(No Model.)

C. E. EMERY.

APPARATUS FOR LUBRICATING JOURNALS UNDER PRESSURE.

No. 588,699. Patented Aug. 24, 1897.

Fig. 2.

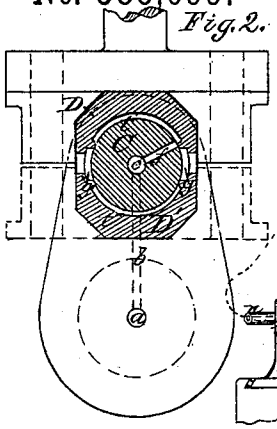


Fig. 1.

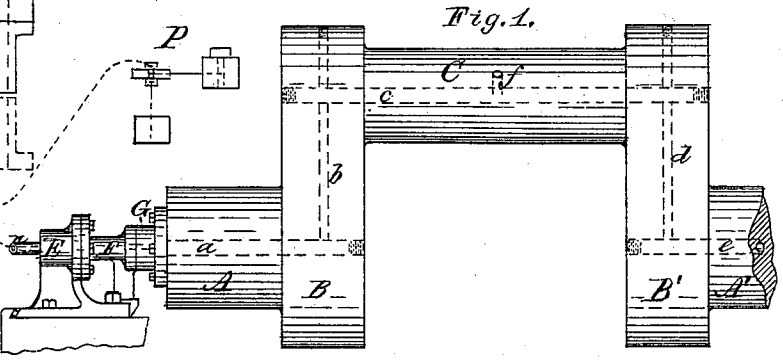


Fig. 5.

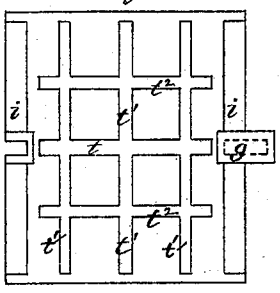


Fig. 4.

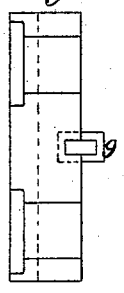


Fig. 3.

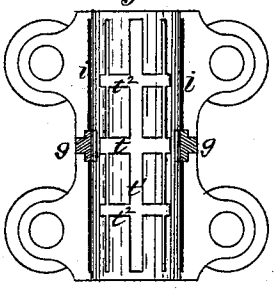


Fig. 6.

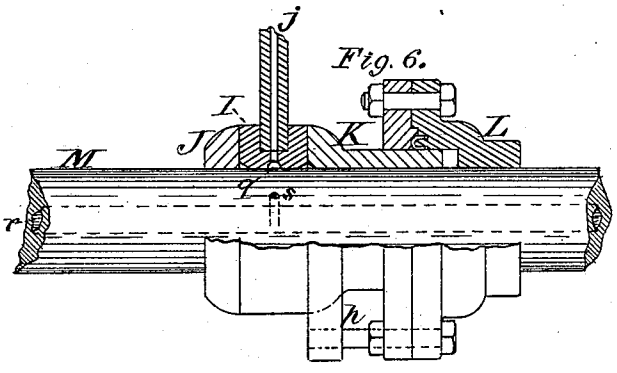


Fig. 7.

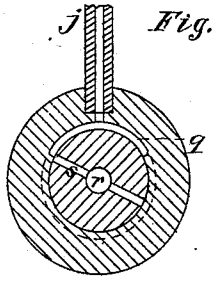
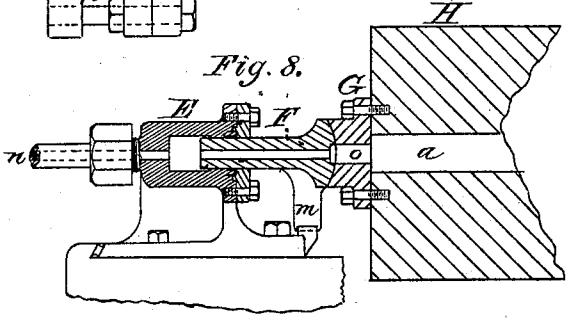


Fig. 8.



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APPARATUS FOR LUBRICATING JOURNALS UNDER PRESSURE.

SPECIFICATION forming part of Letters Patent No. 588,699, dated August 24, 1897.

Application filed February 12, 1891. Serial No. 381,165. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. EMERY, a citizen of the United States, residing in the city of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Apparatus for Lubricating Journals with Lubricant Under Pressure, of which the following is a specification, reference being had to the accompanying drawings, forming a part of the same.

It has been proposed to reduce the load on journals by supplying fluid under pressure to cavities in the bearing-brasses, thereby supporting a portion of the journal directly upon the fluid under pressure. I have discovered that it is not necessary to enlarge the cavities in the brasses when the lubricating fluid is supplied under sufficiently high pressure. I find that if fluid under a pressure equal to or somewhat less than the unit pressure due to the load on the journals be admitted to grooves of customary area and arrangement it will thicken or increase the thin film formed by ordinary lubrication, and the thicker film will be continuously maintained by the pressure and the motion of the journal and act to lift the brass away from the journal, or vice versa, and reduce the friction while such journal is in motion as well as if the pressure were applied in large cavities directly to the journal.

The present invention relates to the application of lubricating fluid under pressure to ordinary oil-grooves without reducing the bearing-surfaces or necessarily making large cavities in the brasses to support the journal directly on the high-pressure fluid. Special means are also provided in the present invention for distributing oil to the brasses of the crank-pin or other revolving journal of a steam-engine.

In a special application of the present invention herein shown it is proposed to make the shaft hollow upon which are the journals to be lubricated and to force through the hollow or pipe thus formed oil under pressure and to distribute the same to the cavities in the bearing-brasses by a suitable radial opening arranged at such an angle in relation to the engine-crank that the outer end of such opening will be in communication with the cavity of one brass during the greater portion of the time it is under strain and pass by such opening and communicate with the cavity in the other brass during the greater portion of the time that it is under strain, whereby the opening in the journal and the cavities in the brass form practically a valve and seat performing the functions of a distributing-valve.

The invention further relates to the details required to insure operation of the various parts and to a method for utilizing the entraining action of the oil to assist the pressure of the lubrication.

Referring to the drawings, Figure 1 represents an elevation of a crank-shaft, showing the oil-channel and the connection of the same with a pump for producing fluid-pressure; Fig. 2, an end view of one of the throws of the crank with crank-pin and brass in section; Fig. 3, a bottom view of the bearing-brass shown in Fig. 2; Fig. 4, a side view of the same; Fig. 5, a bottom view of the wearing-surface and grooves of the brass shown in Figs. 2 and 3 developed on a plane; Fig. 6, a short length of shaft with apparatus, partly in section, for introducing oil under pressure to an intermediate bearing in its length; Fig. 7, a cross-section of the same on the center line of the pipe *j*, and Fig. 8 a longitudinal section of the apparatus used for introducing oil at the end of a hollow shaft.

The same letters in all figures refer to corresponding parts.

In Figs. 1 and 2, A and A′ represent the main journals of a crank-shaft, B and B′ the "throws" of the crank, and C the crank-pin. Another similar crank-shaft may be attached to the end A′ and others beyond as desired. As shown, the shaft is made hollow, being provided throughout its length so far as is necessary with a hole made continuous through the shaft, crank-throws, and crank-pins. This hole is designated *a*, through journal A, and is continued until it meets the hole *b* in the throw B of the crank, and hole *b* is continued until it connects with the hole *c*, which extends through the crank-pin C, and if there are other journals to be lubricated this hole may continue through the crank-pin and connect with another hole *d* in the throw B′ of the crank, which in turn connects with another hole *e* in the journal A′, which hole *e* is

continued in a similar way through the other shafts, cranks, and crank-pins, thus forming a channel or pipe from one journal to another. In practice the holes will necessarily be drilled entirely through the several pieces, but the surplus openings are to be stopped by plugs, as shown by dotted lines, so that the several branches of the central channel will form one pipe to convey lubricating material under pressure to the points desired.

A small hole *f* is drilled in the crank-pin, preferably opposite the central groove *t* of the brass D, and, as shown in cross-section, Fig. 2, this hole is angularly arranged, like an eccentric operating a steam-valve, sufficiently in advance of a right angle to the crank that its outer end will come in communication with the groove *t* in the brass at, before, or about the same time that the steam-pressure is admitted to the piston, and thereby the strain brought upon the brass. As the crank moves from right to left, the opening *f* will continue in the groove for nearly the whole period that the brass is under strain, when it will be covered by the bearing-surface of the brass beyond the groove, and if such bearing-surface at the edge of the brass meets that on the other brass closely the hole *f* will remain covered until it comes opposite the groove *t*, (shown in dotted lines in such lower brass,) at or about which time the crank will be on its lower center and receiving steam-pressure to bring a load upon such lower brass and the relation of the opening to the lower brass D′ be then exactly the same as if the drawing were inverted and the brass D′ represented by brass D.

In order to permit the edges of brasses to be separated a little, as is customary, I prefer to insert across the joint of the abutting edges on each side a side plate *g*, fitted in a cavity inside the edges of the brass in such a way as to bear on the side of the journal, each plate acting alternately as a valve to close the outlet of the hole *f* as the same passes by. Each plate may fit loosely in a vertical direction, but should be of the right thickness to bear tightly on the journal and on the bottom of the cavity in the edge of the brass. Each plate may have a rectangular tongue attached and protruding through the brass to further stiffen and guide it, if desired.

The face of the journal-brass is preferably provided with a number of cross-grooves t' and longitudinal grooves t^2, so that the fluid admitted to the central or any other longitudinal groove will be distributed to various points of the brass. The spaces *i i* (shown at the edges in Figs. 3 and 5) represent the clearances usually left at the edges of brasses to prevent lateral binding. The plates *g g* can be made to bridge across these grooves *i i*, as well as the space between the two brasses. Under light pressure the oil is by this arrangement conveyed directly to the point desired and efficient lubrication is secured, but if the oil be introduced under high pressure—for instance, be forced into the hollow of the shaft by a device shown in Fig. 1—the oil will more readily enter between the surfaces of the brass and journal and better lubrication be assured, and if such pressure be made sufficiently high a film will be formed between the bearing-surfaces of sufficient thickness to lift the brass away from the journal, so that the surfaces will practically glide over the fluid instead of sliding one over the other, or in any case the pressure of the brass on the journal, and consequently the friction, be greatly relieved. When a film of this kind is formed, the pressure of the fluid between the brasses must evidently be equal to or greater than the unit pressure on the journal due to the load, but generally the lubrication is sufficient with a less pressure from the pressure device for the reason that the motion of the journal in the brasses entrains oil between the surfaces, as in ordinary lubrication, and this action supplies part of the pressure required—as, for instance, the oil under pressure enters the groove *t*, is conducted therefrom to the transverse grooves, and is entrained by the motion of the journal between the bearing-surfaces thereof and that of the bearing-brass, forming a film of oil. The pressure from the pressure device can be increased as desired to still further thicken the film and cause a decided flow, thereby cooling the journal.

If the space inclosed by the various grooves *t*, t', and t^2 were made one large cavity bounded by a surface bearing on the journal and oil under pressure be delivered to such cavity, the brass would lift off the journal when a comparatively high pressure on the comparatively small area of the cavity balances the lower pressure on the larger piston of the engine. In such case, however, if the pressure-supplying device should be stopped the whole load would be carried by the reduced bearing-surface, which would become greatly enlarged on account of the high unit strain. I have, however, discovered that when a thin film of lubricating fluid is formed in the ordinary way between the surfaces this film will be increased in thickness by a supply of fluid under pressure and the brass in whole or in part supported on the fluid, thereby reducing the friction to the same or approximately the same extent as if the grooves were enlarged into cavities, as above explained. It is not ordinarily proposed, therefore, to enlarge the grooves *t* t' t^2 into cavities of a size which will, when lubricant is introduced under pressure, materially reduce the load on the wearing-surfaces by partially supporting the journal by lubricant under pressure, but to simply depend upon ordinary lubrication in starting and afterward in case of derangement to the pressure apparatus and in regular operation to apply lubricating fluid under high pressure to reduce friction and prevent heating.

The ordinary oil-holes may be stopped by pipes provided with stop-cocks to be closed when the oil is supplied under pressure, or the oil may be caused to flow through the pressure-pipes at a low pressure sufficient for ordinary lubrication until the engine is up to working speed, when the full pressure may be employed. With my invention it is practicable to reduce the friction on a bearing-brass provided only with oil-grooves of the customary area and arrangement by simply connecting the pipe from the pressure apparatus fluid-tight with such grooves, either making the connection to the ordinary oil-hole or elsewhere or closing the latter, as previously referred to. It is preferred, however, to have at least one cross-groove, like *t'*, Fig. 5, extended nearly across the brass, parallel with and near one of the clearance-spaces *i*, on the side from which the surface of the journal approaches when the engine is going ahead. The drawings show three such grooves, but if the one on the approach side be located substantially as shown or even nearer the clearance-space *i* the other grooves may be of any desired arrangement—for instance, arranged in the form of a cross, as is customary. All these grooves should be connected together, which may be done by the longitudinal groove *t*, to which oil is delivered by radial opening *f* in the pin, and in such case a supply of oil under pressure will be assured to the surface of the journal soon after it commences to move over the surface of the brass and this film be continued between the bearing-surfaces to the other side of the journal whatever the intervening arrangement of oil-grooves may be.

A hole similar to *f* may be drilled in either of the journals A, for instance, and the action will be the same as described in relation to the crank-pin C. As the shaft is apt to play somewhat in its bearings, it is necessary to supply some means whereby a fluid-tight joint can be maintained with such shaft. To this end the device shown in Fig. 8 and exterior view in Fig. 1 is employed. The oil is admitted through the pipe *n* to a hydraulic cylinder E and presses upon the end of a hydraulic ram or plunger F, provided with suitable packing in the end of the cylinder E. The outer end of the plunger F bears upon the end of the shaft H or A or a plate G, attached fluid-tight thereto, the contact-surfaces of F and G being preferably globular to permit slight changes of direction. The plunger F is prevented from turning by a lug *m*, engaging with a notch in the bed-plate. The hydraulic pressure from the cylinder E passes through an opening *o* in plate G to the opening *a* in the end of shaft H and is then distributed, as shown in Fig. 1. The end of shaft H represents that part of the shaft usually extended by the journal A, Fig. 1, to receive eccentrics and other attachments. In practice the plunger F will be forced away from the plate G with a pressure corresponding to the area of the opening *o* and will be forced toward such surfaces with a pressure corresponding to the area of plunger F. The latter may be made sufficiently in excess to keep the contact between surfaces F and G fluid-tight. Any other method may be used to conduct the pressure from the exterior pump to the hollow shaft—for instance, an ordinary slip-joint, such as would be formed by joining F and G and removing lug *m*—so that the plunger will turn in the packing at the end of the hydraulic cylinder E.

A modification of the above adapted to admit pressure to the center of a shaft, like A', extended at any point other than the end, is shown in Fig. 6, in which M represents a section of the shaft; *r*, the hollow in same; *s*, a radial hole from the central hole *r* to the exterior of the shaft, and I a ring surrounding the shaft and provided with a circular groove *q*, opposite the opening *s*. J and L are collars fastened to the shaft, the latter forming an annular hydraulic cylinder provided with suitable packing, and K is a ring-shaped hydraulic piston in such cylinder, enlarged at its end to bear against one side of the ring I. When fluid under pressure is admitted to pipe *j*, the fluid passes from cavity *q* in ring I, as desired, to the hole *s*, and thus to hole *r* in shaft M. The pressure also passes through grooves in the inner surface of the ring I and ring-piston K to the annular hydraulic cylinder L, thereby bringing pressure upon the annular piston K to hold the ring I fluid-tight against its own bearing-surface and that of the collar J. The ring hydraulic piston K, by means of an arm *p*, engages with a pin on the cylinder L, and thereby turns with it, as well as with the shaft M and collar J. The ring I, however, is prevented from revolving by pipe *j* and any auxiliary means desired. The groove *q* may extend entirely around the circumference of the shaft, and thereby constantly feed the central opening *r* through hole *s*, or, as shown in Fig. 7, the groove may only include a part of the circumference, and thereby a pressure be transmitted to the hole *s* only during an angle corresponding to the length of such groove. In this way the arrangement may be used as a distributing-valve, or the hole *s* may be so located in relation to the crank that it will only receive oil under pressure during the time that a hole *f*, Figs. 1 and 2, is in communication with a cavity in the brass, thereby supplementing and, if desirable, permitting the omission of the plates *g*. When the groove *q* only extends through an angle at the top, the hole *s* would be run entirely through the shaft, as shown, so as first to receive oil at one end for one brass and then at the other end for the other brass. By omitting one branch the angle through which oil is admitted to the hole *r* in the shaft and therefrom to a particular brass or set of brasses—the top ones, for instance—may be regulated by this arrangement, and another small hole communicating with an-

other set of channels through the shaft, like *r*, be used to distribute oil to another brass or set of brasses—the lower ones, for instance. In a somewhat similar way evidently the abutting surfaces of the ram and plate G may form a valve and valve-seat in which ports and divisions may be arranged and the device act as a distributing-valve to one or more openings in the shaft communicating with upper and lower brasses and operating substantially as described.

With the hole *f* in the angular position shown in Figs. 1 and 2 the operation will be as described for motion of shaft in one direction only. In backing the engine the oil-pressure can be reduced to that required to cause a flow of oil for ordinary lubrication. When it is important to use oil under pressure for motion of shaft in both directions, a duplicate set of channels may be provided through the shaft, cranks, and crank-pin, one arranged for use in going ahead, the other in backing.

The word "oil" is used herein in the same sense as "lubricating fluid." Water may be used, with or without other ingredients, as such lubricating fluid in some cases.

The apparatus herein described is also applicable to distribute oil under moderate pressures, such as can be obtained from an elevated supply-tank.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In combination with bearing-brasses provided with lubricating-cavities and in combination with plates closing the space between such brasses, a journal working in such brasses provided with an opening therein communicating through a hollow shaft with apparatus for supplying oil under pressure, such opening in the journal being so arranged in relation to the cavities in the brasses and the plates between the same that as the journal revolves oil under pressure will be supplied to the cavities in the brass under strain and cut off from such brass as the strain is relieved, substantially as and for the purposes specified.

2. In an apparatus for lubricating the journals with lubricant under pressure, the combination of a device for supplying lubricant under pressure to a hollow in a shaft, bearing-brasses, provided with suitable lubricant-cavities, a journal having lubricant-passages supplying lubricant under pressure from a hollow in said journal to the lubricant-cavities in said brasses, and with plate-valves fitting the curvature of the journal and closing the lubricant-passage while passing over the joints of the brasses, substantially as set forth.

3. In combination with a device for supplying lubricant under pressure to a hollow in a shaft, a hollow journal provided with an exterior valve-seat or wearing-surface, a stationary hydraulic cylinder with suitable hydraulic connections, a hollow hydraulic ram connecting the same and fitting one end of the hydraulic cylinder, and at the other provided with a valve-seat or wearing-surface to engage with said journal and also with a suitable stop to prevent revolution, substantially as set forth.

4. In combination with a device for supplying lubricant under pressure to a hollow in a shaft and with bearing-brasses provided with lubricant-cavities extending laterally and lubricant-cavities extending longitudinally, a journal provided with a lubricant-passage for supplying lubricant under pressure to the brass under strain, plate-valves fitting the curvature of the journal and closing the lubricant-passage as it passes over the joints of the brasses, substantially as set forth.

5. In combination with an apparatus for supplying lubricant under pressure to a hollow in a shaft and with a hollow journal and with bearing-brasses provided with suitable cavities or grooves, and with lubricant-passage for supplying lubricant under pressure from the hollow in the journal to the brasses when such are under strain, a fluid-tight joint consisting of a hydraulic cylinder, a hollow hydraulic ram fitting said cylinder at one end and the end of the shaft or journal at the other end held in contact therewith by pressure, substantially as set forth.

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