

Dec. 31, 1968

J. G. ATTWOOD ET AL

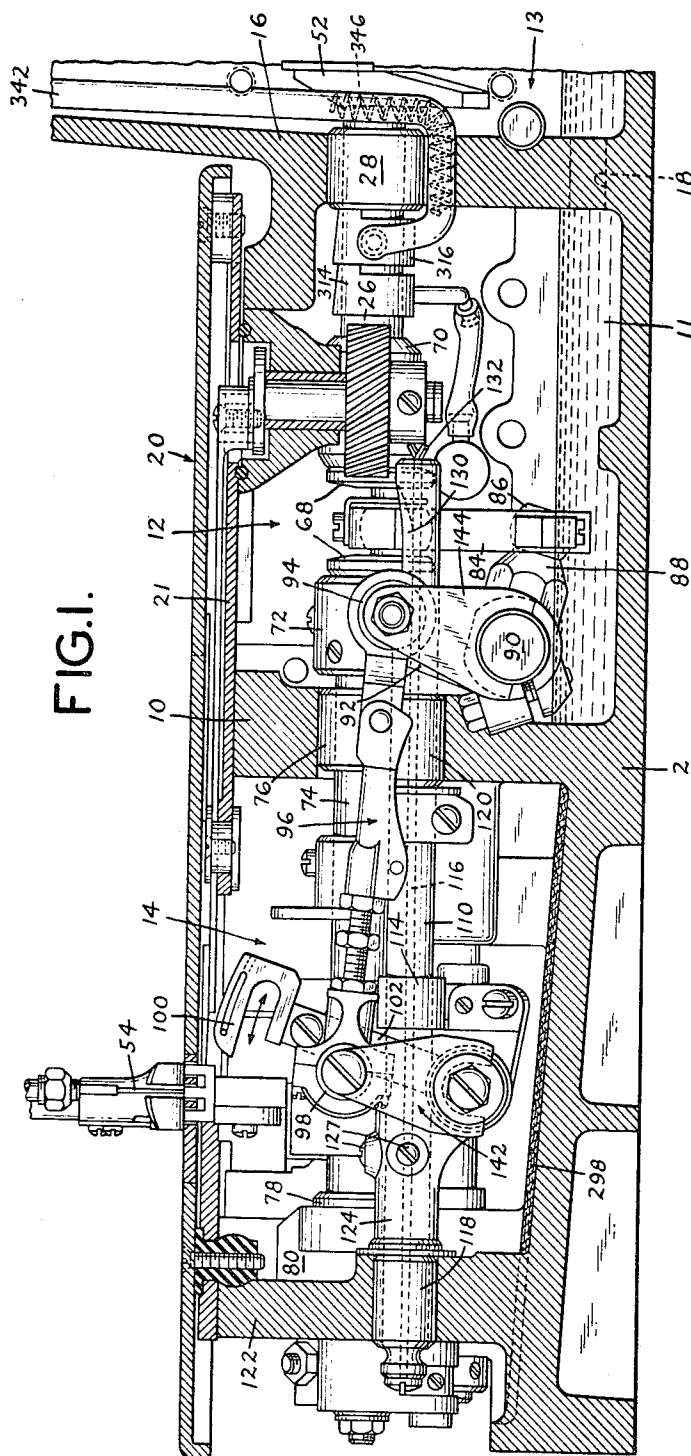
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LUBRICATION SYSTEM FOR SEWING MACHINES

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FIG. 1.



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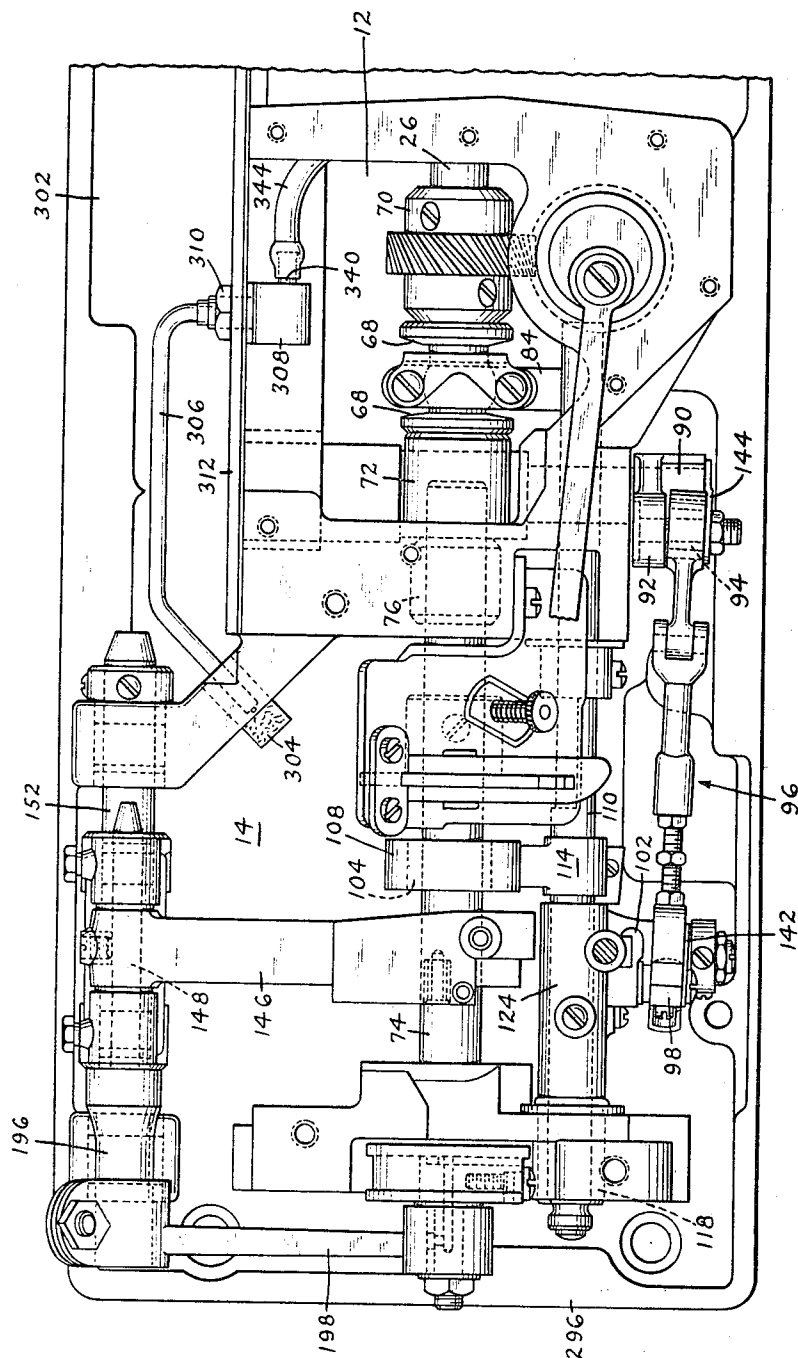
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FIG. 2.



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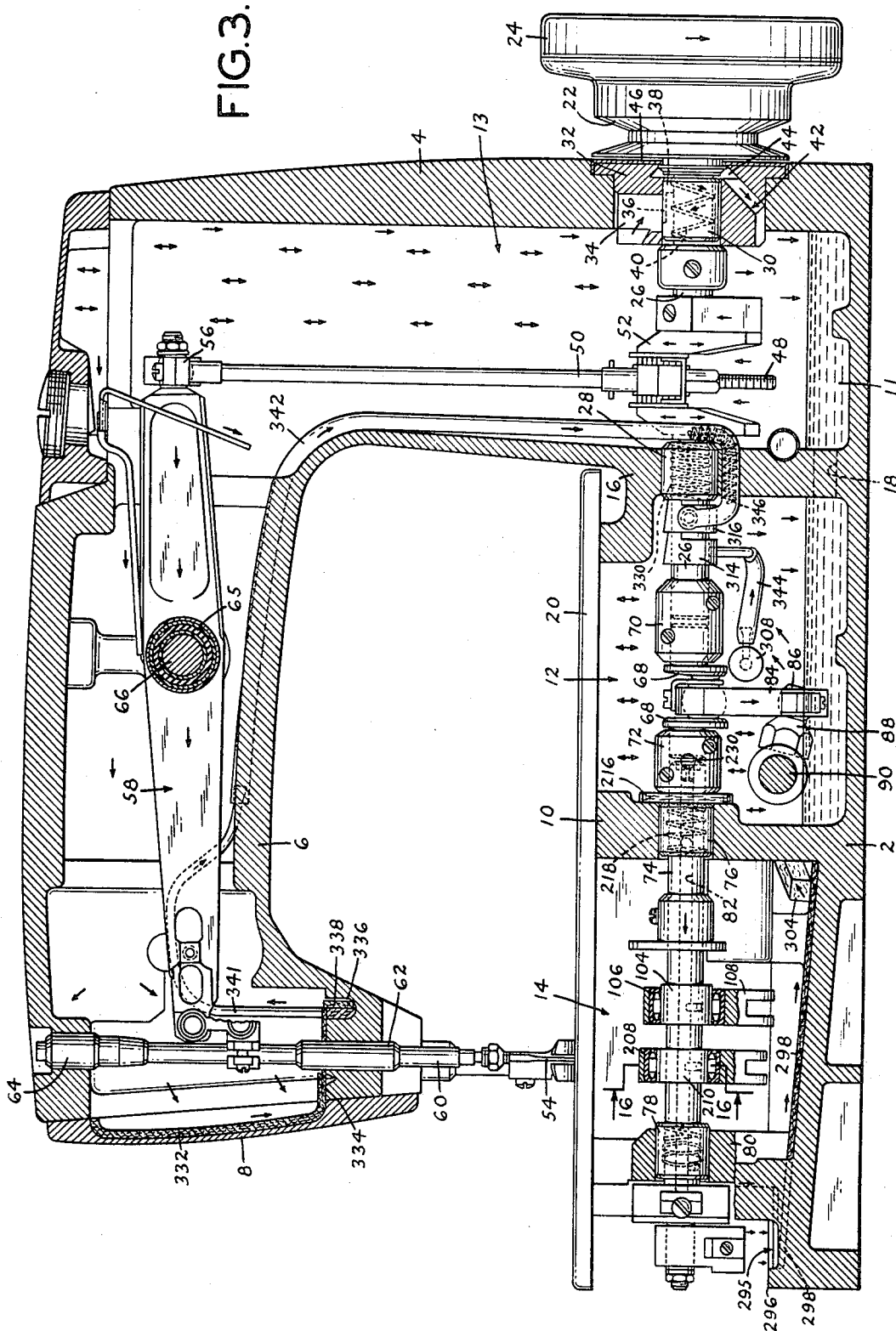
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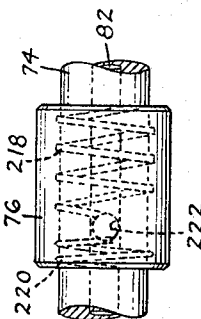
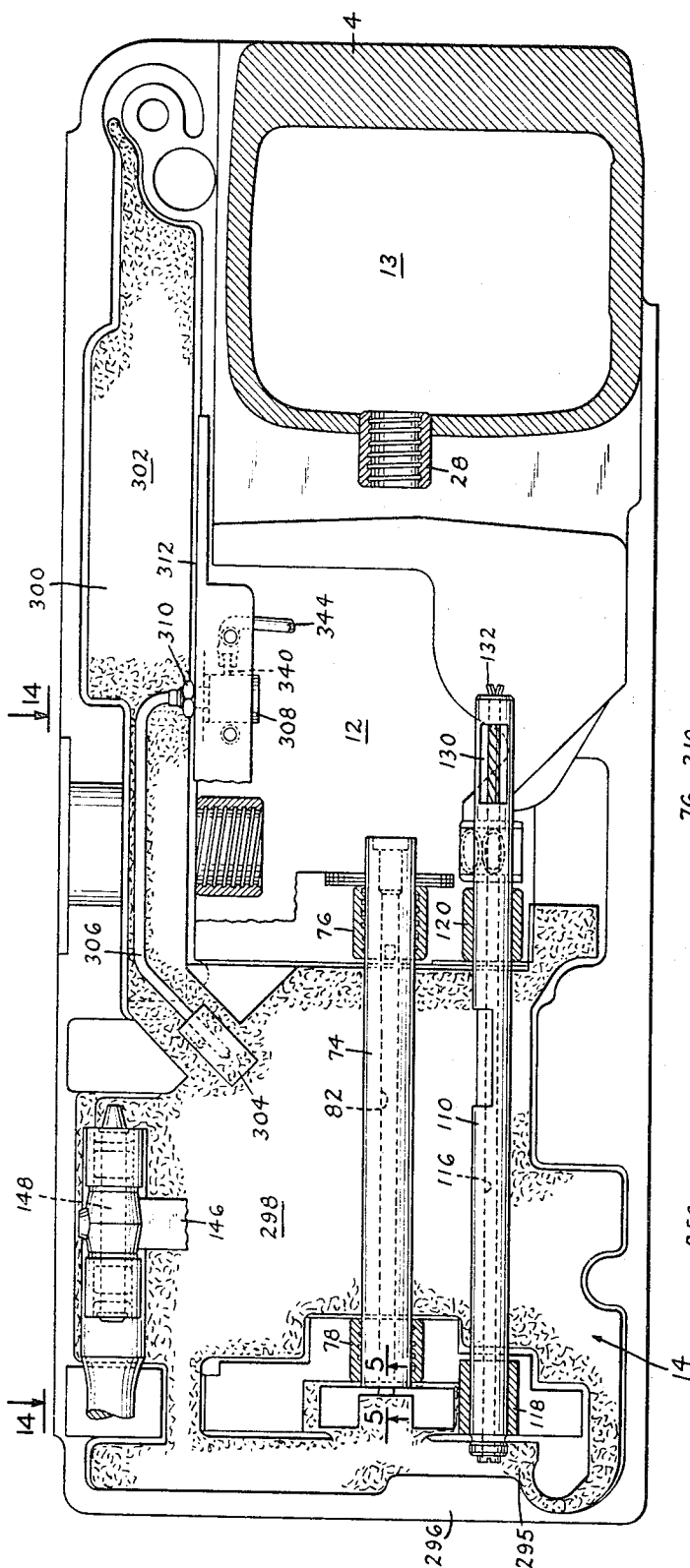
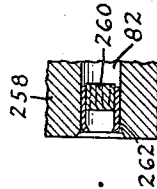


FIG. 27.



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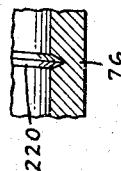


FIG. 28.

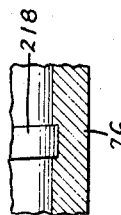


FIG. 29.



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FIG.13.

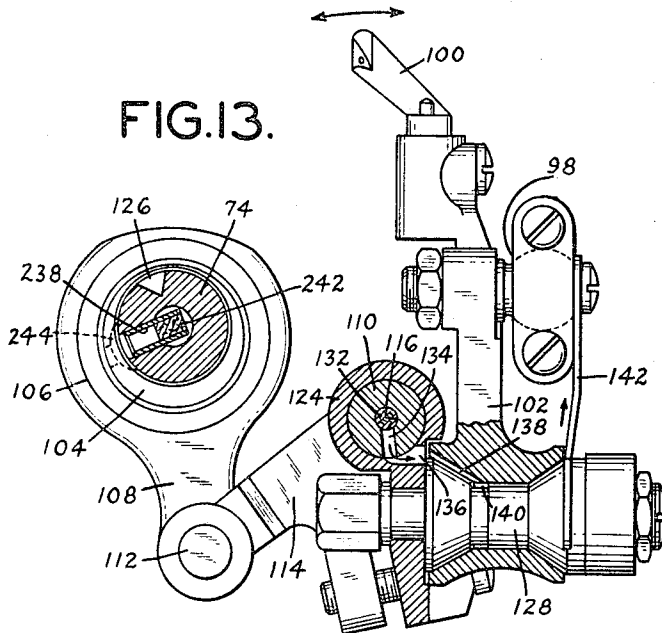


FIG.19.

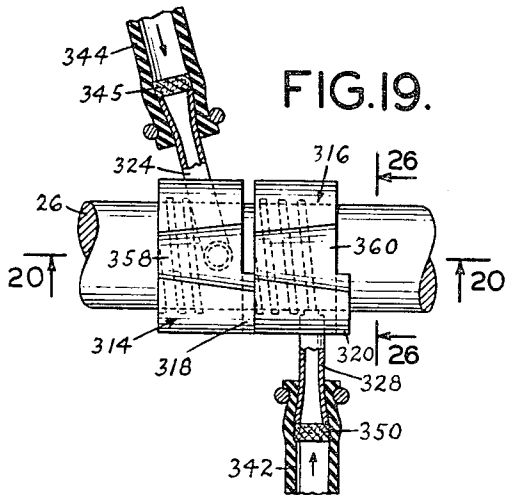
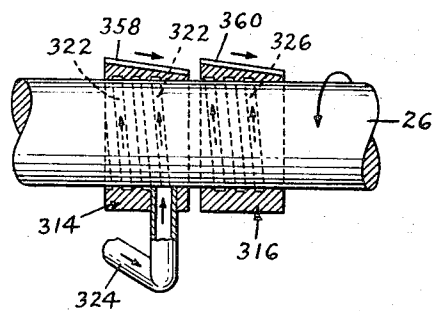


FIG.20.



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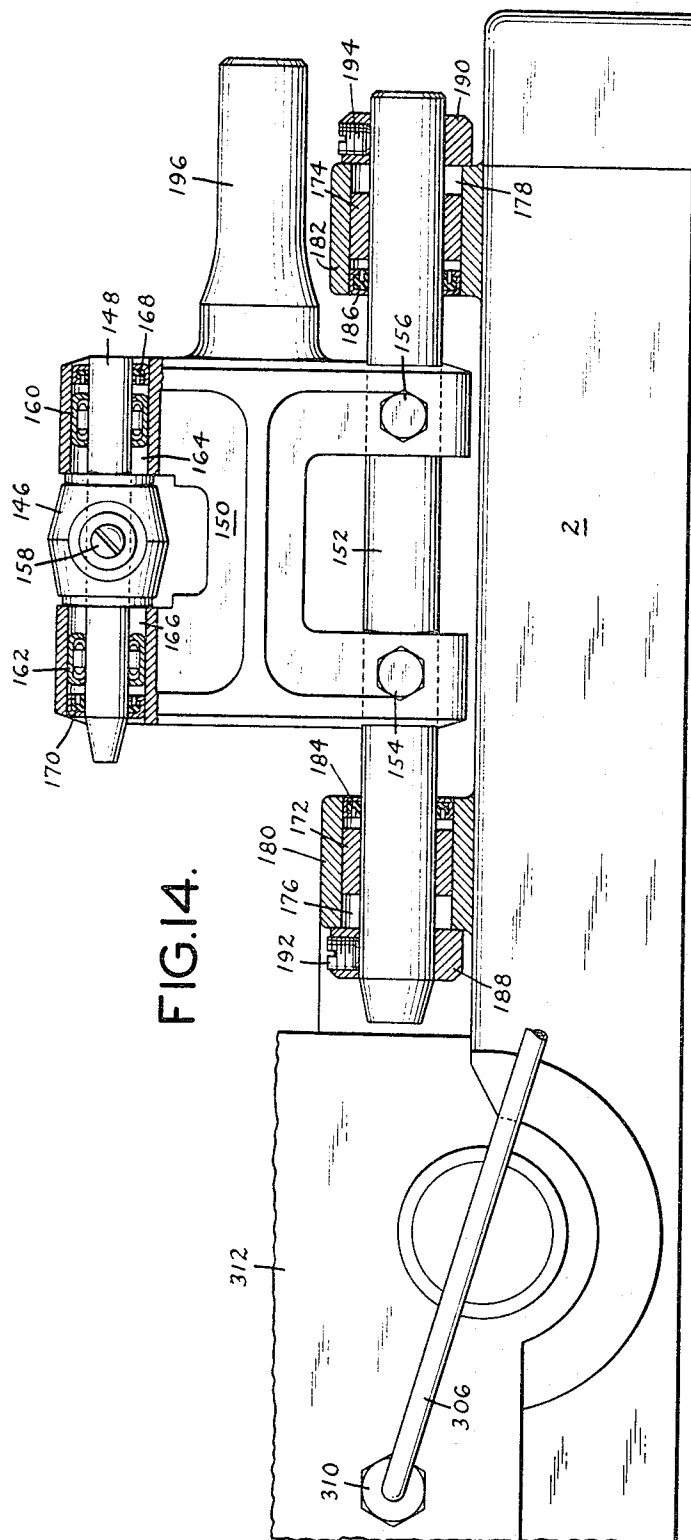


FIG. 4.

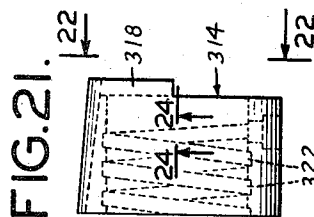


Fig. 2.1.

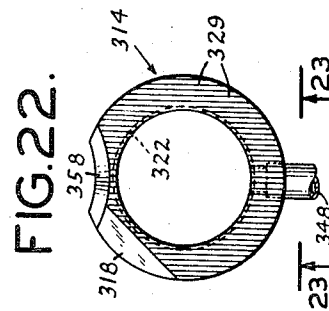


FIG. 22

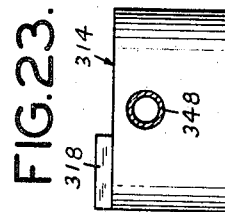


FIG. 23.

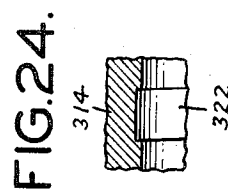


FIG. 24.

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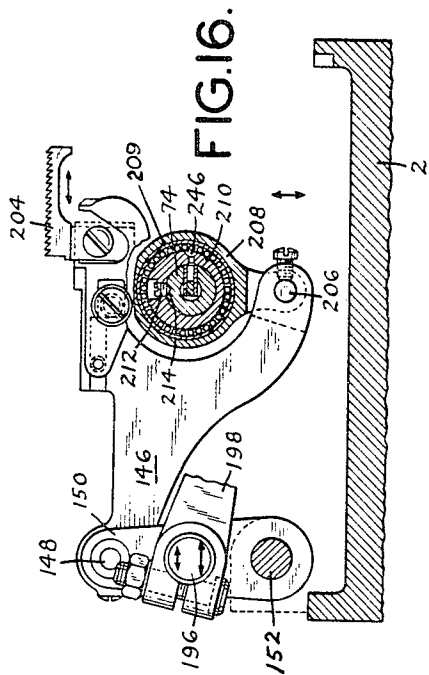


FIG. 16.

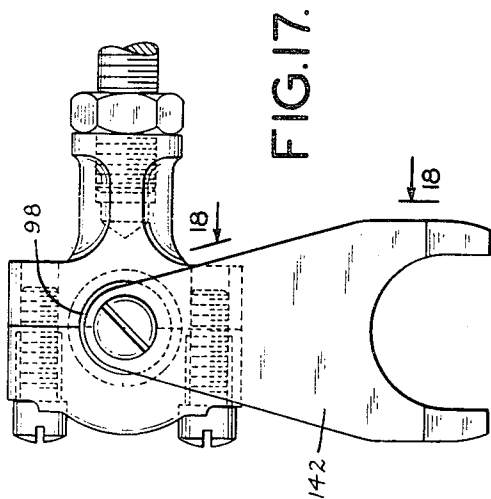


FIG. 17.

FIG. 15.

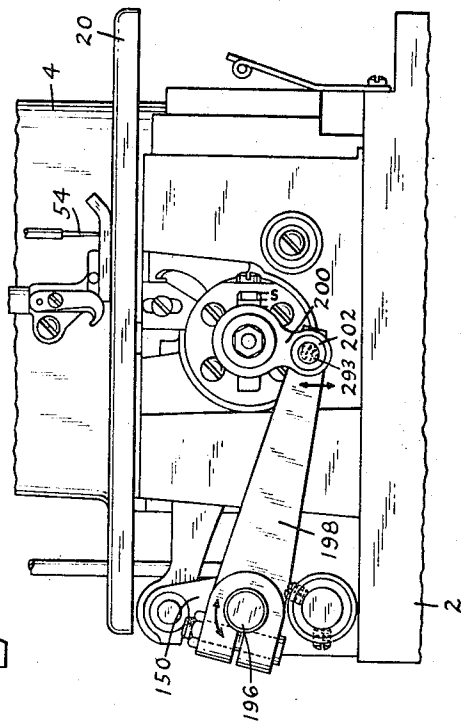


FIG. 18.

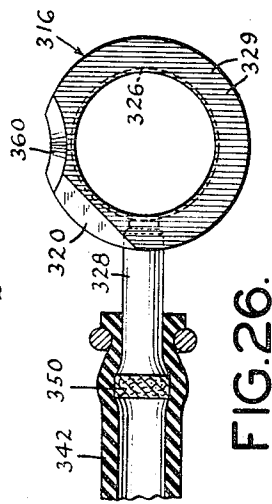


FIG. 26.

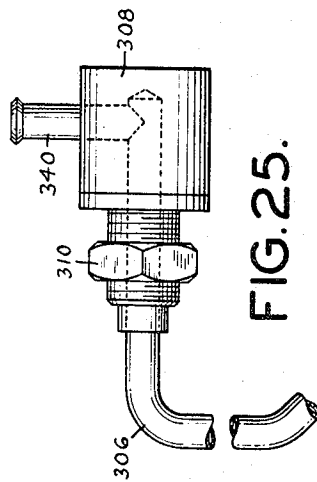


FIG. 25.

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## LUBRICATION SYSTEM FOR SEWING MACHINES

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17 Claims. (Cl. 112-256)

### ABSTRACT OF THE DISCLOSURE

A sewing machine lubrication system including floating bushing pumps having a spiral groove on their interior and a novel system for delivering a predetermined quantity of lubricant to one or more given locations in a sewing machine using porous metering plugs mounted at predetermined radial positions in a hollow lubricant carrying rotating shaft.

This invention relates to sewing machines, and more particularly to lubrication systems for industrial sewing machines.

It is common practice in sewing machines, specially in high speed industrial sewing machines, to enclose at least the major portion of the machine housing and to lubricate the parts within the housing with a mist of liquid lubricant. Such a lubrication system usually includes a splasher attached to one of the rotating parts of the machine. As the splasher rotates, it dips into the lubricant in the reservoir creating a lubricant mist inside the housing. This mist collects, or condenses on the walls and moving parts of the machine, and then flows back into the reservoir. The lubricant not only lubricates but also acts, to a certain extent, as a coolant.

Mist, or splash, lubrication systems are, for the most part, dependent upon oil flowing or seeping between the moving parts, but while such flow or seepage is effective to a certain degree, it does not provide adequate lubrication under all conditions at every point in the machine where lubrication is needed.

To remedy this inadequacy some sewing machines have heretofore been provided with pressure lubrication systems. Such systems, however, have required the addition of pressure pumps which add to the complexity, cost and maintenance of the machine. In addition, these pumps provide a different type of lubrication and cooling than is attained with a mist or splash system, and are more susceptible to oil leakage.

It is of considerable importance not to have oil leakage in a sewing machine, because if oil reaches the sewing portions of the machine, or any part of the machine exterior where it can come into contact with the material being sewed, it soils and stains the material. To prevent this from happening lubrication of the working parts must be controlled, and the exterior of the machine comprising and adjacent the sewing area must be kept free of oil.

It is therefore one object of the present invention to provide a new and improved sewing machine lubrication system which is reliable and capable of providing adequate lubrication under all normal operating conditions, for all parts requiring lubrication whether within or outside of an enclosed housing.

It is a further object to provide an improved splash feed lubrication system in which sufficient lubricant is fed at controlled rates to the various operating parts throughout a wide range of sewing machine speeds.

A still further object is to provide an improved lubrication system in which the oil flow can be controlled, and

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kept away from those parts of the machine having exposed surfaces with which the material being sewed may come into contact.

These, and other objects, will be more apparent from the following description and attached drawings in which:

FIG. 1 is a vertical sectional view taken longitudinally through the base portion of a sewing machine embodying the lubrication system of the invention, certain parts being shown in front elevation;

FIG. 2 is a top plan view of the base portion of the machine shown in FIG. 1 with the top plate removed;

FIG. 3 is a vertical sectional view through the sewing machine, taken along a plane parallel with the front of the machine, showing portions of the preferred embodiment of the invention in elevation;

FIG. 4 is a horizontal sectional view through the base of the sewing machine, showing the main drive shaft and other parts of the novel lubrication system, with certain parts of the machine omitted;

FIG. 5 is an enlarged vertical sectional view through an oil metering plug provided in the machine, taken along line 5-5 of FIG. 4;

FIG. 6 is an enlarged view, partly in section, of one portion of the main drive shaft of the machine;

FIG. 7 is an end view of the portion of the drive shaft shown in FIG. 6, as viewed from the right hand end of that figure;

FIGS. 8, 9, 10, 11 and 12 are vertical views taken along the section lines 8-8, 9-9, 10-10, 11-11 and 12-12, respectively, through the drive shaft in the directions indicated by the arrows in FIG. 6;

FIG. 13 is an enlarged view, partly in section, of a portion of the looper mechanism and its driving means showing means for lubricating it according to the invention;

FIG. 14 is a rear elevation view taken on line 14-14 of FIG. 4 showing part of the housing base and including the lubricating means for a portion of the feed rocker mechanism;

FIG. 15 is a profile view of part of a sewing machine including the inventive lubrication system taken from the left hand end of FIG. 3;

FIG. 16 is a vertical section taken through the feed lift bearing in FIG. 3 on line 16-16 showing the means by which the bearing is lubricated;

FIG. 17 is an enlarged view of the portion of FIG. 1 showing the oiler plate means for lubricating the looper ball and socket;

FIG. 18 is a profile view of the oiler plate of FIG. 17 taken on line 18-18 of that figure;

FIG. 19 is an enlarged top plan view of two novel spiral groove transfer pumps according to the invention with their connections to adjacent conduits shown in section;

FIG. 20 is a front elevation view of FIG. 19 taken on line 20-20 of that figure with the pump shown in cross section;

FIG. 21 is a front elevation view of the left hand pump shown in FIG. 19 with the spiral groove shown in dotted lines;

FIG. 22 is a profile view of FIG. 21 taken on line 22-22 of that figure;

FIG. 23 is a front elevation view of FIG. 22 taken on line 23-23 of that figure;

FIG. 24 is an enlarged detail view of the spiral groove shape used in the pumps of FIG. 20 taken on line 24-24 of FIG. 21;

FIG. 25 is an elevation view of a connection member between the left hand spiral pump in the middle chamber of FIG. 3 and the sump in the left hand chamber;

FIG. 26 is a profile view of the right hand pump of FIG. 19 taken on line 26-26 of that figure;

FIG. 27 is an enlarged elevation view of bearing 76 in FIG. 3;

FIG. 28 is an enlarged cross section of groove 220 in the bearing of FIG. 27;

FIG. 29 is an enlarged cross section of groove 218 in the bearing of FIG. 27.

The invention is illustrated on a flat bed sewing machine having the usual needle bar, looper and feed mechanisms driven from a rotatable shaft, but it should be understood that the invention is not limited to this particular machine. It may be used as well on other sewing machines having a rotary drive and an oil tight or substantially oil tight housing enclosing at least a part of the rotary drive.

One advantage of the novel lubrication system according to the invention is that it provides an adequate supply of oil to bearings, eccentrics and other moving parts at all operating speeds. For example, sewing machines incorporating this system have been satisfactorily tested at low speeds, at very high speeds up to 7,000 r.p.m. as well as at moderate speeds in between.

Adequate lubrication throughout this entire speed range is accomplished, according to the invention, by using a splash system to provide a fine oil mist throughout the interior of the sewing machine housing, together with an absorbing means at one or more points inside the housing on which the oil particles collect in quantities sufficient to comprise a secondary lubrication supply. From this supply means are provided for transferring and carefully metering the oil in controlled quantities to various operating parts and surfaces throughout the machine which are in need of lubrication.

Careful metering of the oil to many of these parts is essential to good lubrication. Some of the eccentrics for example, may need no more than a drop of oil every three minutes under normal running conditions. Other elements, such as shaft bearings, need considerably more oil during the same time period to be properly lubricated. In the lubrication system according to the invention proper amounts of oil are measured and sent to each of these types of elements by novel means which will be explained hereinafter in more detail in connection with the description of the forward portion of the main drive shaft.

Another advantage of the lubrication system according to the invention is that oil is transferred to all lubrication points either by the oil mist directly, or by one or a combination of three different forces, namely gravity, centrifugal force and capillary action. The invention does not include a pressurized lubrication system. Distributing oil using only the oil mist and these three forces enables applicant's sewing machines to be more reliable, simpler in design and less expensive than prior art machines. For example, the use of costly pressure pumps such as gear pumps which are common in many sewing machines being sold today, and the leakage and maintenance problems which go with them are completely avoided.

In one or two cases, where more oil has collected at a point in the housing than is needed, the excess is returned to the main oil reservoir by the force of suction. To provide this suction a novel style of spiral groove oil transfer pump is used, the details of which and the manner in which it cooperates with the other elements of the system will be explained in detail hereinafter.

Referring now to the drawings, and particularly FIGS. 1 and 3, the sewing machine in which the inventive lubrication system is illustrated includes a frame or housing comprising a base 2, a vertical standard 4 (FIG. 3), an overhanging arm 6, and a needle head 8. For reasons which will be more apparent later, the housing base is divided into a middle section or chamber 12, a forward chamber 14, and a rear chamber 13. A wall 10 separates chamber 12 from a chamber 14 and a wall 16 separates chamber 12 from chamber 13. The bottom of each chamber 12, 13 comprises a reservoir 11 containing a supply of

oil, and a passage 18 in wall 16 interconnects the oil supply in both chambers so as to maintain the oil therein at the same level. A work-supporting cover plate means 20 extends over base 2 and includes an oil tight closure plate 21 which seals the upper portion of chamber 12 closed so as to keep the oil mist inside the chamber. Base 2 standard 4, arm 6, needle head 8, and walls 10, 16 may comprise an integral housing shell or frame, like the casting illustrated, or it may comprise separate units bolted or otherwise suitably fastened together.

Referring now more particularly to FIG. 3 the apparatus is conventionally powered by a drive shaft 26 the right end of which is connected to a power source (not shown) by a pulley 22 through a conventional belt (also not shown). The outer end of pulley 22 is provided with a flywheel 24 which also serves as a handwheel for manually turning the drive shaft. Drive shaft 26 is divided into left (i.e. forward) and right (i.e. rear) sections by a crank 52, and these sections are mounted in bearings 28, 30 respectively.

For purposes of assembly and disassembly, bearing 30 is mounted in a bearing housing 32 carried in standard 4. Bearing housing 32 has an oil well 34 at an upper portion of its forward end, which opens into chamber 13 and supplies oil to bearing 30. Well 34 gets its oil from the oil mist created in chamber 13 by means to be hereinafter explained. At the bottom of its rear end well 34 communicates with the radially outer portions of bearing 30. At this location bearing 30 has an axial groove 36 extending rearwardly a distance in the outer surface of the bearing toward pulley 22. At the rear end of this groove there is a radial aperture 38 which communicates with drive shaft 26. The aperture also communicates with the rear end of a spiral groove 40 in the inner wall of bearing 30. The forward end of spiral groove 40 opens directly into chamber 13, and the direction of spiral is such that when shaft 26 is rotated counterclockwise (see arrows in FIG. 3) oil entering aperture 38 will be sucked from the aperture into the groove. As the oil moves through the groove it lubricates the bearing, and then falls back into the reservoir 11 in chamber 13. Any oil which works its way rearwardly of the bearing will fall into a conduit 42 which lies diametrically below well 34 and extends from the pulley end of bearing housing 32 downwardly and forwardly into chamber 13. At its pulley end, conduit 42 comprises an annular chamber 44, the rear or pulley end of which is sealed with an oil seal 46 surrounding the rear end of shaft 26.

The lubricating oil mist in chamber 13 spoken of hereinafter is provided by a splasher 48 which is connected to the lower end of a pitman 50. One end of pitman 50 is mounted on the crank 52 which divides the forward and rear sections of shaft 26. Crank 52 powers the sewing machine needle 54 by means of a linkage which includes pitman 50, a ball and socket 56, a needle lever 58 and a needle bar 60. Needle bar 60 is mounted in two bearings 62 and 64 in needle head 8, and needle lever 58 is pivotally supported in overhanging arm 6 by a bearing 65 on a fixed stationary shaft 66.

The forward section of shaft 26 extends from crank 52 through bearing 28 in wall 16 into middle chamber 12. At its forward end shaft 26 is connected to one end of a spherical crank 68 by a coupler 70. The opposite end of spherical crank 68 is connected by another coupler 72 to the rear end of main drive shaft 74 which lies on the same axis as and acts as a forward continuation of drive shaft 26. Shaft 74 is mounted for rotation in bushings or bearings 76, 78 carried in wall 10 and support 80, respectively. Shaft 74 cooperates with bearing 76 in a manner to be hereinafter described in detail to deliver lubricant into the shaft, and through a bore 82 along its centerline to the feed lift and looper avoid bearings, bearing 78 and into the drive shaft head.

Before explaining that part of the system, however, the looper and feed mechanisms will be described. The

looper mechanism (see FIGS. 1, 2, 3, and 13) is reciprocated in one plane by means of a pitman 84 (see FIG. 3), one end of which is connected to spherical crank 68. The other end of pitman 84 is connected to a looper drive arm 88 by means of a ball member 86 which together with the lower end of pitman 84 acts as a splasher to create an oil mist in chamber 12 and thereby lubricate the outer surfaces of all the parts the mist comes in contact with in the chamber. The other end of looper drive arm 88 is connected to the looper 100 (FIG. 13) by means of a linkage which includes a transverse shaft 90, a looper drive lever 92 (FIG. 1), a needle bearing 94, a connecting linkage mechanism 96, and a ball and socket 98. Ball and socket 98 is mounted on a looper carrying arm 102 which carries the looper 100. Because of these connecting link elements, as shafts 26 and 74 rotate the looper 100 is rocked to the right and to the left as shown by the arrow in FIG. 1.

Referring now to FIGS. 2, 3, 10 and particularly FIG. 13 the looper mechanism and one of its internal lubricating features may be seen. This mechanism includes means for oscillating a looper lubricating shaft 110 (see FIG. 2 and 13) about its central axis to provide part of the avoid motion in which the looper 100 orbits around the needle 54 by passing behind it while moving from right to left (see FIG. 1), and in front of it as the looper is pulled back to the right by linkage 96. These means include an eccentric driving assembly which is powered by the rotation of shaft 74, and linked to shaft 110 by a looper rocker arm 114. The driving assembly, (see FIG. 13) comprises an eccentric 104 which is mounted rigidly on shaft 74 by a screw (not shown) which fits into a shaft depression 126, a needle bearing 106 which surrounds and is driven by the eccentric as shaft 74 rotates and a linking member 108, one end of which is integral with bearing 106. The other end of member 108 is connected to one end of looper rocker arm 114 by a pin 112, and the other end of arm 114 is rigidly connected to shaft 110. When shaft 74 rotates, eccentric 104 raises and lowers bearing 106, and this in turn oscillates shaft 110 about its axis by raising and lowering linking member 108, pin 112 and the end of arm 114 attached to the pin. Shaft 110 has a bore 116 extending along its length (FIG. 4), and is mounted in bearings 118, 120 which are fixed in front and rear walls 122 and 10 respectively (FIG. 1). Similarly to wall 10 wall 122 is a part of base 2.

Surrounding shaft 110 adjacent but to the left of arm 114 as seen in FIGS. 1 and 4 is the looper assembly which includes a body portion 124 fixed to shaft 110 by screws 127. At its lower end looper carrying arm 102 is mounted on and pivotable around a rocker cone stud 128 (FIG. 13) which is attached to the body portion 124 so that it lies in a horizontal plane parallel the axis of shaft 110 and at 90° to said axis. Ball and socket 98 is connected to arm 102 intermediate its two ends thereby giving the looper 100 its right and left oscillating motion spoken of hereinbefore in connection with FIG. 1. As discussed above simultaneously with this motion the looper is reciprocated in and out by the oscillation of shaft 110 about its axis thereby causing the looper to follow its orbital path around the needle.

The right hand end of shaft 110 lies in chamber 12 and has a slot 130 extending from an upper portion thereof radially downwardly into bore 116 (see FIGS. 1 and 4). A strand of wool yarn or other wicking material 132 is provided in this bore and extends from its open end in chamber 12 forwardly through the bore. Adjacent the interior of looper body portion 124 there is an opening 134 (FIG. 13) in shaft 110 which extends radially downwardly through the shaft from bore 116 and communicates with an opening 136 in the body portion. This enables oil to flow from wick 132 into the latter opening.

A channel 138 is provided in the lower end of looper carrying arm 102, and is aligned with opening 136 to receive oil from shaft 110. Communicating with channel

138 there is an annular recess 140 in stud 128. This recess fills with oil from the channel and keeps the stud and carrying arm lubricated. Since an excess of oil flows from wick 132 into opening 136 some of it will flow into recess 140 and in the space between the arm and stud beyond this recess toward the opposite end of the stud where there is an oiler plate 142. The lower end of this plate (see FIGS. 17 and 18) is wetted by oil which works its way from recess 140 into and out from the space between the stud and arm 102 to plate 142. The upper end of plate 142 is connected to ball and socket 98.

Plate 142 is treated, i.e., luberized, in a known manner so that its surfaces have a tendency to retain oil, and to move such retained oil over the surfaces of the plate whenever it is moved. Also, the lower part of plate 142 is bifurcated, as shown in FIG. 17, so as to cover a major part of the space at the end between stud 128 and arm 102. The plate collects oil which exudes from between these two elements, and its movement caused by the combined oscillations of shaft 110, stud 128 and ball and socket 98 is sufficient to push the collected oil up the plate so that it reaches and lubricates the ball and socket. A profile view of plate 142 can be seen in FIG. 18. It should also be noted that linkage 96 is preferably luberized in the same manner as plate 142. The purpose of luberizing this linkage is not only to ensure that the linkage itself is well lubricated, but also to enable some of the oil travelling up plate 142 to be transferred over the linkage to needle bearing 94. Ordinarily a sufficient amount of oil will travel over the linkage to lubricate bearing 94 quite adequately, but if more oil is desired a luberized oiler plate 144 similar to plate 142 can be connected between one end of shaft 90 and needle bearing 94. Oil from the mist will move up this plate as it reciprocates and ensure plenty of lubricant for the bearing.

The workpiece feed portion of the mechanism with its special lubrication features will now be described in connection with FIGS. 2, 3, 8, 14, 15 and 16. Referring particularly to FIGS. 2 and 14 there is a feed bar 146 which is rigidly connected at one of its ends to a shaft 148. This shaft is pivotally supported in an upper portion of a feed rocker bracket 150 which bracket is pivotally attached, at its bottom end, to base 2 by a shaft 152. Bracket 150 is locked to this shaft by set screws 154, 156, and feed bar 146 is locked to shaft 148 by a set screw 158. Shaft 148 is mounted in bearings 160, 162 carried in bores 164, 166 in feed rocker 150. The ends of bores 164, 166 are preferably closed to form sealed bearing chambers by seals such as 168, 170. Bearings 160, 162 may be needle bearings which are packed and sealed with a permanent lubricant or they may be any other type of permanently lubricated bearings.

Connected at the right hand side of feed rocker 150 (FIG. 14), intermediate shafts 148 and 152, there is a trunnion rod 196 to which one end of a feed rocker arm 198 (FIG. 15) is rigidly connected. The other end of rocker arm 198 is connected to a pitman 200 by a hollow pin 202 (see FIGS. 15 and 16). Rotation of drive shaft 74 will rotate the drive shaft head spoken of hereinbefore and will cause pitman 200, pin 202 and one end of rocker arm 198 to move up and down as shown by the arrow in FIG. 15. This motion is caused by an eccentric feature in the stitch length adjusting mechanism of the drive shaft head which will be explained in more detail hereinafter. The motion of pitman 202 causes trunnion 196 to move back and forth in an arc about shaft 152 (see arrows FIGS. 15 and 16), thereby giving feed dog 204 its in and out (i.e. right and left) movement as seen in FIG. 16.

As best seen in FIG. 16 the right hand end of feed bar 146 is bifurcated, with its upper portion carrying the feed dog at a point above shaft 74. Its lower portion is bearingly connected to shaft 74 at a point below the shaft which lies between its upper and lower portions. This connection is accomplished by means of a pin 206, a link-

ing member 208, a bearing 209 and a feed lift eccentric 210.

Eccentric 210 is locked onto shaft 74 by a set screw 212 which projects into a shaft recess 214 (see FIG. 6) and rotates in bearing 209 which is fixedly mounted in member 208. Bearing 209 is preferably a needle bearing, as illustrated, in which the shaft 74 and eccentric 210 rotate together as a unit within the bearing race containing the needles. With this construction, the motion of eccentric 210 due to the rotation of shaft 74 will add an up and down component (see FIG. 16) to the right and left motion of feed dogs 204 thereby moving them in a proper orbit for feeding the material to be sewed to the needle 54. The means for lubricating bearing 209 will be explained hereinafter in connection with FIGS. 3, 6 and 7.

Referring now to FIGS. 3 and 6 it will be seen that between bearing 76 and coupler 72 there is a collar or washer 216 surrounding shaft 74. This washer is mounted adjacent the bearing and is preferably made of felt or some other suitable wicking material which collects and absorbs droplets of lubricant from the oil mist in chamber 12. The oil which collects on the washer serves as a secondary oil supply from which bearings 76, 78, the drive shaft head and bearing 106 and 209 are lubricated. To accomplish this, oil is pulled from washer 216 by a unique transfer pump formed in bearing 76.

This pump comprises two helical grooves 218, 220 (see FIG. 27) which communicate with the shaft around the inner surface of the bearing. Groove 218 forms a left hand spiral which begins at the bottom of the right hand end of the bearing as seen in FIGS. 3 and 27, where it communicates with felt washer 216. Groove 220, on the other hand, forms a right hand spiral beginning at the left hand end of the bearing. For the purposes of this specification both kinds of spiral are defined with reference to right cylindrical body. A right hand spiral is one which starts at the base of such a body and travels clockwise around it as the groove progresses upwardly (i.e. forwardly). A left hand spiral is one which also starts at the base of the body, but travels counterclockwise about it as the groove progresses upwardly. A right hand spiral is also defined as having a clockwise direction of spiral, while a left hand spiral has a counterclockwise direction of spiral. This is due to the fact that when the shaft, within the bushing or bearing having the spiral groove, is rotated in the direction of spiral of the groove, the lubricant will be urged away from the end of the bushing where that spiral begins. Preferably, the spiral grooves used in the bushings of the lubrication system of this invention are helical, but they may also have a variable pitch not characteristic of the helix. By starting groove 218 at the bottom of bearing 76 more oil is available since it tends to collect at the bottom of the felt washer adjacent the groove end. From there it extends leftwardly to a point intermediate the ends of the bearing where as the shaft is rotated it communicates with a duct 222 in shaft 74. Preferably duct 222 is radial and positioned near the forward or lefthand end of the bearing. Counterclockwise rotation of shaft 74 will cause a quantity of oil to be sucked from washer 216 along the groove and pushed into duct 222 with each revolution of the shaft. Shaft 74 has a bore 82 along the length of its central axis with which radial duct 222 communicates so that the oil in duct 222 is transferred into bore 82 (see FIGS. 6, 12 and 27).

As it can be seen from FIG. 29 groove 218 is flat and preferably about .025 of an inch wide and .010 of an inch deep. The rather larger than normal width of this groove serves to insure proper communication with duct 222 since bushing 76 cannot easily be tapped into position with extreme accuracy when the sewing machine is assembled. With a narrower groove it is more likely that duct 222 would not be accurately set in register with the groove during such assembly, and would therefore impede

rather than facilitate the flow of oil into bore 82. Of course, as oil flows along groove 218, bushing 76 is lubricated.

Groove 220 forms a right hand spiral, and as stated above extends to the right from the left side of bearing 76 to a point where it is also in registration with the duct 222. It does not communicate directly with groove 218 however (see FIG. 27). When shaft 74 is rotated counterclockwise groove 220 acts as a pump to return any oil to duct 222 which may have been pushed past it by groove 218. In this way grooves 218, 220 not only ensure the transfer of oil from washer 216 to the shaft bore 82, they also ensure adequate lubrication of bearing 76.

Groove 220 is substantially narrower than groove 218, has a smaller pitch length and instead of being flat is preferably V-shaped (see FIG. 28). This conformation is preferable because groove 220 does not have to carry any substantial amount of oil, and its communication with duct 22 is less critical.

The amount of oil transferred from washer 216 into bore 82 in this manner is normally in excess of the amount needed to lubricate the main shaft head and bearings 76, 78, 106 and 209. The excess is returned to the reservoir through venting means which will now be described. Oil entering the rotating shaft spreads itself in a cylindrical film over the inside surface of the bore 82, and when sufficient oil has entered, the level of this film reaches a vent 224 (FIGS. 6, 7) in a threaded plug 226. Plug 226 has a screw slot 228 at the end of shaft 74 for easy removal and access to the bore. Any surplus oil flowing into bore 82 will escape through vent 224 and flow back into the oil reservoir in the bottom of chamber 12 through an opening 230 (see FIG. 3) in coupler 72. Thus, the oil remaining in the shaft is not pressurized. It extends in a cylindrical film from one end of the bore to the other.

To use the oil in the bore to lubricate bearings 106 and 209 radial outlet ducts 232 and 234 are axially spaced along the shaft intermediate its ends (see FIGS. 6, 9, and 10). These ducts extend from the bore 82 to the exterior of shaft 74 and are fitted with sleeves 236, 238 respectively. Both sleeves are of precise length so as to control the amount of oil entering them from the bore. They extend from the exterior of shaft 74 all the way into the bore beyond the shaft centerline and each is fitted with a parous oil metering plug 240, 242 preferably made of a fairly dense felt or some other suitable wicking material. Bearings 106 and 209 (see FIGS. 13 and 16) are preferably needle bearings and require only a very small amount of lubricant in a given period of time. For example, each of them may require only one drop of oil for every three minutes of running time.

Referring again to FIGS. 9 and 10, it will be seen that both of plugs 240 and 242 are pushed so far into their sleeves that each of them straddles the centerline of lubricating shaft 74 with a slightly greater length of felt on the outlet side of the centerline than the other. The longer portion of both plugs extends radially outwardly in its respective sleeve just beyond the outer limits of bore 82. This construction will cause the plugs to act as pumps which transfer oil from the bore in metered quantities, due to the effect of the centrifugal force created when the shaft rotates. Analyzing this construction in more detail, the centrifugal force on the oil in the felt portion below the shaft centerline tends to keep the oil in the plug inside the shaft, whereas the centrifugal force on the oil in the portion above the centerline tends to transfer the oil in the plug through the sleeve to the exterior of the shaft. The centrifugal force on the oil in one felt portion is in an opposite direction to that in the other, but because of the differing lengths of the two plug portions a net force is exerted tending to transfer a small amount of oil out of the shaft through sleeves 236, 238.

As mentioned previously, eccentrics 104 and 210 are locked onto shaft 74. They surround the shaft and would cover the ends of ducts 232, 234 and sleeves 236, 238 were it not for apertures 244 and 246 provided in the eccentrics which communicate with the ducts and allow the oil to pass through the eccentrics to their respective needle bearings.

The quantity of oil transferred by each plug in a given period of time is controlled not only by the amount of centrifugal force created by the rotating shaft, but also by the length with which the plug on one side of the shaft centerline exceeds its length on the other. The longer this excess length is the greater the net centrifugal force will be tending to push oil out through the plug. It should also be noticed that for any given amount of centrifugal force the length and density of the plug will control the quantity of oil flowing through it. These three factors together enable the amount of oil flowing through the plug to be metered and controlled accurately. Since bearings 106 and 209 are similar, their lubrication requirements are the same and their metering plugs and sleeves are the same size and length.

As will be seen from FIGS. 6 and 11 between duct 222 and duct 234 there are two axially spaced recesses 248 which have no ducts opposite them. These recesses enable certain operating parts to be driven by shaft 74 though they do not receive lubrication from it.

Referring now more particularly to FIG. 8, another oil duct 250, sleeve 252 and porous plug 254 construction can be seen. This one provides oil to bushing bearing 78 which requires considerably greater quantities of lubricant than either of bearings 106 or 209. In this construction sleeve 252 extends into bore 82 a distance short of the shaft centerline, and plug 254 lies in the sleeve almost entirely outside of bore 82. It should be clear from the previous discussion that the centrifugal force from the rotating shaft in this construction will push considerably more oil through plug 254 than through either of plugs 240 and 242. Since the felt is all on one side of the centerline, the force pushes the oil only outwardly through the sleeve. The function of duct 250, sleeve 252 and plug 254 is to provide lubricant to bearing 78 at the end of shaft 74. The closer the felt plug is placed towards the outside surface of the shaft, the greater will be the centrifugal force pushing oil through it, and the greater the amount of oil transferred to bearing 78.

As shown more particularly in FIG. 6, there is a support 256 having a cylindrical extension 258 mounted in and positioned co-axially with the left or main shaft head end of drive shaft 74. Support 256 and its extension 258 may also be made integral with the lubricating shaft, though it is shown as a separate element in the drawings. It is obvious that if the apparatus includes support 256 as a separate element, as shown in FIGS. 6 and 8, sleeve 252 will be mounted in the co-axial extension of the support as well as the end of shaft 74.

Referring now to FIGS. 4, 5 and 6 at the left hand end of lubricating shaft 74 there is another porous oiling plug 260 mounted in a sleeve 262 concentrically around the centerline of shaft 74 in support 256 and extension 258. Plug 260 is preferably made of material similar to that of the other plugs and serves to act as a restriction which controls and meters the amount of oil flowing through it to the stitch length regulating means comprising the main shaft head which is attached to support 256. The oil passes through plug 260 and enters an orifice 266 in an insert 268. From there it moves into an axial passageway 270 in a feed crank stud 272 which may be moved into an eccentric position with respect to the central axis of shaft 74 by screw means 274. From passageway 270 the oil moves radially by centrifugal force through a feed crank branch passage 276 and an opening 278 in a ferrule 280 to a needle bearing 282. Ferrule 280 is mounted on stud 272 and revolves with it inside bearing 282. Excess oil in the bearing escapes through an orifice 284

in the bottom of the bearing into an oil passage 286 having radial branches 288 and 290. Each of these branches is intersected by the hollow pin 202 spoken of previously in connection with arm 198. The excess oil flows down branch passages 288, 290 into the center of pin 202 by means of pin apertures 292. Fitted into the center of this pin is some oil wicking material 293 which helps retard the flow of oil through passages 288, 290 to ensure adequate pin lubrication. Any excess oil will fall from the pin through apertures 294 back into passages 288, 290 and eventually down into a hollow 295 formed by a lip 296 at the front end of base 2 (see FIGS. 3 and 4).

The constructional features of the stitch length control mechanism and the details of its operation are set forth at length in a copending U.S. patent application, Ser. No. 505,288, filed on Oct. 26, 1965, entitled "Sewing Machine Improvements," George Reimer, inventor. For the purposes of the present invention it is sufficient to say that the stitch length is adjusted by changing the eccentricity of feed crank stud 272 with respect to shaft 74. The greater the eccentricity the greater the up and down motion of pin 202 and the longer the distance between stitches.

Referring now more particularly to FIGS. 3 and 4 at the bottom of hollow 295 there is preferably provided a layer of felt which absorbs the surplus oil as it drops into the hollow. Felt layer 298 extends from hollow 295 into forward chamber 14 and lies at a slight slope so that oil absorbed at the front end of the sewing machine will tend to flow through the felt toward the rear of forward chamber 14, both by capillary action and by gravity. Communicating with forward chamber 14, as best seen in FIG. 4, is a side chamber 300 which also has a layer of felt 302 lying on its bottom. This chamber extends to the side of chambers 12 and 13 and its felt layer serves to absorb and collect oil which falls upon it. Layers 298 and 302 join and overlap to an extent adjacent the point at which chambers 14 and 300 meet.

To absorb the excess oil from felt layers 298, 302 and to return it to the reservoir there is a small felt pad 304 one end of which rests on felt 298 at the side and rear of chamber 14. That portion of the chamber is the lowest portion and acts as a sump to collect excess oil from felt layers 298 and 302. The other end of pad 304 is connected to one end of an oil tube 306 and the other end of which is preferably soldered to a transfer element 308 (see FIGS. 2, 4 and 25). This element carries the oil through a side wall 312 and may be mounted in side wall 312 by a nut 310. The portion of transfer element 308 which lies in chamber 12 has another oil tube 340 soldered to it which connects it to one end of a plastic tube 344 which leads to the new style spiral grooved suction pump spoken of hereinbefore. Connecting the other end of tube 344 with the pump is one end of a tube 324 (see FIG. 19), the other end of which communicates with and is preferably soldered to spiral groove pump 314. In addition there is an oil filter 345 on the end of tube 324 within plastic tube 344 to prevent lint, felt pieces and other foreign materials from entering the pump. If such materials were not filtered and were to enter the suction pump, they might interfere with its operation. The filter element itself may be made of any oilite metal such as "porex" or another suitable or similar product.

Referring now more particularly to FIGS. 19-24 the construction of the spiral grooved suction pumps will be described. There are two such pumps 314 and 316 both of which are preferably made from floating brass bushings prepared with very shallow grooves. The construction of pump 314 is the same as that of pump 316 except that the oil tube 324 feeding pump 314 enters from the bottom, whereas oil tube 328 feeding pump 316 enters the pump from the side as seen in FIG. 19.

The spiral grooves of both pumps 314, 316 are prefer-

ably left hand helical grooves so that counterclockwise rotation of drive shaft 26 will cause each pump to suck oil from the tube which feeds it. These grooves are preferably rectangular in construction as shown in FIG. 24, and extend radially into their bushings a distance of preferably not more than .005". Grooves deeper than about .010" would prevent the pump from creating adequate suction. Ideally the grooves should have a depth of between about .002"—.003". Though the exterior physical dimensions of the pumps are not critical, in the sewing machine with which they are illustrated, each is about  $\frac{7}{16}$ " long, and maintained about  $\frac{1}{16}$ " away from the other. Pump 314 is spaced this distance from pump 316 by a spacer 318 which is integral with pump 314 and pump 316 is kept the same distance from bearing 28 by a similar spacer 320 integral with pump 316. Groove 322 begins at the point where it meets tube 324 entering pump 314 and ends to the left as it exists onto shaft 26 and into chamber 12 (see FIG. 20). A similar groove 326 in pump 316 begins where it meets oil tube 328 entering the pump and ends opposite pump 314 where the groove exits onto shaft 26. To make these pumps create adequate suction to pull oil from points in the housing where excess lubricant has collected, not only must the grooves be properly dimensioned as discussed above, but the space between the pumps and shaft, adjacent the input side of each pump, must be so adjusted that oil but no air is sucked into the pump through that space. For this reason the radial gap between the right hand or contact edge of each pump and shaft 26 should not be substantially more than .0005". In the sewing machine with which the present pumps are illustrated the clearance between the two elements is preferably held to .0003" or less. If the clearance is as much as .0006" experience has shown that the pump may suck air through the gap. This would break the pump's suction generating ability. Only when the gap is kept filled with oil will the pump be adequately primed, and be able to draw not only oil, but also air from the remote regions of the machine when most of the oil at that point has been returned to the reservoir. Enough suction to return the oil to the reservoir and break any air lock that might form in the felt pads 304 and 338 will only be obtained however if the pumps are properly primed by keeping the clearance between the pumps and the shaft filled with oil.

According to the present invention the pumps are primed in several different ways. First, the oil mist in chamber 12 causes some oil particles to be deposited in the critical area (i.e. the gap). Second, a trough is provided at the top of each pump to collect additional oil droplets from the mist. These troughs 358, 360 are narrow at the left hand end of each pump, but become wider and slope radially inwardly as they extend to the right as shown in FIGS. 19 and 20. The oil which they collect drains over their right hand edges down the side of each pump toward the clearance gaps between the shaft and the pumps. In this way, while the machine is running, a constant stream of lubricant from these troughs is fed into the radial gap between each pump and the shaft so as to keep the pumps primed.

To guide the oil evenly toward this gap on the entrance side of the pumps a plurality of linear vertical capillary grooves 329 are provided in the right hand side surface of each pump. These grooves are arranged perpendicularly to a horizontal plane through both the shaft and axis of the pump, and may be formed by briefly touching a vertically moving sanding belt to the right side surface of each pump. The oil flowing down from the trough will tend to follow these grooves, and be guided to the contact edge between the pump and the shaft. If no grooves of this type are formed the pumps may not receive enough oil for adequate priming. This is particularly likely to happen when the pumps themselves are manufactured on screw machines which automatically seem to cut circumferential capillary grooves into the

pump's right side surfaces thereby causing the oil to travel around the shaft and drop off at the bottom of the pump without ever having reached the gap at which it is needed.

Third, the pumps are primed by oil exiting onto the shaft adjacent the clearance in question. It will be noted, for example, that pump 316 is maintained  $\frac{1}{16}$ " from pump 314 by spacer 318 and that the exit in the groove in pump 348 lies across this space opposite the contact edge between pump 314 and shaft 26. In this way oil coming from pump 316 is directed toward the contact edge between pump 314 and the shaft thereby tending to prime the pump by insuring an inadequate supply of oil at that edge.

It has also been found that though some of the oil exiting onto the shaft from the pumps tends to be thrown into the reservoir, some of it climbs upwardly along the left hand side face of the pump until it reaches the beginning of the trough so as to make the pump partially self priming in that some of the initial priming oil recirculates through the pump to prime it again. Anything which will help increase this recirculation of oil will help keep the pump properly primed. It should be noted that the suction creating ability of the pump doesn't seem to change according to the viscosity of the oil. It is relatively constant over a wide range of machine speeds, only dropping off when the speed gets below about 500 r.p.m. At very high speeds more oil is thrown off the shaft than at low speeds, but this tendency should be curbed to the extent possible, because it tends to reduce the amount of oil available for priming.

Referring now to FIG. 3 it will be seen that bearing 28 has a groove 330 which acts as a pump and supplies oil along the shaft to prime pump 316 at its contact edge with shaft 26. The groove in bearing 28 sucks oil from the mist in chamber 13 and from the side of the vertical portion of overhanging arm 6 as it collects from the mist and flows down toward the reservoir. Groove 330 is preferably a left hand helical groove starting at the right end of the bearing. In this way bearing 28 is lubricated and at the same time suction pump 316 is provided with a sufficient supply of priming oil at its contact edge.

Referring again to FIG. 3 the oil mist in chamber 13 travels up through the column of the sewing machine and then longitudinally through overhanging arm 6 to the sewing head where it gathers on the working parts as well as on the walls. Oil which collects on the working parts tends to be thrown back onto the side, top and bottom walls of the sewing head. A layer of felt 332 is attached to the left side of the head and overlaps another layer 334 which lies on the bottom of the head to collect this oil. Oil thrown off the working parts and oil particles in the head are absorbed into this felt and moved downwardly by gravity and capillary action toward a sump 336. A small felt pad 338 is provided in sump 336 which absorbs oil from layer 334 by capillary action. A portion of pad 338 is connected to an oil return tube 341 which extends from the pad into the overhanging arm 6 where it is connected to one end of a plastic tube 342. To prevent plastic tubes 342 and 344 from collapsing due to the partial vacuum within them, as well as the heat which may build up inside the sewing machine, a spring 346 (see FIG. 1) may be inserted in each tube to keep them open at all times. At the other end of tube 342 there is a conduit 328 having a filter 350 which connects with pump 316. This filter is preferably similar to the one discussed in connection with tube 324.

The spiral groove pumps which have just been described are simple in its design, inexpensive to manufacture and quite efficient for their size. Each one is capable of sucking approximately 10 cc.'s of oil per minute from its felt pad and returning it to the reservoir. This capacity is much larger than that needed by the machine since excess oil does not collect at anywhere near such a rate. One advantage of these pumps is that they have no mov-

ing parts, and since an oil film is maintained at all times between the pump and the shaft, almost no wear takes place, thereby considerably reducing machine maintenance.

In operation all of the lubricating elements and features which have been described operate simultaneously to provide the moving parts with an adequate supply of oil regardless of the speed at which the machine is run. The oil mist created by the splashing elements keeps many moving parts adequately lubricated all by itself. Others which can not be properly lubricated by the mist alone are fed various amounts of oil appropriately metered to each point from the bore 82 in lubricating shaft 74. All of the oil inside this shaft, of course, comes from the mist by way of the felt washer 216 and the spiral grooves in bearing 76. Excess lubricant either drops back directly into the reservoir or is collected in remote areas of the machine by one of the felt pads 304, 306 from which it is sucked back into chamber 12 where it falls back into the reservoir with the rest of the oil. Thus, the lubricant moves in a complete recirculating cycle, leaving the reservoir as a mist and being returned to it in the form of mist droplets and drops of oil which has collected on the parts or been returned by the suction pumps previously mentioned. It is never pressurized but travels in its cycle freely under the forces of gravity, capillary action, vacuum and centrifugal force.

It will be understood that various changes in the details, materials, steps and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

What is claimed is:

1. In a sewing machine having operating parts to be lubricated; a frame having a lubricant retaining reservoir therein; bearing means including a bushing bearing mounted in said frame and having one end face free of said frame; means for agitating at least a portion of the lubricant in said reservoir to create a mist therefrom for lubricating said operating parts; a rotary shaft supported by said bearing above said reservoir and having an axial bore along at least a portion of its length and a duct extending from said bore to said bearing with which it communicates intermediate its ends; the improvement comprising lubricant wicking means in circumferential contact with both said shaft and said bearing end face and adapted to lubricate said shaft and to collect lubricant droplets from said mist and deliver a supply of lubricant to said end face; and means comprising axially extending spiral suction groove means in said bearing peripherally contacting said shaft and extending between said duct and said bearing end face and defining an opening in said face; and means for rotating said shaft in the direction of spiral of said groove means to simultaneously suck lubricant from said wicking means through said opening and pump it into said shaft bore.

2. In a sewing machine as in claim 1 the combination wherein said wicking means comprises a felt collar pad and said spiral groove means comprises two spiral grooves, one comprising a left hand helical groove beginning at the bottom of the end face of said bearing where it defines said opening and communicates with the lower portion of said pad and ending intermediate the ends of said bearing at said duct with which it communicates as said shaft revolves, the other comprising a right hand helical groove beginning at the opposite end of said bearing and extending from there into communication with said duct, said shaft rotating means revolving said shaft in the direction of spiral of said left hand helical groove.

3. In a sewing machine having operating parts to be lubricated, a frame having a lubricant retaining reservoir therein, a rotary shaft supported above said reservoir, splasher means cooperating with said shaft for creating a lubricant mist therearound, sump means remote from

said reservoir adapted to receive surplus lubricant from said operating parts, a conduit connected at one end with said pump means, and a bushing pump connected to the other end of said conduit for drawing lubricant from said sump means through said conduit and back to said reservoir, the improvement wherein said bushing pump is operable in a plurality of axial positions on said shaft and comprises a bushing surrounding said shaft above said reservoir, there being sufficient radial clearance between said shaft and said bushing to permit said shaft to rotate therewithin, said bushing having spiral groove means peripherally contacting said shaft beginning at a point within said bushing spaced a distance from one end thereof and extending around said bushing to the opposite end thereof where it exits onto said shaft, said bushing also having a duct connecting said conduit with said groove means adjacent said point where said groove means begins, there being means on said bushing for collecting lubricant from said mist and transferring it to said clearance between said shaft and bushing at said one end of said bushing to keep said clearance full of lubricant whenever the shaft is rotated during machine operation.

4. In a sewing machine as in claim 3 the combination wherein the groove in said bushing is flat in cross section and not more than 0.005 of an inch deep, and said radial clearance between said shaft and said bushing at said one end of said bushing is less than 0.0006 of an inch.

5. In a sewing machine as in claim 4 the combination wherein said bushing comprises a floating brass bushing having an axial trough on the upper surface thereof which trough slopes radially inwardly from one end of the bushing to the other and has its inner-most portion at the end of said bushing where said clearance is less than 0.0006 of an inch, said end also having a plurality of vertical capillary grooves carved therein so as to keep said clearance filled with lubricant while the machine is running by directing the flow of said lubricant, collected by said trough from said mist, downwardly in said capillary grooves directly toward said clearance as said lubricant comes over the edge of said trough.

6. In a sewing machine as in claim 5 the combination wherein there are at least two such sumps at spaced apart locations in said machine remote from said reservoir and at least two such pumps mounted side by side on said shaft, each pump having its groove form an outlet at its end opposite said clearance, at least one of said pumps having a spacer lug on at least one end face thereof to keep the end face of the adjacent pump out of contact with said one pump's end face.

7. In a sewing machine as claimed in claim 3, the combination wherein there are at least two such sumps at spaced apart locations in said machine remote from said reservoir and two such pumps mounted side by side on said shaft, at least one of said pumps having an integral spacer lug at one end thereof to keep the end face of the adjacent pump out of contact with said one pump's end face so as to permit a quantity of lubricant to flow down said one pumps end to keep said pump primed, said conduit means communicating each sump with one of said pumps to return said surplus lubricant received from said operating parts to said reservoir.

8. In a sewing machine having operating parts to be lubricated, a lubrication system which comprises a frame having an enclosed portion providing a lubricant retaining reservoir, rotary drive shaft means having an axial bore therethrough and extending into said enclosed portion above said reservoir, splasher means cooperating with said shaft means for creating a mist of lubricant thereabove to supply said operating parts with lubricant, means for collecting lubricant particles from said mist and for depositing the lubricant so collected inside said bore, there being at least two of said operating parts needing lubrication surrounding said shaft at axially spaced apart locations, and a radial duct in said shaft at each of said spaced apart locations connecting said parts with said

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bore, said ducts each having a sleeve fitted therein, a porous plug in each sleeve for metering the flow of lubricant within said sleeves, at least one of said plug and sleeve in each duct being positioned a different radial distance from the centerline of said shaft, so that when said shaft is rotating lubricant flows through each plug in different amounts.

9. In a sewing machine as claimed in claim 8 the combination wherein each of said sleeves and plugs has a precise length and one of said sleeves and its plug both cross the centerline of the shaft, the other of said sleeves and its plug extending radially into said shaft a distance short of said centerline, and wherein there is another porous plug fixed in one end of said shaft bore to control and restrict the flow of lubricant out of the end of said bore.

10. In a sewing machine having operating parts to be lubricated as in claim 9 the combination wherein there is a venting plug fixed in the end of said shaft opposite the end carrying said porous plug, said venting plug having an opening around the central axis of said bore through which excess lubricant can escape after a film of lubricant of desired thickness has been built up in said bore.

11. In a sewing machine as claimed in claim 8 the combination wherein said means for collecting lubricant particles from said mist and for depositing the lubricant so collected inside said bore comprises bearing means including a bushing surrounding said shaft means intermediate its two ends, lubricant, wicking means contacting one end of said bushing in said enclosed frame portion above said reservoir to collect lubricant from said mist when the machine is running, a radial duct in said shaft means communicating with said bore and the interior of said bushing, and spiral groove means on the interior of said bushing adjacent said shaft extending from the juncture between said bushing and said wicking means to a point intermediate the ends of said bushing at which it communicates with said duct as said shaft rotates so as to suck lubricant from said wicking means whenever the shaft is rotated in the direction of spiral of said groove and to transfer said lubricant into said bore while simultaneously lubricating said bushing.

12. In a sewing machine as claimed in claim 11 the combination wherein at one end of said shaft there is also a porous plug in one end of said shaft bore for allowing lubricant to flow out from said bore in metered quantities.

13. In a sewing machine having operating parts to be lubricated, a lubrication system which comprises a frame having an enclosed portion providing a lubricant retaining reservoir, shaft means having an axial bore therein, splashers means cooperating with said shaft means for creating a lubricant mist to supply said operating parts with lubricant, means supporting said shaft means above said reservoir including means for collecting lubricant mist particles and depositing them within said bore, one of said operating parts to be lubricated having a body portion rigidly mounted on said shaft means intermediate its ends, there being stud means mounted on said body portion for pivotably supporting said carrying arm at one end thereof, a reciprocable looper carrying arm, and duct means in said shaft means and in said body portion for transferring lubricant from said bore into said body portion and between said stud means and said arm, drive means bearingly connected intermediate the ends of said arm for reciprocating said arm about said stud, a lubricating plate mounted at one end to said bearing connection and at the other adjacent the end of said stud around which said arm is supported so as to reciprocate with said arm about said stud, and means whereby some of said lubricant in said duct means flows to said plate from between said stud and said arm, the surfaces of said plate having a surface which is easily wetted by said lubricant and adapted to move lubricant over its surface to lubri-

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cate the bearing connection between said drive means and said carrying arm when said plate and arm are reciprocally moved.

14. In a sewing machine as in claim 13 the combination wherein said drive means includes a reciprocable linkage having a bearing connecting joint in need of lubrication at each end thereof, one such joint connecting said linkage to said carrying arm and being lubricated by lubricant moving across said plate, said linkage having surfaces which are easily wetted by said lubricant similarly to said plate whereby in operation some of the lubricant delivered from the plate to said one joint moves in a thin film across said linkage to provide adequate lubrication for the bearing connecting joint at the other end thereof.

15. In a sewing machine as claimed in claim 13 said shaft means comprising an oscillatable drive shaft on which said body portion is mounted and rotary drive shaft means parallel said shaft and having an axial bore there-through, bearing means supporting said rotary shaft means above said reservoir, lubricant wicking means contacting said shaft and bearing means to collect lubricant droplets from said mist, a radial duct in said rotary shaft means communicating with said shaft bore and the interior of said bearing means which comprises a bushing having spiral groove means on the inner surface thereof extending from the junction between said bushing and said wicking means along and spirally around said rotary shaft means to a point opposite said radial duct with which it communicates as said shaft means revolves.

16. In a sewing machine as claimed in claim 15, said rotary shaft means having at least two radial ducts communicating with said bore at axially spaced locations along said shaft means remote from said bushing, said ducts each having a sleeve fitted therein with a porous plug for metering the flow of lubricant through its sleeve, the plug and sleeve in one duct being positioned a different radial distance from the centerline of said rotary shaft means as compared to the plug and sleeve in said other duct.

17. A lubricant system in a sewing machine as claimed in claim 16 including a sump remote from said reservoir means adapted to receive excess oil from said operating parts, a suction pump, and conduit means communicating said sump with said pump, said pump comprising bushing means surrounding said rotary shaft means remote from said wicking means and said radial ducts, said bushing means having a spiral groove therein communicating with said rotary shaft means and said conduit, said groove having a direction of spiral such that when said rotary shaft means is rotated in that direction within said bushing said bushing acts as a suction pump to remove lubricant from said remote sump to said reservoir means.

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