18;

Figure 22 is a front view thereof;

Figure 23 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap similar showing the lubricating system according to a modification of the seventh embodiment in which the slosh pump of Fig. 18 is incorporated as part of a reservoir-pockets splash sleeve of Fig. 3;

Figure 24 is a side elevational view showing a wick holder with attached splash sleeve of Fig. 23 incorporating the slosh pump of Fig. 18;

Figure 25 is a front view thereof; and
Figure 26 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap similar to Fig. 23, but showing the lubricating system of the invention according to another modification thereof in which the inlet of the slosh pump of Fig. 23 is located interiorly, rather than exteriorly, of the central wick lubricator;

Figure 27 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle cap similar showing the lubricating system according to another embodiment of the present invention in which the slosh pump of Fig. 17 is diaphragm pump;

Figure 28 is a detail view of the diaphragm pump of Fig. 27; and

Figure 29 is a partial vertical cross-sectional view of a locomotive traction support bearing and axle showing the lubricating system according to yet another embodiment where the slosh pump of Fig. 17 or Fig. 27 of the invention is used alone for lubrication.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings in greater detail, and to Figs. 2A-2C, there is shown the first embodiment of the improved wick holder of the invention. The wick holder 40 of the first embodiment of the invention is similar to that utilized in the conventional wick holder assembly 10 of the prior described hereinabove with reference to Fig. 1, with the exception that wick holder member 44, which is similar in arcuate shape as the wick holder member 34 of the prior art, is provided with two reservoir louver pockets or collectors 46, 48, at a location along the height of the wick holder member 44 that is above the minimum serviceable oil level of the oil reservoir 12. The two louver pockets 46, 48 are provided along the main elongated front and rear surfaces of the wick holder element 44, and at an approximate height where the wick holder's curvature is most pronounced, although other heights are also suitable. The first, inwardly-facing reservoir louver pocket 46 is formed on the bottom or rear, interior-facing wall or surface 42' of
the wick holder, while the reservoir louver pocket 48 is formed on the upper or front surface or wall 42" facing away from the bearing surface. Owing to the curvature of the wick holder 40, the front reservoir louver 48 is at a higher elevation than that of the lower reservoir louver. The lower reservoir louver 46, being closer to any minimum serviceable oil level on the oil reservoir 12, serves to collect and provide oil to the lubricating wick during such minimum level as compared with the upper reservoir louver.

The location of these reservoir louvers 46, 48 are such that, when the oil level in the oil reservoir tank 12 falls to a level below the cups 46, 48, the reservoir louvers 46, 48, collect oil that has been splashed within the reservoir during normal locomotive operation, and delay the run off of the oil to increase the oil saturation of the wick housed within the wick holder, in order to continue to provide additional wick-lubrication from internal oil-splashing and sloshing, even after the oil level falls to a minimum serviceable level below the height of the reservoir louvers 46, 48 due to the normal splashing and sloshing of the oil in the reservoir 12 during normal operation of the locomotive. The splashed oil is collected in each reservoir louver via each upwardly-facing opening 46', 48', respectively, and delivered to the felt wick lubricator via an opening 46" formed in the wick-holder member in opposite juxtaposition to each louver 46, 48 as seen in Fig. 2C. As may be seen in Fig. 2C, each reservoir louver pocket is formed by punching out a portion of the material of the wick holder, to thus form the upwardly-facing openings or mouths 46', 48', respectively, and to also form the front wall 50 thereof. In the preferred form of the invention, the lower, rear louver is less than two inches away from the wick delivery face of the wick, although this distance may be changed.

The splash reservoir louvers 46, 48 are initially submerged under the oil-line of the oil reservoirs during normal use. As the oil is consumed during normal service-operation of the
locomotive, with the concomitant falling of the oil level below the splash reservoir louvers 46, 48, oil saturation of the wick material is restored at the intermediate point of the wick from the oil stored in these splash reservoir louvers and directed toward the wick. While the reservoir louvers 46, 48 are submerged in the oil, they continue to feed the felt and maintain maximum wick oil saturation in parallel with the wick-tail immersion. During locomotive operating service, the journal oil in the bearing housing reservoir is sloshed and splashed within the bearing housing reservoir, and continuously refills the splash louvers to maintain maximum oil saturation of the wick material, even after the oil level in oil-reservoir 12 has fallen below the entrance mouths 46', 48'.

Referring now to Figs. 3-8, there is shown a second embodiment of the invention. In this embodiment, a separate, independent splash sleeve 60 is used that slides over, or is telescopingly received about, the free end-portion 36' (Fig. 1) of the felt wick lubricator stationed in the oil reservoir. This free end-portion of the wick lubricator 36 is that which projects downwardly from the wick holder, such as wick holder 34 of Fig. 1.

The hollow splash sleeve 60 is made of metal, plastic, or other suitable material, and is preferably rectilinear in cross section to match the shape of the felt wick lubricator 36 over which it is received. The splash sleeve 60 is provided with a series or plurality of elongated openings 62 on all four surface walls in order to allow the oil stored in the oil reservoir 12 to pass therethrough and lubricate the felt wick lubricator. These openings 62 are necessary since the splash sleeve covers the portion of the felt lubricator that is usually positioned within or inside the oil of the oil reservoir during at least the higher oil levels of the reservoir.

The splash sleeve 60 is also provided with a series or plurality of oil-collecting reservoir pockets or cups 64 on each of the longer rear and front walls 60', 60" of the splash sleeve. Each
pocket or cup 64 may be a louver similar to those described hereinabove with respect to the first embodiment, but in the preferred embodiment are pockets or cups, that are arranged in a vertical array where each is parallel to another, although different formations may be utilized, as well as more or less than the three cups 64 shown in the drawing for each of the front wall surface 60' and rear wall surface 60".

Each cup 64 has an upper opening or mouth formed to form a front wall 66 and side walls 66', 66", which form a temporary reservoir for delivering the oil splashed therein during normal operation of the locomotive, for subsequent delivery to the felt wick located within the splash sleeve, via openings 70 cut out of the splash sleeve during formation of each cup 64, similar to the opening 46' of Fig. 2C. As can be seen in Fig. 7 and 8A, the splash sleeve 60 covers the lower exposed portion 36' of the wick lubricator extending or protruding from the bottom of the wick holder 34.

Referring to Figs. 8B and 13-15, there is shown the manner by which the splash sleeve 60 is secured or mounted about the wick lubricator by means of, for example, a retaining pin 70' that passes through oppositely-aligned openings 62' of the side walls 64', 66' of the sleeve 60 and through the interface of the felt layers of the felt wick lubricator. The retaining pin 70' has a first tapered end 72 to aid in the insertion of the pin through and between the felt layers of the wick lubricator, and a second enlarged end 74 defining an annular retaining groove 76 for receiving therein portions of the circumferential rim in an opening 62' in one of the side walls 64', 66' through which the pin has been passed, to retain the pin in place. The portion of the pin 70' directly adjacent to, and inwardly of, in a direction taken from the enlarged end 74 toward the tapered end 72, is canted or sloped in order to provide a snap-fit type of connection. The pin 70' is preferably oval in cross section as the shape of the openings 62' of the side walls 64', 66'.
However, other cross-sectional shaped may be employed, with the openings in the side walls through which it passes being of similar cross section and matching dimensions. As may be seen in Figs. 13-15, the retaining pin 70' rests upon the conventional two rivets 70" that hold two felt layers of the conventional wick together at the bottom or wick tail-end of the lower exposed portion 36' of the wick, thereby supporting and retaining the splash sleeve on the wick tail-end of lower exposed portion 36'. As seen in Figs. 13-15, when mounting the splash sleeve to the lower, or tail-end, of the lubricating wick, the retaining pin is inserted at the interface between the two felt-layers of the wick and rests upon the two spaced-apart rivets, which extend perpendicularly to the length of the retaining pin 70', which rivets, in the conventional manner, secure the two felt-layers of the wick together. It is, of course, possible to secure or mount the splash sleeve to the wick in other ways or manners.

Referring to Fig. 9, there is shown yet another embodiment of the invention which is a combination of the first two embodiments. In this embodiment, the wick holder 80 is the same as the wick holder 40 of Fig. 2A-2C, with the two reservoir louvers 46, 48. In order to enhance even more the lubrication of the wick, the splash sleeve 60 of the second embodiment of Figs. 3-8 is also simultaneously employed over the cantilevered end of the felt lubricating wick, as described herein above with reference to Figs. 3-8. In this embodiment, as shown, the reservoir collectors 64' are shaped as louvers, as in the reservoir louvers 46, 48 of the wick holder.

Figs. 10A and 10B show a modification of the first embodiment of Figs. 2A-2C, where instead of utilizing two louver-shaped reservoir pockets or cups 46, 48, only the inner, or bearing-support facing, reservoir pocket 46 formed in the rear wall of the wick holder is used.

Figs. H A and H B show a modification of the embodiment of Figs. 9A-9B, where the wick holder 90 is similar to wick holder 40 of Fig. 2A-2C, but with an interior and downwardly-
projecting extension 92 extending integrally from, and serving as an extension of, the rear wall or surface 42'. Punched out of this rear-wall extension 92 are a plurality of the reservoir louvers 92'. The length of the extension 92 may vary depending upon lubricating requirements. The extension 92 preferably extends about one inch from the main wick frame, although this length may be different.

Figs. 12A-12B show yet another modification similar to the modification of Figs. 11A and 11B, but instead of a rear-wall extension having louver-shaped reservoir cups formed therein, the wick holder 100 of this modification has an exterior and downwardly-projecting extension 102 extending integrally from, and serving as an extension of, the front wall or surface 42" of the wick holder 40 of the first embodiment of Figs. 2A-2. Punched out of this rear-wall extension 102 are a plurality of the louver-shaped reservoirs 104. The length of the extension 102 may vary depending upon lubricating requirements. It is also noted, that in this modification, the front or upper surface 42" of the wick holder is provided with three separate wick reservoir pockets: A central one 106, and two end ones 108, 110, instead of the one louver-shaped reservoir 48 of Fig. 2A-2C. The extension 102 preferably extends about one inch from the main wick frame, although this length may be different.

Referring now to Fig. 16, there is shown a graph depicting the enhanced lubrication of the friction support bearing utilizing the invention in contradistinction to the lubrication of achieved in a conventional unit, and shows wick-oil delivery rate vs. oil consumption, that is, the oil level of the reservoir 12. The upper line "A" represents the maximum improvement of oil delivery rates according to the present invention, while the lower line that of the prior-art system. As can be seen, while at the beginning, immediately after servicing, the rates for both are the same (y-axis intercept), where the oil in the reservoir 12 is at its maximum. Over time, however,
as oil is consumed during normal usage, the oil delivery rate provided by that of the present invention is consistently greater, with the difference in the delivery rate between that of the present invention and that of the prior art system, increasing the greater the drop in the level of the oil in the reservoir 12. The line "B" represents this range of possible improvement in the oil delivery rate between the system of the present invention and that of the prior art.

The length of the reservoir pocket of the invention is preferably approximately three inches in length, although each may be made shorter or longer.

In order to explain the enhanced lubrication provided by the louver-shaped reservoir pockets of the invention, the oil delivery rate is defined by the following equation:

\[
\text{Oil Delivery} = Q = \frac{[K_u A F_0 (h_u - h)]}{\mu L} = 5 \text{ max. cm}^3/\text{min}
\]

where,

- \(K_u\) = approximately 4.6 for mineral oil and SAE grade F-I felt,
- \(A\) = cross-sectional area of the wick (cm\(^2\)),
- \(F_0\) = volume fraction of oil in saturated wick (approximately .75),
- \((h_u - h)\) = vertical lift [ultimate lift ability of SAE grade F-I felt (about 18 cm] minus the elevation of the wick face above the oil supply],
- \(\mu\) = approximately 58 centipoise viscosity at 40 degrees C. oil temperature;
- \(L\) = distance from the wick delivery face to the point of absorption (cm).

The two terms \((h_u - h)\) and \(L\) are the ones that are favorably effected by the addition of the oil reservoir pockets of the invention. The term \((h_u - h)\) is increased in magnitude as the required lift is decreased by introduction oil above the reservoir surface. At the same time, the term \(L\) is decreased as the oil travels as shorter distance from the point of absorption to the point of delivery.
While the reservoir louver pockets of the invention have been described as being louver-shaped, it is understood that such is not meant to be limiting, and that it is also within the scope and purview of the invention to use reservoir pockets that are of different shape and configuration, as long as the oil being splashed during operation is trapped therein and then delivered to the lubricating felt wick, especially during oil levels in the oil reservoir approaching the minimum serviceable operational level. Moreover, while it has been stated that these reservoir cups or pockets are punched out of the wick holder itself, or punched out of the splash sleeve or wall-extensions of the wick holder, other methods may be employed.

It is also to be understood that while the oil-reservoir pockets of the invention have been shown to be part of a specific type of wick holder, such as that shown in U.S. Patent Nos. 3,827,769 and 5,082,089, they may easily and readily be employed in other and all types of wick holders, such as those disclosed in U.S. Patent Nos. 2,980,472 and 3,905,659, as well as others, and no limitation has been meant with disclosure of the reservoir pockets of the invention provided in one kind of wick holder.

With regard to the splash sleeve of the second embodiment of Figs. 3-8, it is also possible to eliminate most of the side walls of the splash sleeve 60 that connect the rear and front walls 60', 60", and use the simple louvers of the first embodiment.

In all of the above versions of the invention, when used for a lubricating wick intended for GE locomotive traction motors, the louver-shaped lubricant-reservoir pockets or splash cups may be, for example, approximately three inches in length. For an EMD locomotive traction motor, the width would be increased to match the increased width of the EMD wick. The length of the splash sleeve may be approximately 3.6 inches, while the material may be metallic or an elastomeric. Of course, the above-mentioned dimensions and material, as well as how the
louver-shaped lubricant-reservoir pockets or splash cups are formed, have been only by way of example, and are not meant to be limiting.

Referring now to the Figs. 17-29, there is shown another version of the improved wick-lubricant delivery system for enhancing and optimizing lubricant flow to the face of the wick used to lubricate an axle-journal surface supported in a locomotive traction-motor friction support bearing. In accordance with this version, a passive inertia-activated slosh pump in the form of a piston-type pump assembly 140 is provided, and is vertically mounted to, and below, the wick carrier-assembly 14 (see Fig. 1) via mounting bracket 140.' Mounting bracket 140' positions the pump assembly below the spring 122. The pump assembly 142 has a pump inlet valve 142' and a pump outlet valve 142". Projecting vertically downwardly from the inlet valve 142' is an inlet tube 144 having a lower inlet-opening 144' deeply submerged in the oil-reservoir 112, so that droplets of oil may be taken in through the inlet-opening 144' and delivered to the pump inlet valve 142' via the inlet tube 144. Projecting at a upward slope from the pump outlet valve 142" is an outlet-tube 146 having an upper outlet-opening 146'. The outlet-tube 146 is located exteriorly of the wick-holder, with the outlet-opening 146' thereof terminating at the wick-face 136' of the felt wick 136, so that droplets of oil taken up through the inlet-opening valve 144' and delivered to the pump inlet valve 142' via the inlet tube 144 are delivered to the wick face 136' during normal operation, as described hereinbelow, in order to supplement normal wick oil-delivery.

The passive inertia-activated slosh pump assembly 140 is best seen in Figs. 18-22, and takes the form of a piston pump 150. The piston pump 150 has a main cylindrical housing 152 made of light-weight, low-wear material that reciprocatively mounts a piston 154. The piston 154 is made of high-inertia material, such as solid steel, and is biased by a spring 156. The
piston 154 is caused to reciprocate in the cylinder due to vertical and lateral accelerations imposed upon the traction motor by rail irregularities encountered during normal operation. The reciprocation of the piston 154 causes oil in the oil reservoir 112 to be drawn in through the inlet valve 142' and output through the output valve 142" to the wick face 36' (Fig. 17). Movement of the piston 154 in a first direction against the spring 156, which direction is to the right when viewing Fig. 18 and, as explained above, is caused by lateral and vertical acceleration forces acting on the piston due to rail irregularities, causes oil droplets to be taken in through inlet valve 142', and movement in the opposite direction via the biasing spring 156 forces the oil out through the outlet valve 142", which outward movement is to the left when viewing Fig. 18.

Each of the inlet valve 142' and outlet valve 142" incorporates a ball check 160, 162, as best seen in Figs. 20 and 21, respectively. The inlet valve 142 (Fig. 20) is provided with an outer cap 164 formed with an inlet hole, and defines an interior seat 164' for the ball 160, which ball 160 is normally biased outwardly against the seat 164' by a spring 166 to close off the inlet hole of the cap 164. The interior of the valve housing also defines passages 168' which permit the oil to bypass the ball check valve when the ball is unseated. The interior of the valve housing defines limit stops 168 against which the ball 160 abuts during its inward movement when the piston 154 moves during its intake stroke, as described hereinabove. The outlet valve 142" (Fig. 21) operates oppositely to that of the inlet valve, and is provided with an inner seat 170 against which the ball check 162 is seated during the piston intake-stroke for closing off the outlet of the pump, which ball is biased against the seat 170 by a spring 172. During the discharge stroke of the piston 154, the ball 162 is forced outwardly against the force of the spring 172, thereby opening and allowing oil to be pumped out through the outlet valve and to the wick face 136' via the outlet tube 146 described hereinabove.
Referring now to Figs. 23-25, there is shown a modification 180 in which the passive inertia-activated slosh pump of Fig. 18 is incorporated as part of the splash sleeve of Fig. 2. The modification 180 utilizes a piston-type pump assembly 182 like that of Figs. 18-22, but which is mounted to a splash sleeve 184 incorporating a plurality of reservoir-pockets or louvers 186 which are used for collecting oil that has been splashed during normal operation of the locomotive, as described in detail hereinabove. The splash sleeve 184 is mounted to the lower free end portion 136" (Fig. 17) of the felt wick positioned in the oil-reservoir, and defines a hollow interior volume that telescopingly receives therein the lower end of the felt wick. The piston-type pump assembly 182 is similar to the piston-pump assembly of Figs. 18-22, and includes a pump inlet valve 182' having a ball check and a pump outlet valve 182" having a ball check. Owing to the mounting of the pump assembly 182 to the lower end of the splash sleeve 184, the inlet valve 182' is substantially deeply submerged in the oil-reservoir, so that an inlet tube, such as the inlet tube 144 of the pump assembly 142 of Figs. 18-22, is not required.

Projecting from the main housing of the pump assembly 182 is the pump outlet valve 182" from which projects an outlet-tube 88 having an upper outlet-opening 88'. The outlet valve 182" projects interiorly through the splash sleeve 184 and into the interior of the lower end portion of the wick lubricator, as seen in Fig. 23. An appropriately placed and sized opening is formed in the housing of the splash sleeve 184 through which the outlet valve 182" projects interiorly of the wick lubricator, with a juxtapositioned portion of the wick lubricator pad being cut out in order to accommodate the outlet-valve 182". The outlet-tube 188 is located interiorly of the wick-holder, and extends or runs vertically upwardly along the interior or center of the central wick-lubricator pad, with the outlet-opening 188' thereof terminating at the upper wick-face 136' of the wick pad. The outlet-tube 188 assumes the same shape or curvature as that of the
wick lubricator itself. Preferably, a cavity or reservoir 190 is formed adjacent, and in close proximity, to the upper wick-face 136' into which the outlet-opening 188' of the outlet-tube 188 feeds, so that oil delivered through the outlet-tube 188 may be temporarily stored therein for providing a more consistent and optimized lubrication of the wick-face 136'.

The inlet-valve 182' with ball check of the pump assembly 182 of the modification 180 of Figs. 23 and 24 may, alternatively, like the outlet-valve 182", be located interiorly of the lubricating wick pad, as seen in Fig. 26. In this case, the inlet-valve 182' extends substantially horizontally from the main housing of the pump assembly 182, and into the interior of the wick pad juxtapositioned thereat. The intake opening of the inlet-valve 182' extends to, and cooperates with, an interiorly-located pocket or cavity 192 that is formed in the interior of the lower end portion of the wick, by which oil is collected for supplying the intake opening of the inlet-valve 182'.

Whether the outlet valve 182", or both the outlet valve and inlet valve 182' project interiorly of the splash sleeve 192, appropriately-situated cutouts are provided in the lower portion 36" of the felt wick in order to accommodate their interior protrusion. With regard to the outlet tube 188, it preferably extends between the two layers of the conventional felt wick 136, as would evident to one of ordinary skill in the art. The lower end portion 136" of the felt wick is also provided with a opening or void to allow for the sloped lower portion 188" of the outlet tube 188 to connect to the outlet valve 182".

Referring now to Figs. 27 and 28, there is shown another embodiment 200 of the improved wick-lubricant delivery system for increasing lubricant flow to the face of the wick used to lubricate an axle-journal surface supported in a locomotive traction-motor friction support bearing. In this embodiment, the passive inertia-activated slosh pump is a diaphragm
pump 202 instead of the piston-type pump of the first embodiment. The diaphragm pump 202 consists of a housing 204 vertically mounted to, and below, the wick-carrier assembly via mounting bracket 206, which housing defines an interior cavity for storing oil being pumped. Mounting bracket 206 positions the pump assembly below the spring 122. The housing 204 is provided with an inlet ball-check valve 208 that is mounted to a bottom open end 210' of an oil-pickup tube 210. The upper end 210" of the tube 210 is connected to a tubular intake 214 formed in the housing 204 of the diaphragm pump 202. The housing 204 also has an outlet opening 212 to which is coupled an outlet ball-check valve 216 to which is connected a pump-discharge tube 218 similar to the tube 146 of the first embodiment of Figs. 16-22, which discharge tube 218 is located exteriorly of the wick-holder, with the upper outlet-opening thereof terminating at the wick-face of the felt wick, so that droplets of oil taken up by the pump are delivered to the wick face 136' during normal operation.

Interiorly of the housing there is located a conventional diaphragm 220 that is biased upwardly by a spring 222. Affixed to the upper surface of the diaphragm 220 is a flexible mounting stem or connector 224 which mounts a downwardly-projecting, elongated flexible cable or connector 226. The connector 226 projects exteriorly of the housing 204 via a lower opening formed in a lower section 204' of the housing. To the bottom end of the flexible connector 226 there is connected an inertial mass 230, which, together with the flexible connector 226, serves as a pendulum. Movement of the inertial mass 230, because of the lateral and vertical acceleration forces acting thereon due to rail irregularities, causes deflections of the spring 222 and diaphragm 220. The deflection of the diaphragm 220 in the downward direction against the spring 222 causes oil droplets to be taken in by oil inlet 208, while the upward
deflective movement thereof in the opposite direction via the biasing spring 222 forces the oil out through the outlet valve 216.

The diaphragm pump 202 of the embodiment of Figs. 27 and 28 may also be mounted to a splash sleeve, in a manner similarly to that of the inertial piston pump of Figs. 23-26. In addition, it is within the scope and purview of the invention that, instead of a splash sleeve being used to mount the inertial pump to the lower end portion of the central lubricating wick, different mounts or sleeves may be used, whether they mount the passive inertia-activated slosh pump to the central lubricating wick or to the wick bracket assembly proper. In addition, although it is preferable that the discharge tube of the passive inertia-activated slosh pump extend at least partially interiorly and through the central lubricating wick for discharging oil droplets at the wick face when the inertial pump is mounted to the splash sleeve or other mount, it is possible to run the discharge tube exteriorly.

In all of the above-described embodiments, the slosh pump works in parallel, or in conjunction, with the capillary action of the wick in order to deliver oil to the interface between the wick face and the journal surface. It is also envisioned that, if the delivery rate of the slosh pump is equal to or greater than that of the wick, a modification may be employed where the wick tail is cut off, with the sustained oil delivery being dependant upon the slosh pump alone. In this modification, the wick serves as a reservoir and part of the delivery system.

In yet another modification shown in Fig. 29, with the volume of oil delivered to the journal surface no longer dependent upon the cross-sectional area of the wick body and face, the wick may be eliminated altogether in favor of the inertial pump oil-delivery system of the invention routed to a simple intake hole or lubricating opening 228 formed through the bearing 18 and its liner, whereby the entire surface-interface lubrication of the journal surface 37 is
accomplished by the slosh pump 202 of Fig. 27, for example, with the slosh pump 202 being mounted directly to the earner assembly 14, or otherwise mounted to the bearing axle cap 16, with its discharge tube 218 feeding directly into the intake hole or opening 228. In this embodiment, the elimination of the wick would also allow replacement of the wick window in the bearing cap and bearing liner with the opening 228. Instead of the diaphragm pump 202, the piston-type pump of Fig. 1 may also be used alone in accordance with this embodiment.

In all of the above-described embodiments and modifications, as a result of the increased oil-saturation of the wick, optimized amounts of oil are delivered to the axle-journal surface-area. This optimized amount of oil saturation and enhanced oil delivery provide better protection against axle-journal bearing failure in the event that a locomotive is used with diminished axle-journal oil levels. In addition, the temperature of the oil is reduced and the viscosity increased, to thus increase the rated load-capacity of the bearing, and to thus increase the tolerance of the bearing to minor surface imperfections. The optimized wick-saturation and oil delivered to journal lowers the wick-face temperature and reduces the rate of wick-face glazing, thereby extending the life of the wick. This enhanced wick-saturation and oil delivered to the journal also limit the ingress of external contaminants into the loaded journal areas, thereby reducing wear and extending the life of the bearings.

The particular type of inlet and outlet valves used in each version of the slosh pump may vary from that disclosed hereinabove. It is, also, preferable, though not requisite, that the inlet valve of each version of the slosh pump be similar in construction and of the same type as that of the outlet or discharge valve thereof.
While specific embodiments of the invention have been shown and described, it is to be understood that numerous changes and modifications may be made therein without departing from the scope and spirit of the invention.
WHAT IS CLAIMED IS:

CLAIM 1. In an arcuate-shaped wick holder for mounting a central lubricating wick so that a lower portion of the lubricating wick is immersed in an lubricant reservoir and an upper portion of the lubricating wick is received in a central wick window for lubricating a journal surface mounted by a support bearing of a railway locomotive traction motor, said wick holder comprising an upper surface and a lower surface, the improvement comprising:

- at least one lubricant-reservoir collection means in at least one of said upper surface and said lower surface of said wick holder for temporarily storing lubricant therein and for delivering the lubricant to a lubricating wick;

- said at least one lubricant-reservoir collection means projecting away from said at least one of said upper surface and said lower surface of said wick holder and comprising an entrance opening for receiving lubricant therein;

- said at least one of said upper surface and said lower surface of said wick holder having at least one opening in fluid communication with said at least one lubricant-reservoir collection means for delivering the lubricant from said at least one lubricant-reservoir collection means to the central lubricating wick, whereby additional lubrication of a central lubricating wick is achieved.

CLAIM 2. The wick holder according to claim 1, comprising at least two lubricant-reservoir collection means, at least one formed in said upper surface and at least one formed in said lower surface of said wick holder.
CLAIM 3. The wick holder according to claim 1, wherein said entrance opening of said at least one lubricant-reservoir collection means faces upwardly so that lubricant splashed during normal operational use may enter therein.

CLAIM 4. The wick holder according to claim 1, wherein said at least one lubricant-reservoir collection means is louver-shaped and comprises a main wall section projecting outwardly at an acute angle from said at least one of said upper surface and said lower surface of said wick holder; said entrance opening facing upwardly.

CLAIM 5. The wick holder according to claim 2, wherein each said lubricant-reservoir collection means is louver-shaped and comprises a main wall section projecting outwardly at an acute angle from said at least one of said upper surface and said lower surface of said wick holder; said entrance opening facing upwardly.

CLAIM 6. The wick holder according to claim 2, wherein each said lubricant-reservoir collection means is cup-shaped and comprises a main section projecting from said main housing, and pair of side wall sections connecting said main section to said main housing; said entrance opening facing upwardly.

CLAIM 7. The wick holder according to claim 1, wherein said at least one lubricant-reservoir collection means is a punched-out section of said at least one of said upper surface and said lower surface of said wick holder.

CLAIM 8. The wick holder according to claim 3, wherein said at least one lubricant-reservoir collection means is a punched-out section of said main at least one of said upper surface and said lower surface of said wick holder.

CLAIM 9. The wick holder according to claim 1, in combination with a splash sleeve; said splash sleeve having substantially the same cross-sectional shape as a central lubricating wick
mounted by said wick holder; said splash sleeve also comprising at least one lubricant-reservoir collection means for temporarily storing lubricant therein and for delivering the lubricant to a lubricating wick; said splash sleeve being slidable over an exposed lower portion of a central lubricating wick projecting downwardly from said wick holder for increasing lubrication of a central lubricating wick.

CLAIM 10. The wick holder according to claim 1, in combination with a central lubricating wick and a splash sleeve; said splash sleeve having substantially the same cross-sectional shape as said central lubricating wick mounted by said wick holder; said splash sleeve also comprising at least one lubricant-reservoir collection means for temporarily storing lubricant therein and for delivering the lubricant to said lubricating wick mounted by said wick holder; said splash sleeve being slidable over an exposed lower portion of said central lubricating wick projecting downwardly from said wick holder for increasing lubrication of said central lubricating wick.

CLAIM 11. The wick holder according to claim 2, wherein said at least lubricant-reservoir collection means formed in said upper surface is at a relatively higher elevation than said at least one lubricant-reservoir collection means formed in said lower surface of said wick holder.

CLAIM 12. The wick holder according to claim 1, wherein at least one of said lower surface and said upper surface comprises a downward extension having said at least one lubricant-reservoir collection means for temporarily storing lubricant therein and for delivering the lubricant to a lubricating wick.

CLAIM 13. In a method of increasing the lubrication of a journal surface mounted by a support bearing of a railway locomotive traction motor, which lubrication is achieved by a central lubricating wick mounted by an arcuately-shaped wick holder that immerses a lower
portion of the lubricating wick in a lubricant reservoir and positions an upper wick-face portion of the lubricating wick in a central wick window, the improvement comprising:

(a) increasing the lubrication-saturation of the central lubricating wick by providing at least one lubricant-reservoir collector;

(b) said step (a) temporarily storing lubricant in the at least one lubricant-reservoir collector and delivering the lubricant to the central lubricating wick.

CLAIM 14. The method of increasing the lubrication of a journal surface according to claim 13, wherein said step (a) comprises providing the at least one lubricant-reservoir collector on at least one surface of the wick holder; said step of delivering of said step (b) delivering the lubricant through at least one opening in at least one wall of the wick holder that is in fluid communication with the interior of the at least one lubricant-reservoir collector.

CLAIM 15. The method of increasing the lubrication of a journal surface according to claim 13, wherein said step (a) comprises providing a sleeve comprising the at least one lubricant-reservoir collector for telescoping mounting over a lower section of the central lubricating wick.

CLAIM 16. A splash sleeve for use with an arcuate-shaped wick holder that mounts a central lubricating wick for lubricating a journal surface mounted by a support bearing of a railway locomotive traction motor, which wick holder mounts the central lubricating wick such that an exposed lower portion of the central lubricating wick extends downwardly from the wick holder for immersion in a lubricant reservoir and such that an upper portion of the central lubricating wick is received in a central wick window, comprising:

a main hollow sleeve for at least partial telescoping mounting over the exposed lower portion of the central lubricating wick

said main sleeve having a plurality of surface-walls;
at least one opening formed in at least one of said surface walls for allowing lubricant contained in a lubricating-wick lubricant reservoir to pass therethrough in order to lubricate the lubricating wick positioned therein;

at least one lubricant-reservoir collector in at least one of said surface-walls for temporarily storing lubricant therein and for delivering the lubricant to a lubricating wick;

said at least one lubricant-reservoir collector projecting away from said at least one of said surface-walls and comprising an entrance opening for receiving lubricant therein;

said at least one of said surface-walls having at least one opening in fluid communication with said at least one lubricant-reservoir collector for delivering the lubricant from said at least one lubricant-reservoir collector to the central lubricating wick, whereby additional lubrication of a central lubricating wick is achieved.

CLAIM 17. The splash sleeve according to claim 16, wherein said entrance opening of said at least one lubricant-reservoir collector faces upwardly so that lubricant splashed during normal operational use may enter therein.

CLAIM 18. The wick holder according to claim 16, wherein said at least one lubricant-reservoir collector is louver-shaped and comprises a main wall section projecting outwardly at an acute angle from said at least one of said surface-walls, said entrance opening facing upwardly.

CLAIM 19. The wick holder according to claim 16, in combination with a central lubricating wick mounted by a wick holder, and retaining means for mounting said splash sleeve to said central lubricating wick; said splash sleeve being telescopingly mounted over at least a section of said exposed lower portion of the central lubricating wick.
CLAIM 20. The wick holder according to claim 16, in combination with retaining pin for mounting said splash sleeve to a central lubricating wick; said splash sleeve having two elongated parallel surface-walls, said two elongated parallel surface-walls having aligned openings for passing therethrough said retaining pin; said retaining pin having a first tapered end to aid in the insertion of the pin through and between the felt layers of the lubricating wick, and means for holding said retaining pin in place.

CLAIM 21. In a lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing comprising a lubricant reservoir, a wick holder assembly for mounting a central lubricating wick so that a lower portion of the lubricating wick is immersed in said lubricant reservoir and an upper wick-face portion of the lubricating wick is received in a central wick window for lubricating the axle-journal surface mounted by the support bearing of a railway locomotive traction motor, the improvement comprising:

   passive inertia-activated pump means having a main housing having a hollow interior for temporarily storing lubricant to be pumped;

   said passive inertia-activated pump means comprising inlet means submersed in said lubricant reservoir and outlet means, and an inertial mass that is set in motion in response to inertial resistance to the accelerations imposed upon the traction motor during normal operation,

   whereby, upon the motion of said inertial mass, lubricant is taken in from the lubricant reservoir via said inlet means and delivered to said upper wick-face portion via said outlet means in order to supplement normal lubricant-delivery by said central lubricating wick.
CLAIM 22. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 21, wherein said outlet means comprises an outlet valve, and a discharge tube having a first end fiddly connected with said outlet valve, and a second end located in close juxtaposition to said upper wick-face portion of said central lubricating wick.

CLAIM 23. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 22, wherein said wick holder assembly comprises a wick holder having an upper portion for mounting said upper wick-face portion to a central wick window, and a lower portion for mounting said lower portion of said lubricating wick is in said lubricant reservoir;

    said passive inertia-activated pump means comprising means for mounting said passive inertia-activated pump means to a portion of said lubricating system in close juxtaposition to said lower portion of said lubricating wick.

CLAIM 24. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 23, wherein said means for mounting said passive inertia-activated pump means comprises a splash sleeve and having at least one lubricant-reservoir collection means for temporarily storing lubricant therein and for delivering the lubricant to the lubricating wick, said splash sleeve being telescopingly mounted over an exposed lower portion of a central lubricating wick projecting downwardly from said wick holder.

CLAIM 25. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 24, wherein said inlet means of said passive inertia-activated pump means being located one of: interiorly of said splash
sleeve, and exteriorly of said splash sleeve; said outlet valve of said outlet means being
operatively associated interiorly of said splash sleeve, and said discharge tube of said outlet
means passing interiorly of both said splash sleeve and at least a portion of said lubricating wick;
said second end of said discharge tube being located in close juxtaposition to said upper wick-
face portion of said central lubricating wick interiorly thereof.

CLAIM 26. The lubricating system for lubricating an axle-journal surface mounted in a
locomotive traction-motor support bearing according to claim 24, wherein said central
lubricating wick is made of felt, and said discharge tube passing therethrough.

CLAIM 27. The lubricating system for lubricating an axle-journal surface mounted in a
locomotive traction-motor support bearing according to claim 21, wherein said lubricating
system comprises a wick carrier-assembly; said passive inertia-activated pump means
comprising means for mounting said passive inertia-activated pump means to a portion of said
wick carrier-assembly for mounting said passive inertia-activated pump means below said wick
carrier-assembly for at least partial immersion in said lubricant reservoir.

CLAIM 28. The lubricating system for lubricating an axle-journal surface mounted in a
locomotive traction-motor support bearing according to claim 21, wherein said passive inertia-
activated pump means is a piston pump, and said inertial mass is the piston thereof.

CLAIM 29. The lubricating system for lubricating an axle-journal surface mounted in a
locomotive traction-motor support bearing according to claim 22, wherein said passive inertia-
activated pump means is a piston pump, and said inertial mass is the piston thereof.

CLAIM 30. The lubricating system for lubricating an axle-journal surface mounted in a
locomotive traction-motor support bearing according to claim 21, wherein said passive inertia-
activated pump means is a diaphragm pump, said inertial mass comprising a weight operatively
coupled to the diaphragm of said diaphragm pump; and means for coupling said weight to said diaphragm.

CLAIM 31. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 22, wherein said passive inertia-activated pump means is a diaphragm pump, and said inertial mass comprising a weight operatively coupled to the diaphragm of said diaphragm pump.

CLAIM 32. The lubricating system for lubricating an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 30, wherein said means for coupling said weight to said diaphragm comprises flexible connecting means for pendulously mounting said weight.

CLAIM 33. A method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing comprising a lubricant reservoir, a wick holder assembly for mounting a central lubricating wick so that a lower portion of the lubricating wick is immersed in the lubricant reservoir and an upper wick-face portion of the lubricating wick is received in a central wick window for lubricating the axle-journal surface mounted by the support bearing of a railway locomotive traction motor, comprising:

(a) providing a passive inertia-activated pump means having a main housing having a hollow interior for temporarily storing lubricant to be pumped;

(b) said step (a) comprising submerging the inlet means of the passive inertia-activated pump means in the lubricant reservoir;
(c) said step (a) comprising delivering the lubricant outflow from said passive inertia-activated pump means to the upper wick-face portion in order to supplement normal lubricant-delivery by said central lubricating wick;

(d) said step (c) comprising setting in motion an inertial mass of said passive inertia-activated pump means in response to inertial resistance to the accelerations imposed upon the traction motor during normal operation, whereby upon the motion of said inertial mass, lubricant is taken in from the lubricant reservoir via said inlet means and delivered to said upper wick-face portion in order to supplement normal lubricant-delivery by said central lubricating wick.

CLAIM 34. A method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 33, wherein said step (a) comprises providing a passive inertia-activated piston pump to the lubricating system.

CLAIM 35. A method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 33, wherein said step (a) comprises providing a passive inertia-activated diaphragm pump to the lubricating system.

CLAIM 36. A method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 33, wherein said step (c) comprises delivering the lubricant outflow through a discharge outlet conduit to the upper wick-face portion.

CLAIM 37. A method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing according to
claim 36, wherein said step (c) comprises passing the discharge outlet conduit interiorly through at least a portion of the central lubricating wick.

CLAIM 38. The method for supplementing the lubrication provided by a lubricating system of an axle-journal surface mounted in a locomotive traction-motor support bearing according to claim 37, wherein said step (c) delivering the lubricant outflow from said passive inertia-activated pump means to an interior pocket formed in an upper portion of the lubricating wick at the wick face for accumulating the lubricant therein.

CLAIM 39. In a friction support bearing apparatus of a railway locomotive traction motor comprising a friction support bearing having an interior surface at least a part of which contacts an axle journal, a lubricant reservoir for storing lubricant, and lubricating means operatively associated with said lubricant reservoir for lubricating the surface-interface between said friction support bearing and an axle-journal supported therein, the improvement comprising:

said lubricating means comprising passive inertia-activated pump means having a main housing having a hollow interior for temporarily storing lubricant to be pumped;

means for mounting said passive inertia-activated pump means to a portion of said friction support bearing apparatus;

said passive inertia-activated pump means comprising inlet means for submersion in said lubricant reservoir and outlet means, and an inertial mass that is set in motion in response to inertial resistance to the accelerations imposed upon a locomotive traction motor during normal operation, whereby, upon the motion of said inertial mass, lubricant is taken in via said inlet means and delivered to said surface-interface between said friction support bearing and an axle-journal supported therein.
CLAIM 40. The friction support bearing apparatus according to claim 39, wherein said outlet means comprises an outlet valve, and a discharge tube having a first end fluidly connected with said outlet valve, and a second end; said friction support bearing having lubricating opening means formed therein in operative communication with said second end of said discharge tube for delivering lubricant to said surface-interface.
INTERNATIONAL SEARCH REPORT

A CLASSIFICATION OF SUBJECT MATTER

**USPC** 184/64, 13 1 11 1 112

According to International Patent Classification (IPC) or to both national classification and IPC

B FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**US** 184/64, 13 1 11 1 112

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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Date of mailing of the international search report 18 DEC 2006

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