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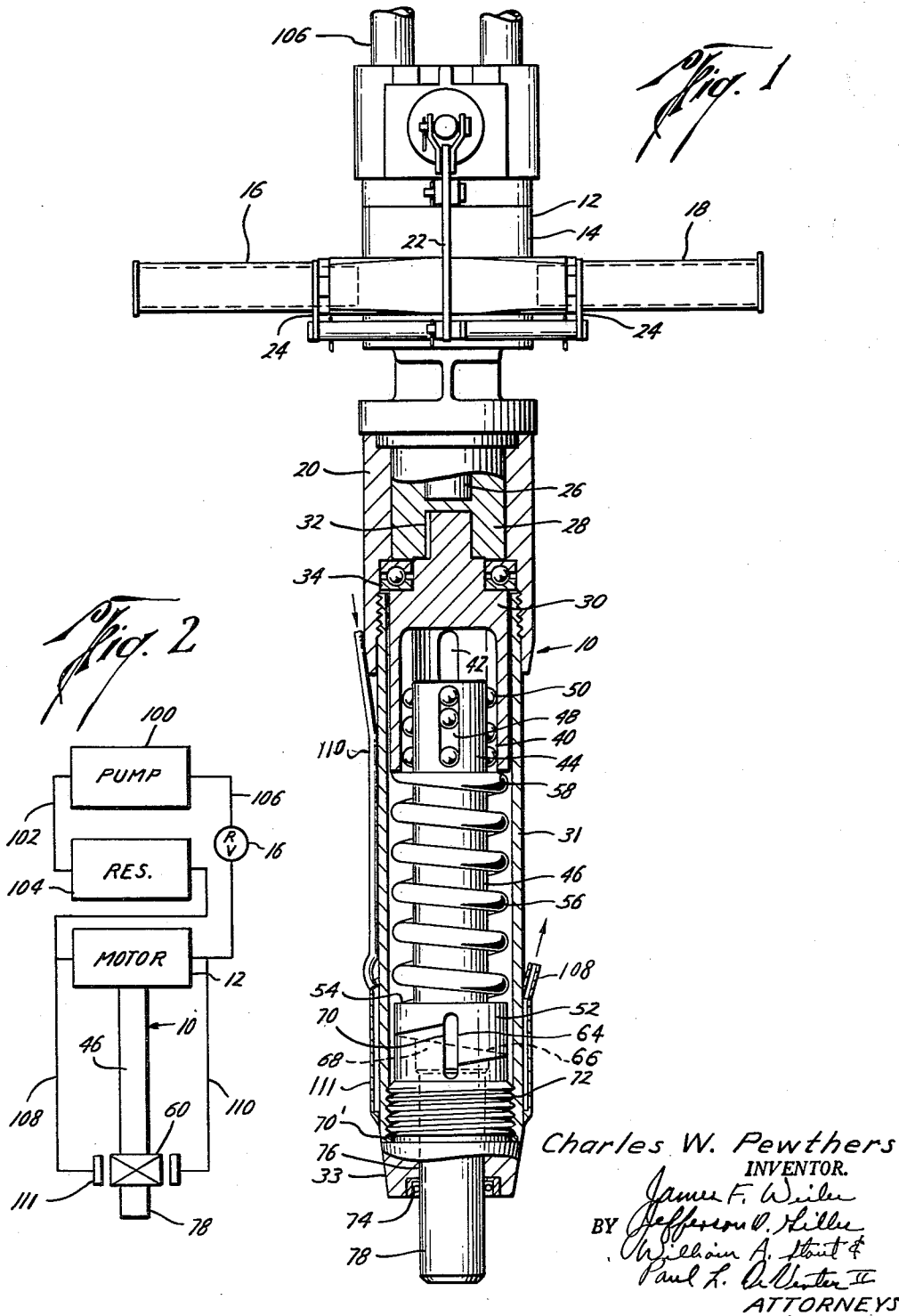
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IMPACT HAMMER

Filed July 1, 1960

2 Sheets-Sheet 1



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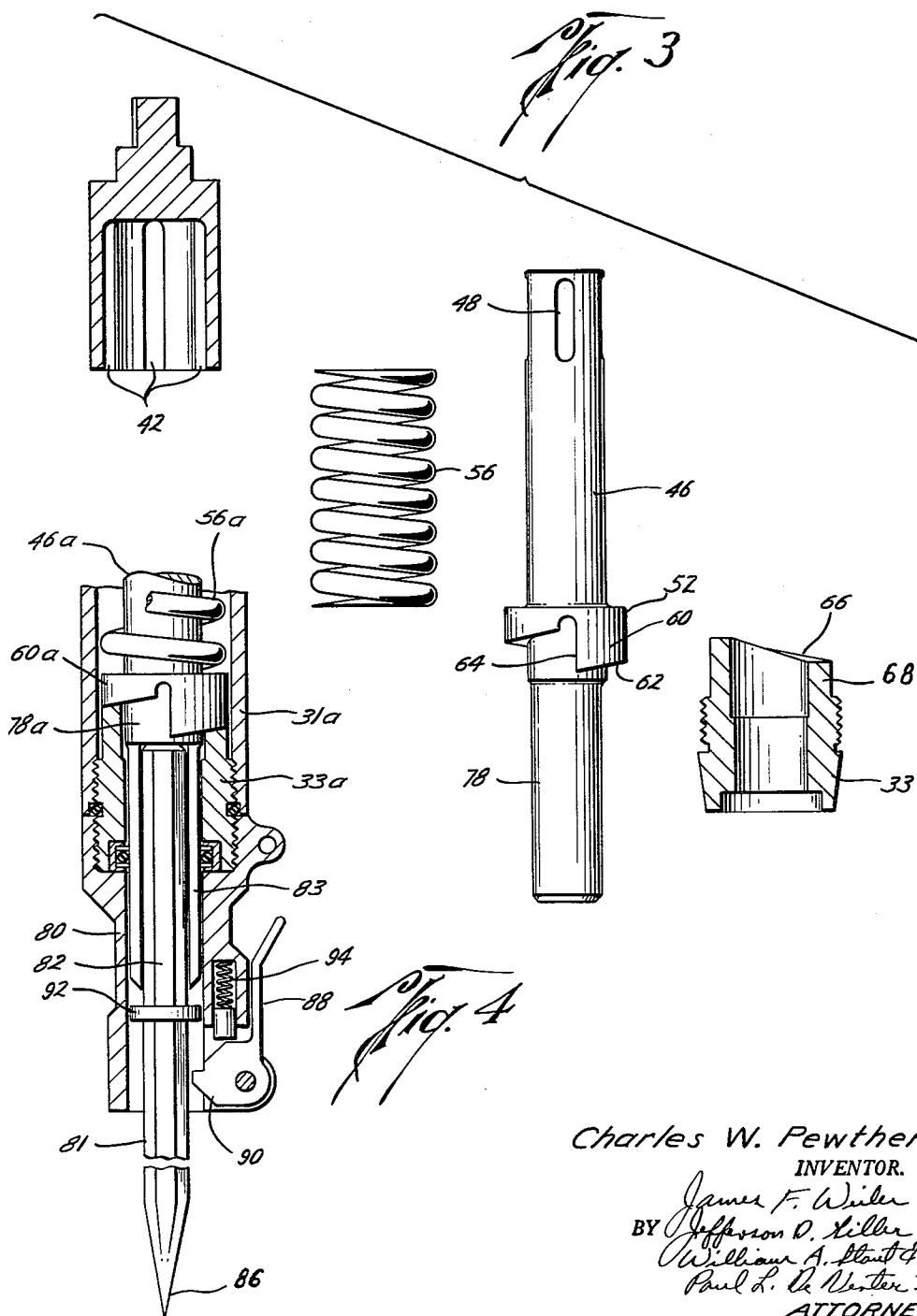
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IMPACT HAMMER

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The present invention relates to improvements in impact hammers of the power actuated type.

There have been many power hammers proposed in the past. Most impact power hammers of the heavy duty type available to the trade are of the pneumatic type. While these provide impact sufficient so that they have been received in the trade, they are disadvantageous in that they are relatively large and complicated in design, have a high noise level, are limited in that they must be driven at a constant speed in order to develop maximum power, they are relatively inefficient in that the air pressure is vented to the atmosphere in use, and the auxiliary equipment is quite expensive, for example the air compressors required to supply a sufficient volume of air pressure for the operation of the hammer.

Other type power impact or percussion tools have been proposed, such as electric motor driven impact drills and the like; however, these have generally been restricted to applications requiring not much force, for example, these are not suitable for impacting and breaking up hard formations, such as pavements, hard formations and the like, but are generally used in impact type electric drills and other light duty applications.

It would be highly advantageous to provide an impact type hammer for heavy duty use in which considerable power is produced, which is highly efficient, which provides a large force in a very small package, which is of simple design, in which the noise level of the tool is low and by which the rate of impacts for a particular impact hammer may be varied with a minimum loss of power. In addition, it would be highly desirable to provide a hydraulic impact hammer, that is one that is actuated by hydraulic force, and which is sufficiently powerful to be used for heavy duty use, for example, for breaking up hard formations, paving, cutting asphalt, chipping, slagging, riveting, rock drilling and the like. It would also be advantageous to provide such an improved impact hammer which may be used as a hand held tool or applied to power-actuated tools such as excavation devices, buckets, shovels and the like. It would also be advantageous to provide an impact hammer in which the impact shaft rotates, for example, for transmitting rotation to a drilling tool for drilling in hard materials, such as rock, concrete and the like. The present invention is directed to such an improved power impact hammer.

It is therefore an object of the present invention to provide an improved power impact hammer which overcomes the previously-mentioned disadvantages of other power impact hammers.

Yet a further object of the present invention is the provision of a rugged power impact hammer which develops a tremendously large force in a very small package, which is of simple design, and in which the noise level is reduced.

Yet a further object of the present invention is the provision of an impact hammer powered by a hydraulic motor and hydraulic system.

Yet a further object of the present invention is the provision of an improved impact hammer powered by a hydraulic motor and a hydraulic system, which hydraulic system includes a jacketing arrangement for cooling the impact hammer which is particularly useful when being operated as a hand tool.

Yet a further object of the present invention is the provision of an improved power impact hammer which

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is less expensive to manufacture than other impact hammers, requires considerably less expensive auxiliary equipment for its operation, and in which the operating costs are materially reduced.

5 Still a further object of the present invention is the provision of a power impact hammer in which variations in the speed or rate of impact can be made while developing maximum or close to maximum power per cycle.

10 Yet a further object is the provision of a hydraulic impact hammer which is of increased efficiency over others and in which very little power or energy is lost during its operation.

15 Yet a further object of the present invention is the provision of an improved power impact hammer which is of sufficiently small size so that it may readily be incorporated in various earth excavating devices, such as power excavating machinery used in moving earth such as front end loader buckets, shovel buckets, clam shell buckets, back hoe buckets or any type of power shoveling device and the like.

20 Yet a further object of the present invention is the provision of an improved impact hammer which is of small enough size and of minimum vibration and noise to be readily used as a hand held tool for heavy duty use.

25 Other and further objects, features and advantages will be apparent from the following description of presently preferred embodiments of the invention, taken in conjunction with the drawings, in which like character references designate like parts throughout the several views, and where

30 FIGURE 1 is an elevational view, partly in section, illustrating a hydraulic impact hammer according to the invention,

35 FIGURE 2 is a schematic view illustrating a satisfactory hydraulic system for use with the impact hammer of FIGURE 1,

FIGURE 3 is an exploded view of components of the impact hammer of FIGURE 1, and

40 FIGURE 4 is a fragmentary view, partly in section, illustrating a modification.

Referring now to the drawings, and particularly to FIGURE 1, the impact hammer is generally designated by the reference numeral 10 and includes the hydraulic motor 12, the housing 14 to which are secured the handles 16 and 18 for operating the impact hammer as a hand tool. As will be apparent later, one of the handles 16 is also a valve control for controlling the rate of flow of hydraulic fluid to the hydraulic motor 12 for controlling the rate of rotation of the motor 12 and hence the rate of impact.

45 The motor housing 14 is shown as an integral part of the upper body member 20 and various structural elements, such as the arms 22 and 24 are provided to releasably secure and releasably mount the hydraulic motor 12, the handles 16 and 18 to the body member 20. Since any desired arrangement may be utilized for this purpose, and the particular form of connecting the parts together, as such, do not constitute the present invention, no further description thereof is deemed necessary or appropriate.

50 Extending from and driven by the hydraulic motor 12 is the output shaft 26 which is connected by a flexible coupling 28 to the combined rotor and coupling 30 so that rotation of the output shaft 26 rotates the combined rotor and coupling 30.

65 The combined coupling and rotor includes the splines 32 which fit into the flexible coupling 28 and, while not shown, suitable splines, keys and the like are provided on the motor output shaft 26 so that rotation is transmitted from the output shaft 26 through the flexible coupling 28 to the combined rotor and coupling 30. As illus-

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trated, the output shaft 26 is connected in axial alignment with the coupling 30.

An antifriction assembly generally designated by the reference numeral 34 is provided adjacent the inner end of the combined rotor and coupling 30 which, of course, reduces friction and particularly any thrust action imparted to the combined rotor and coupling 30.

A counterbore 40 is provided in the outer end of the combined rotor and coupling 30 which is provided with a plurality of axially-extending grooves 42 for reception of the upper end 44 of the impact shaft 46 which is provided with a complementary set of axially-extending grooves 48 into which the antifriction balls 50 are provided.

The coupling arrangement between the combined rotor and bushing 30 and the impact shaft 46 provides an axially-aligned connection and is highly advantageous in that it provides a very simple, rugged and efficiently-reliable connection which permits limited axial movement of the impact shaft 46 with a minimum of friction and yet provides a nonrotatable connection so that the motor 12 driving the motor output shaft 26 through the flexible coupling 28 and thus the combined rotor and coupling 30 transmits this rotation to the impact shaft 46.

The impact shaft 46 is provided with an annular enlargement 52 intermediate its ends and includes the inwardly facing annular shoulder 54 which serves as a stop for one end of the compression spring 56, the other end of which stops against the outwardly facing annular shoulder 58 of the combined bushing and coupling 30.

As best shown in FIGURE 3, to which reference is now made the outer portion of the enlarged intermediate section 52 of the impact shaft 46 is provided with a single cam face 60 which includes the annular inclined cam face or helix 62 provided with the single, abrupt, axially-aligned shoulder surface 64 which permits the axial travel of the shaft in an outward or downward direction in response to the action of the coil spring 56.

Referring again to FIGURE 1, the impact shaft 46 and a portion of the combined rotor and coupling 30 are disposed within a generally cylindrically-shaped housing member 31 which, preferably, is releasably secured to the housing member 20, such as by threading as illustrated, so that the various parts may readily and easily be assembled or replaced and repaired.

Disposed within the outer end of the body member 31 is the nose cone 33 which, preferably, is releasably secured to the body member 31, such as by threading as illustrated, again for the purpose of ease of assembly and making repairs and replacement of parts.

The nose cone 33 is provided with a cooperating annular cam face or helix 66 which is complementary to the cam 52 and, accordingly, includes the inclined helical cam face 68 provided with the single, abrupt, axially-aligned shoulder 70.

It should be noted that the helical cam surfaces 62 and 66 of the cam 60 and the nose cone 33, respectively, are continuously in engagement throughout their length either at or shortly after the impact and decrease in engagement during rotation until they are completely released at the drop off point of the axially-aligned shoulders 64 and 70. This is highly advantageous in that maximum strength is provided so that a rugged and efficiently reliable impact hammer is provided for rugged and heavy duty, such as pavement breaking, asphalt chipping, slagging tools, riveting guns, rock drilling, hard formation breaking and any type of percussion work which requires powerful impacts.

The nose cone 33 is provided with the seals 70' adjacent the threaded portion 72 and the seal 74 adjacent the outer end of the central bore 76 of the nose cone 33 through which the outer end 78 of the impact shaft 46 extends. While a flat end is shown any desired percussion type tool may be secured thereto or, if desired, the percussion tool might be formed as an integral part of the shaft 78, as desired.

A modification is illustrated in FIGURE 4, to which reference is now made, and to which the reference letters "a" have been added to parts corresponding to those of FIGURES 1-3 for convenience of reference.

Essentially, the modification of FIGURE 4 includes the nose cone 33a, to which is threadedly or otherwise secured a generally tubular retainer body 80 which slidably receives the multi-sided percussion type tool 81 including a multi-sided portion or shank 82 fitting into the coating extensions 83 extending from the end of the impact shaft 78. This arrangement transmits the rotation from the impact shaft 46a to the percussion tool 81 although a nonrotatable connection may be provided, if desired. As illustrated, the percussion tool 81 terminates in a sharp or spike point 86.

The percussion tool 81 is removably secured in the retainer body 80 by means of the spring type latch 88, one end 90 of which is disposed to engage the annular stop member 92 on the tool 81, the spring 94 releasably retaining the latch 88 in the position illustrated. Thus, a readily releasable latching arrangement is provided for securing to and removing from the impact hammer any desired tool.

Since any desired arrangement may be utilized for securing a particular tool to the impact hammer 10, such as that illustrated at 88 in FIGURE 4, or the end of the impact shaft 78, as shown in FIGURES 1 and 3 may actually form the impact tool, no further description thereof is deemed necessary or appropriate.

As previously mentioned, one of the important aspects of the invention is the operation of the impact hammer hydraulically. A suitable hydraulic arrangement is schematically illustrated in FIGURE 2, to which reference is now made. As there illustrated, a suitable hydraulic pump 100 is provided which is connected by the hydraulic line 102 extending from the reservoir 104. The flow line 106 is provided from the pump 100 to the motor 12, the flow of hydraulic liquid from the pump 100 and in the flow line 106 being regulated by the regulator valve 16 forming part of the handle, if desired, as previously mentioned in connection with FIGURE 1, although it may otherwise be located.

Referring again to FIGURE 2, the hydraulic system advantageously also provides a cooling system for the impact hammer 10 which is particularly advantageous when used as a hand tool, and includes the flow line 110 extending from the flow line 106 to the motor 12 to the jacket 111 disposed about the cam enlargement 60 with a return line 108 to the reservoir 104 to complete the hydraulic circuit. It will be understood, of course, that any conventional and suitable hydraulic pump 100, hydraulic motor 104, regulator valve 16 and the like may be utilized to provide the required torque or rotational force to the impact shaft 46. Also, by regulating the valve 16 the rate of impact is controlled by regulating the speed of the motor 12. In addition, when utilizing the cooling feature of the hydraulic system, which may be omitted if desired, but which is highly advantageous when using the impact hammer as a hand tool, the hydraulic liquid maintains the impact hammer 10 cool. Also, the hydraulic motor considerably reduces the noise level, for example with respect to pneumatic type impact hammers, and the hydraulic pump 100, hydraulic reservoir 104 and flow lines are considerably less expensive than, for example, air compressors and the like. In addition, the hydraulic drive system is highly advantageous for use in connection with various tractors and mobile earth moving equipment inasmuch as these all contain their own hydraulic system and controls. In this event, of course, the regulator valve 16 would be at a position adjacent the operator, the handles 16 and 18 omitted so that control of the impact hammer is convenient to the operator along with the other controls for various power excavating machinery, for example, front end loader buckets, shovel buckets, clam shell buckets, back hoe buckets or any type of shoveling or earth moving device. In addition, the very small and compact size and

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the considerable power and force generated advantageously permits the impact hammer to be installed and used with such power excavating devices with a minimum of interference with their normal operations.

In operation, hydraulic liquid is provided to the hydraulic motor 12, the rate of flow being regulated by the regulator valve 16 which thereby regulates the speed of the motor 12 and thus the rotation of the impact shaft 46. During rotation of the impact shaft 46 the cam surfaces 62 and 66 engage to compress the spring 56, then suddenly release the impact shaft 46 to the energy built up in the spring 56 when the axially-aligned shoulders 64 and 70 are just past opposite one another, the impacting cam thereby releasing the impact shaft 46 to provide an impacting blow. In the event the full blow of the impact shaft 78 is not absorbed by that which is being impacted, the cam surfaces or faces 62 and 66 are in substantial engagement substantially along their length to provide a very rugged hammer and anvil surface.

It is further noted that by the combined rotor and bushing 30 and the antifriction connection described between the inner end 44 of the impact shaft 46 and the rotor and coupling 30, along with the action of the coil spring 56, is such to provide minimized shock or impact to the motor end of the tool 10. Also, when utilizing the hydraulic cooling arrangement described, a major portion of the heat built up in the tool is carried away by the hydraulic field as part of the hydraulic circuit.

Additionally, a completely sealed body is provided in which the moving parts may be lubricated completely for minimum friction.

The impact hammer of the present invention is therefore well suited and adapted to attain the objects and ends and has the advantages and features mentioned as well as others inherent therein.

While presently preferred embodiments of the invention have been given for the purpose of disclosure, along with representative and typical uses thereof, other uses thereof will occur to those in the various arts in which the invention may be used and changes in details and arrangement of parts may be made which are within the spirit of the invention as defined by the scope of the appended claims.

What is claimed is:

1. A hydraulic impact hammer comprising,
 - a housing,
 - a rotary hydraulic motor mounted on the housing, the output shaft of which extends axially into the housing,
 - an impact shaft mounted axially in the housing for both rotation and limited axial movement relative thereto,
 - a driving connection connecting the output shaft to the impact shaft,

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a cam formed on the impact shaft,
a cam cylinder fixed to the housing,
said impact shaft rotatably extending through the cam cylinder,

a pair of complementary mating faces on the cam and cam cylinder, each said face comprising substantially circumferentially extending helical surfaces terminating in an abrupt, axially aligned shoulder surface permitting sudden axial travel of the shaft in one direction,

a compression spring within the housing and around the shaft for actuating the shaft axially in said one direction,

a cooling jacket carried by the housing adjacent the cam faces, and

hydraulic flow lines providing an inlet to and an outlet from the cooling jacket.

2. In an impact hammer including a housing, an impact shaft mounted in one end of the housing for both rotation and limited axial movement relative thereto, cam means in the housing permitting sudden axial travel of the shaft in one direction, and a spring within the housing actuating the shaft axially in said one direction, the improvement comprising,

a rotary hydraulic motor carried by the housing adjacent the other end, the output shaft of which extends into the housing,

a driving connection between the output shaft and impact shaft transmitting rotation to the impact shaft from the output shaft and permitting limited movement therebetween,

a cooling jacket carried by and exteriorly of the housing adjacent the cam means, and

hydraulic flow lines connecting the cooling jacket with the hydraulic outlet of the motor and to the source of hydraulic liquid for circulating hydraulic liquid in said cooling jacket.

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