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(54) **ELECTRIC TOOL**

(57) It is an object of the invention to provide a cooling technique which contributes to improvement of the performance of cooling a motor and a high-temperature region in a power tool. The power tool includes a tool body 103 and a motor 111 which is housed within the tool body 103, and performs a predetermined operation on a work-piece by driving the motor 111 to drive a tool bit 119 which is disposed in a front end region of the tool body 103. A

motor cooling air passage 137 is provided within the tool body 103 and cooling air for cooling the motor flows through the motor cooling air passage 137. A heat pipe 131 connects the motor cooling air passage 137 and a high-temperature region 108 located away from the motor cooling air passage 137 and cools the high-temperature region 108 by transferring heat of the high-temperature region 108 to the motor cooling air passage 137.

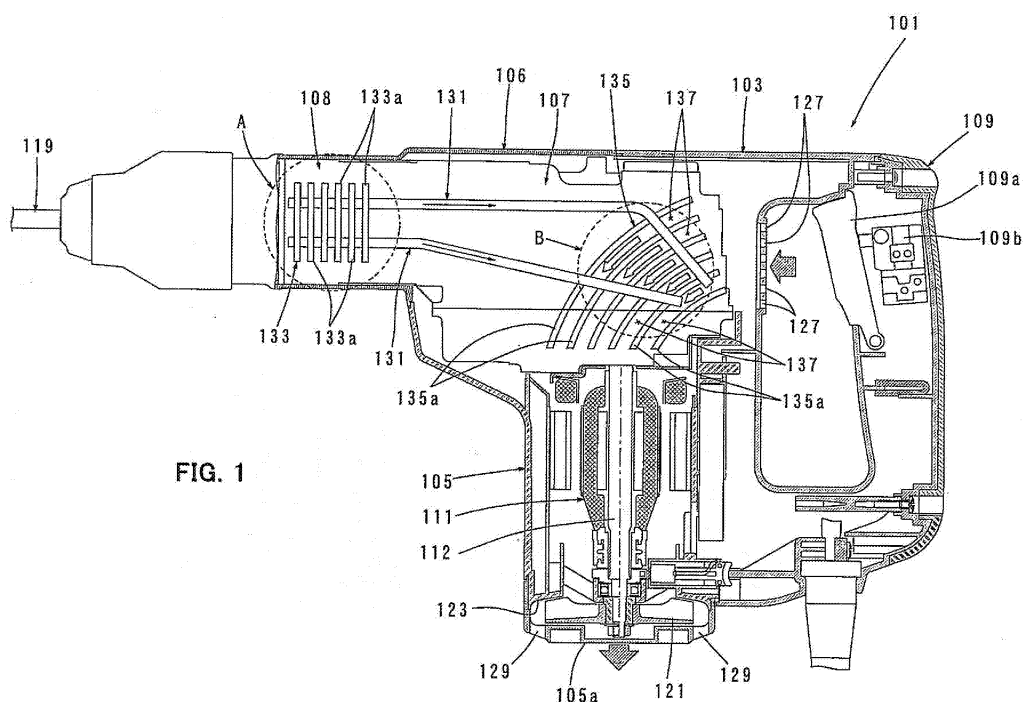


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a cooling technique for a power tool.

BACKGROUND OF THE INVENTION

[0002] Japanese non-examined laid-open Patent Publication No. 2000-84868 discloses a technique for cooling a driving motor and an operating mechanism part in the form of a high temperature region in an electric hammer. In this known electric hammer, a first cooling air passage for cooling a driving motor and a second cooling air passage for cooling an operating mechanism part such as a striking part and a power transmitting mechanism which generate heat when the motor is driven are formed within a housing by partitioning the housing. When a cooling fan is rotated, outside air is led into the cooling air passages through inlets which are formed for each of the cooling air passages, and individually cool the driving motor and the operating mechanism part. Thereafter, the cooling air flows are merged with each other and discharged to the outside of the housing.

[0003] In the above-described known technique, air is led into the housing and used for cooling. As for the cooling air passage for the driving motor, an air passage can be formed by utilizing a clearance which exists between a rotator and a stator. Therefore, a relatively smooth air flow having a low flow resistance can be secured. The operating mechanism part such as the striking part and the power transmitting mechanism is complicated in structure, so that a passage for cooling air cannot be easily formed within the housing. Therefore, sufficient cooling performance cannot be easily obtained.

DISCLOSURE OF THE INVENTION

[0004] It is, accordingly, an object of the invention to improve the performance of cooling a motor and a high-temperature region in a power tool.

[0005] Above-described object can be achieved by the claimed invention. According to a preferred aspect of the invention, the representative power tool includes a tool body and a motor which is housed within the tool body, and performs a predetermined operation on a workpiece by driving the motor to drive a tool bit which is disposed in a front end region of the tool body. The "power tool" here widely includes power tools such as a hammer, a hammer drill, a drill, a grinder, an impact driver, an impact wrench, a cutter, a trimmer, a circular saw and a reciprocating saw. Particularly, this invention is suitably applied to a power tool which is used for an operation in which dust is generated during operation.

[0006] According to the preferred embodiment of the invention, the power tool includes a motor cooling air passage that is provided within the tool body and through

which cooling air for cooling the motor flows, and the motor cooling air passage and the high-temperature region which is located away from the motor cooling air passage are connected by a heat pipe. The high-temperature region is cooled by transferring heat of the high-temperature region to the motor cooling air passage. The "high-temperature region" in this invention refers to an operating mechanism part that is driven by the motor and operates to cause the tool bit to perform a predetermined movement for the operation, such as linear movement in its axial direction and rotation around its axis when the tool bit is driven to perform a predetermined operation. According to the preferred embodiment, with the construction in which heat generated in the high-temperature region is transferred to the motor cooling air passage and cools the high-temperature region, even if the high-temperature region is located away from the motor cooling air passage or at a position which is difficult to cool by the air flow, the high-temperature region can be efficiently cooled. Particularly with the construction in which heat of the high-temperature region is transferred to the motor cooling air passage by the heat pipe, it is not necessary to provide a ventilating opening in the high-temperature region, so that the high-temperature region can be hermetically sealed from the outside. Therefore, entry of dust into the high-temperature region can be prevented. Thus, a cooling structure can be provided which is effective in protecting against dust.

[0007] According to a further embodiment of the power tool of the invention, the tool bit performs at least a hammering operation on a workpiece by linear movement in an axial direction of the tool bit, and the power tool further includes a striking element which is linearly driven by the motor and strikes the tool bit. The high-temperature region comprises a striking region in which the striking element applies a striking force to the tool bit.

In the case of an impact tool in which the tool bit performs a hammering operation on a workpiece by linear movement, heat is generated when the striking element strikes the tool bit, and the barrel that houses the striking element is heated to high temperature. According to this invention, heat generated in the barrel can be transferred to the motor cooling air passage and cooled, so that the barrel which is located at a position difficult to cool by cooling air can be efficiently cooled. Particularly in the case of an impact tool which is used for chipping or drilling concrete, the barrel which is located near to a region of operation is susceptible to dust. According to this invention, the barrel can be cooled in a hermetically sealed state from the outside without need of providing a ventilating hole or opening in the barrel for communication with the outside, so that a cooling structure can be provided which is effective in protecting against dust.

[0008] According to a further embodiment of the power tool of the invention, the motor is disposed such that an extension of an output shaft of the motor extends in a direction transverse to the axial direction of the tool bit, and the motor cooling air passage is formed toward one

end of the output shaft in its axial direction which is nearer to an axis of the tool bit. In the power tool in which an extension of an output shaft of the motor extends in a direction transverse to the axial direction of the tool bit, an operating mechanism is provided toward one end of the output shaft in its axial direction which is nearer to an axis of the tool bit and serves to convert a rotating output of the driving motor into linear motion and transmit the motion to the tool bit or to transmit the rotating output as a rotating force, and the operating mechanism is housed within a housing. Heat is generated when the operating mechanism is driven and the housing is heated to high temperature. Specifically, a different high-temperature region from the high-temperature region of which heat is transferred by the heat pipe exists toward one end of the output shaft in its axial direction which is nearer to the axis of the tool bit. According to this invention, the motor cooling air passage can be provided in a housing existing in this different high-temperature region, so that the different high-temperature region can also be cooled at the same time together with the high-temperature region of which heat is transferred to the motor cooling air passage by the heat pipe.

[0009] According to a further embodiment of the power tool of the invention, the motor cooling air passage is defined by a radiating fin. According to this invention, with such a construction, heat can be efficiently transferred from the heat pipe to the motor cooling air passage via the radiating fin. Thus, this construction is effective in improvement of the cooling efficiency. In this case, preferably, one end of the heat pipe in its extending direction is disposed closely to the radiating fin.

[0010] According to a further embodiment of the power tool of the invention, the motor cooling air passage and the high-temperature region are connected by a plurality of heat pipes. According to this invention, with such a construction, heat can be transferred from the high-temperature region to the motor cooling air passage over a wider range, so that the efficiency in cooling the high-temperature region can be enhanced.

[0011] According to this invention, a cooling technique is provided which contributes to improvement of the performance of cooling a motor and a high-temperature region in a power tool. Other objects, features and advantages of the invention will be readily understood after reading the following detailed description together with the accompanying drawings and the claims.

DETAILED DESCRIPTION OF THE EMBODIMENT OF THE INVENTION

[0012] Each of the additional features and method steps disclosed above and below may be utilized separately or in conjunction with other features and method steps to provide improved power tools and devices utilized therein. Representative examples of the invention, which examples utilized many of these additional features and method steps in conjunction, will now be de-

scribed in detail with reference to the drawings. This detailed description is merely intended to teach a person skilled in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed within the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe some representative examples of the invention, which detailed description will now be given with reference to the accompanying drawings.

15 (First Embodiment)

[0013] An embodiment according to the invention is now described with reference to the drawings. In this embodiment, an electric hammer drill is explained as a representative example of a power tool according to the invention. FIG. 1 shows an entire construction and a cooling structure of a hammer drill 101. As shown in FIG. 1, the hammer drill 101 mainly includes a body 103 that forms an outer shell of the hammer drill 101, a tool holder (not shown) connected to a front (left as viewed in FIG. 1) end region of the body 103 in the longitudinal direction, a hammer bit 119 detachably coupled to the tool holder, and a handgrip 109 that is connected to the other (right as viewed in FIG. 1) end of the body 103 in the longitudinal direction and designed to be held by a user. The body 103 and the hammer bit 119 here are features that correspond to the "tool body" and the "tool bit", respectively, according to the invention. The hammer bit 119 is held by the tool holder such that it is allowed to reciprocate in its axial direction (the longitudinal direction of the body 103) with respect to the tool holder and prevented from rotating in its circumferential direction with respect to the tool holder. For the sake of convenience of explanation, the hammer bit 119 side is taken as the front and the handgrip 109 side as the rear.

[0014] The body 103 mainly includes a motor housing 105 that houses a motor 111, a crank housing 107 that houses a motion converting mechanism (not shown) and a power transmitting mechanism (not shown), a cylindrical barrel 108 that houses a striking part (not shown), and a housing cover 108 that covers the crank housing 107 and the barrel 108. The barrel 108 is disposed on the front end of the crank housing 107 and extends forward along the axis of the hammer bit 109. The handgrip 109 includes a grip which extends in a vertical direction transverse to the axial direction of the hammer bit 119 and is designed to be held by a user. The handgrip 109 is designed as a D-shaped handle in which upper and lower ends of the grip in the extending direction are connected to the rear of the body 103. A trigger 109 is disposed on the grip of the handgrip 109. When the user depresses the trigger 109a, an electric switch 109b is turned on and the driving motor 111 is driven.

[0015] The rotating output of the driving motor 111 is appropriately converted into linear motion via the motion converting mechanism and transmitted to the striking part. Then, an impact force is generated in the axial direction of the hammer bit 119 (the horizontal direction in FIG. 1) via the striking part.

[0016] The motion converting mechanism serves to convert rotation of the driving motor 111 into linear motion and transmit it to the striking part and mainly includes a crank mechanism. The crank mechanism is constructed such that a driving element in the form of a piston forming a final movable member of the crank mechanism linearly moves in the axial direction of the hammer bit within a cylinder which is housed within the barrel 108 when the crank mechanism is rotationally driven by the driving motor 111.

[0017] The striking part mainly includes a striking element in the form of a striker that is slidably disposed within a bore of a cylinder together with the piston, and an intermediate element in the form of an impact bolt that is slidably disposed in front of the striker within the tool holder. The striker is driven via an air spring action (pressure fluctuations) of an air chamber of the cylinder by sliding movement of the piston and collides with (strikes) the impact bolt. The striker then transmits a striking force caused by the collision to the hammer bit 119 via the impact bolt.

[0018] Further, the speed of the rotating output of the driving motor 111 is appropriately reduced by the power transmitting mechanism which mainly includes a plurality of gears and then transmitted to the hammer bit 119 via the tool holder. As a result, the hammer bit 119 is caused to rotate in its circumferential direction together with the tool holder.

[0019] The driving motor 111 is disposed between the hammer bit 119 and the handgrip 109 on one side of (below as viewed in FIG. 1) the axis of the hammer bit 119. The driving motor 111 is disposed such that an extension of an axis of an output shaft 112 extends transversely to the axis of the hammer bit 119 and the driving motor 111 is located toward the little finger of the user when the user holds the handgrip 109. Thus, in the hammer drill 101, the hammer bit 119 and the handgrip 109 are arranged generally in an L shape. In the following description, the driving motor 111 side with respect to the axis of the hammer bit 119 is taken as the lower region and the opposite side as the upper region.

[0020] The crank housing 107 that houses the motion converting mechanism and the power transmitting mechanism is disposed above the driving motor 111, and a region below the crank housing 107 is covered by the motor housing 105 from outside. Further, an upper surface region, side surface regions and a rear surface region of the crank housing 107 and a circumferential surface region of the barrel 108 that houses the striking part are covered by the housing cover 106 from outside. Therefore, the crank housing 107 and the barrel 108 form an inner housing, and the housing cover 106 and part of

the motor housing 105 forms an outer housing. A space of appropriate size is formed between the inner housing and the outer housing.

[0021] In the hammer drill 101 constructed as described above, when the electric switch 109b is turned on and the driving motor 111 is driven by depressing the trigger 109a, the hammer bit 119 performs a linear hammering movement in the axial direction via the motion converting mechanism and the striking part, and a drilling movement around its axis via the power transmitting mechanism. Thus, operations such as chipping and drilling can be performed on a workpiece.

[0022] During operation on the workpiece, not only the driving motor 111 but the crank housing 107 that houses the motion converting mechanism and the power transmitting mechanism and the barrel 108 that houses the striking part are heated to high temperature. This is caused by heat generated by friction when components of the motion converting mechanism and the power transmitting mechanism are driven, heat generated when the piston compresses air, and heat generated when the striker strikes the hammer bit 119 via the impact bolt.

[0023] Therefore, in this embodiment, a cooling structure for cooling the driving motor 111 and the high-temperature region including the crank housing 107 and the barrel 108 is provided. The cooling structure for cooling the driving motor 111, the crank housing 107 and the barrel 108 is now explained. A forced draft device in the form of a cooling fan 121 is mounted on the output shaft 112 of the driving motor 111 such that it rotates together with the output shaft 112. In this embodiment, the cooling fan 121 is disposed on the lower end of the output shaft 112. When the driving motor 111 is driven, the cooling fan 121 is rotationally driven together with the output shaft 112 and sucks outside air as cooling air into the housing cover 106 through a plurality of vertically arranged inlets 127. The inlets 127 are formed through an upper region of a back wall (on the handgrip 109 side) of the housing cover 106 which forms the outer housing. Flow of the cooling air is shown by arrow in FIG. 1.

[0024] The cooling air taken into the housing cover 106 through the inlets 127 flows through a lateral space between the housing cover 106 and the crank housing 107 and then through the inside of the driving motor 111 or a clearance between the stator and a rotator and is finally discharged to the outside through an outlet 129. In this manner, the crank housing 107 and the driving motor 111 are cooled. In this embodiment, a centrifugal fan is used as the cooling fan 121. Therefore, the cooling air used for cooling the motor is guided by a generally bowl-shaped baffle plate 123 and discharged downward to the outside through the outlet 129 which is formed in a bottom wall 105a of the motor housing 105.

[0025] In order to cool the barrel 108, two heat pipes 131 are provided within the body 103. The heat pipes 131 are provided as a heat transfer member for transferring heat from a high-temperature region (generally shown circled by a dotted line A in FIG. 1) of the body

103 or the barrel 108 to a low-temperature region (generally shown circled by a dotted line B in FIG. 1) or a space through which cooling air for cooling the motor flows. In this embodiment, a lateral rear space above the driving motor 111 (on the upper end side of the output shaft 112) in a lateral space between the housing cover 106 and the crank housing 107 is configured as a region of flow of cooling air.

[0026] The lateral rear space designed as a region of flow of cooling air is a space defined by an outer lateral surface of the crank housing 107. Therefore, this space is inherently heated to high temperature by heat generation of the motion converting mechanism and the power transmitting mechanism, but this space is cooled by the cooling air flow and becomes a low-temperature region in comparison with the barrel 108.

[0027] The two heat pipes 131 are disposed in a lateral space between the outer surfaces of the barrel 108 and the crank housing 107 and the inner surface of the housing cover 106 and extend in the axial direction of the hammer bit 119 such that the heat pipes connect the barrel 108 and the flow region of cooling air. Specifically, the two heat pipes 131 disposed within the body 103 connect the high-temperature region A and the low-temperature region B. Further, the two heat pipes 131 are spaced apart from each other. The heat pipes 131 may be disposed either in only one of the right and left lateral spaces formed between the outer surfaces of the barrel 108 and the crank housing 107 and the inner surface of the housing cover 106, or in both of the lateral spaces. In order to enhance the cooling performance, however, it is preferable to dispose them in both of the lateral spaces.

[0028] A front end portion of each of the heat pipes 131 is disposed lateral to the barrel 108 and extends in the axial direction of the hammer bit 119, and a rear end portion of the heat pipe is inclined downward and placed in the flow region of the cooling air. Working fluid and a capillary tube for transferring the working fluid are provided within the hollow heat pipe 131. Vapor of the working fluid vaporized in the high-temperature region moves to the low-temperature region and is condensed, and subsequently, the condensed liquid returns to the high-temperature region through the capillary tube. This cycle is repeated, so that heat transfer between the high-temperature region and the low-temperature region can be realized. Therefore, heat generated in the barrel 108 is transferred to the flow region of the cooling air by the heat pipes 131 and radiated. In this manner, the barrel 108 can be cooled.

[0029] Fins 133 and 135 are provided on an outer wall surface of the barrel 108 (or an inner wall surface of the housing cover 106) and an outer wall surface of the crank housing 107 (or an inner wall surface of the housing cover 106) corresponding in position to the flow region of the cooling air, respectively. The fin 133 on the barrel side serves as a heat input fin for transferring heat of the barrel 108 to the heat pipes 131, and the fin 135 on the crank

housing side serves as a radiating fin for radiating heat of the heat pipes 131 to the flow region of the cooling air. The heat input fin 133 is formed by a plurality of airfoil pieces 133a. The airfoil pieces 133a linearly extend in a direction transverse to the extending direction of the heat pipes 131 and are arranged at predetermined intervals in the extending direction of the heat pipes 131. The airfoil pieces 133a are disposed closely to or in contact with the heat pipes 131. Thus, heat can be more efficiently transferred from the barrel 108 to the heat pipes 131.

[0030] The radiating fin 135 is formed by a plurality of airfoil pieces 135a. The airfoil pieces 135a extend in a direction transverse to the extending direction of the heat pipes 131 and are arranged at predetermined intervals in the extending direction of the heat pipes 131. The airfoil pieces 135a are arcuately shaped to guide the cooling air sucked in horizontally forward from behind through the inlets 127 such that the cooling air veers downward toward the driving motor 111. The airfoil pieces 135a are disposed closely to the heat pipes 131. Specifically, the radiating fin 135 not only serves to radiate heat of the heat pipes 131 to the flow region of the cooling air, but serves to define cooling air passages 137 by adjacent ones of the airfoil pieces 135a. Thus, the cooling air can smoothly flow through the air passages 137 between the airfoil pieces 135a, and heat can be efficiently radiated from the heat pipes 131 to the cooling air flowing through the air passages 137, directly or via the airfoil pieces 135a. The cooling air passages 137 defined between the airfoil pieces 135a are features that correspond to the "motor cooling air passage" according to this invention.

[0031] Thus, according to this embodiment, with the construction in which the flow region of the motor cooling air which is formed lateral to the crank housing 107 is connected to the barrel 108 by the heat pipes 131, high-temperature heat of the barrel 108 which is located at a position difficult to cool by using cooling air and away from the flow region of the motor cooling air, can be transferred to the flow region of the motor cooling air which is located at a position easy to cool on the crank housing 107 side and collectively cooled together with the crank housing 107. Thus, a rational cooling system is realized which contributes to higher efficiency in cooling the barrel 108 and the crank housing 107.

[0032] Further, in this embodiment, with the construction in which the two heat pipes 131 are spaced apart from each other, heat can be transferred from the side surface region of the barrel 108 to the flow region of the cooling air over a wider range, so that the efficiency in cooling the barrel 108 can be enhanced.

[0033] Particularly in the case of the hammer drill 101 for use in chipping or drilling concrete, the barrel 108 which is located near to a region of operation is susceptible to dust which is generated by operation. Therefore, according to this embodiment, the barrel 108 can be cooled in a hermetically sealed state from the outside without need of providing a ventilating hole or opening in the barrel 108 for communication with the outside, so that

entry of dust into the barrel 108 can be prevented. Specifically, according to this embodiment, the hammer drill 101 can be provided with a cooling structure which is effective in protecting against dust.

(Second Embodiment)

[0034] A second embodiment of the invention is now described with reference to FIG. 2. This embodiment is a modification to the cooling structure. In this embodiment, the cooling fan 121 is disposed above the driving motor 111, and an inlet (not shown) is formed in a lower portion of the motor housing 105. Outside air is taken in as cooling air through this inlet and supplied to cool the driving motor 111 and a high-temperature region within the body 103. Thereafter, the cooling air is discharged through outlets 129 which are formed in upper portions of side walls of the housing cover 106. In the other points, this embodiment has about the same construction as the above-described first embodiment. Therefore, in FIG. 2, components or elements in the second embodiment which are substantially identical to those in the first embodiment are given like numerals and are not described or briefly described. In FIG. 2, flow of cooling air is shown by arrow.

[0035] The cooling fan 121 is mounted on one end of the output shaft 112 of the driving motor 111 on the crank housing 107 side and can rotate together with the output shaft 112. In this embodiment, a centrifugal fan is used as the cooling fan 121. Cooling air used for cooling the motor flows upward through the inside of the driving motor 111 and then further flows upward as being guided by a generally bowl-shaped baffle plate 123. Then the cooling air substantially linearly flows through a lateral space between the housing cover 106 and the crank housing 107 and discharged to the outside through the outlets 129 which are formed in the side walls of the housing cover 106 at an upper position of the lateral space. Specifically, in this embodiment, the cooling air for cooling the driving motor 111 is designed to flow substantially linearly upward from below. Therefore, resistance to the flow of the cooling air can be reduced.

[0036] Further, in this embodiment, the two heat pipes 131 extend substantially horizontally in the flow region of the cooling air. A plurality of airfoil pieces 135a which form a radiating fin 135 or a fin on the side of the flow region of the cooling air, extend vertically linearly in a direction transverse to the extending direction of the heat pipes 131. Thus, cooling air passages 137 for guiding the cooling air linearly upward are defined between adjacent ones of the airfoil pieces 135a.

Further, like in the first embodiment, the heat input fin 133 on the barrel side is formed on the outer wall surface of the barrel 108 (or the inner wall surface of the housing cover 106) and disposed closely to or in contact with the heat pipes 131.

[0037] Therefore, according to this embodiment, like in the first embodiment, high-temperature heat generat-

ed in the barrel 108 or the high-temperature region A which is difficult to cool by using cooling air, can be transferred to the flow region of the cooling air or the low-temperature region B which is located on the crank housing 107 side and easy to cool by the heat pipes 131, and the heat can be collectively cooled together with the crank housing 107. Further, the barrel 108 can be cooled in a hermetically sealed state from the outside without need of providing a ventilating hole or opening in the barrel 108 for communication with the outside, so that entry of dust into the barrel 108 can be prevented.

[0038] Further, in the above-described embodiments, the two heat pipes 131 are spaced apart from each other, but the number of the heat pipes 131 may be one, or three or more.

When a plurality of heat pipes 131 are provided, in order to enhance the radiating effect, it is preferable that the distance (pitch) between the heat pipes 131 and the radiating fin 135 is long. For example, when two heat pipes 131 are provided, the pitch is set to be at least about the same as the distance between one end of the radiating fin 135 and one of the heat pipes 131. This is the same with the heat input fin 133.

Further, preferably, the radiating fin 135 may be disposed as closely as possible to the cooling fan 121 so that the cooling air more actively gets in contact with the radiating fin 135.

Further, in the above-described embodiments, the hammer drill 101 is described as a representative example of the power tool. However, the invention is not limited to a hammer drill, but it can be naturally applied to an electric hammer in which a hammer bit performs only a hammering movement in the axial direction, and can also be applied to any power tool having a tool bit to be driven by a motor and having a high-temperature region which generates heat when the tool bit is driven.

[0039] In view of the scope and aspect of the invention, following features can be provided.

(1)

[0040] "The power tool, further comprising an operating mechanism that converts a rotating output of the driving motor into linear motion and transmits the motion to the tool bit or transmits the rotating output as a rotating force, and a housing that houses the operating mechanism, wherein the motor cooling air passage is formed in a lateral region lateral to the housing."

(2)

[0041] "One end of the heat pipe in its extending direction is disposed closely to the radiating fin. "

(3)

[0042] "The radiating fin which forms the motor cooling air passage extends transversely to the extending direc-

tion of the heat pipe and is formed by a plurality of airfoil pieces which are arranged in parallel at predetermined intervals in the extending direction of the heat pipe."

(4)

[0043] "The power tool, comprising a fin which is formed by a plurality of airfoil pieces in order to transfer heat of the high-temperature region to the heat pipe, wherein the airfoil pieces extend transversely to the extending direction of the heat pipe and are arranged in parallel at predetermined intervals in the extending direction of the heat pipe."

(5)

[0044] "The power tool as defined in claim 5, wherein the two heat pipes are spaced apart from each other."

BRIEF DESCRIPTION OF THE DRAWINGS

[0045]

FIG. 1 is a sectional side view showing an entire construction and a cooling structure of a hammer drill 101 according to a first embodiment of the invention.

FIG. 2 is a sectional side view showing an entire construction and a cooling structure of a hammer drill 101 according to a second embodiment of the invention.

Description of Numerals

[0046]

101 hammer drill (power tool)
 103 body
 105 motor housing
 105a bottom wall
 106 housing cover
 107 crank housing
 108 barrel (high-temperature region)
 109 handgrip
 109a trigger
 109b electric switch
 111 driving motor
 112 output shaft
 119 hammer bit (tool bit)
 121 cooling fan
 123 baffle plate
 127 inlet
 129 outlet
 131 heat pipe
 133 heat input fin
 133a airfoil pieces
 134 second outlet
 135 radiating fin

135a airfoil pieces

137 cooling air passage (motor cooling air passage)

5 Claims

1. A power tool comprising:

10 a tool body,
 a motor that is housed within the tool body and drives a tool bit which is disposed in a front end region of the tool body,
 a motor cooling air passage that is provided within the tool body and through which cooling air for cooling the motor flows,
 a high-temperature region within the tool body and
 a heat pipe that connects the motor cooling air passage and the high-temperature region and cools the high-temperature region by transferring heat of the high-temperature region to the motor cooling air passage.

25 2. The power tool as defined in claim 1, wherein the tool bit performs at least a hammering operation on a workpiece by linear movement in an axial direction of the tool bit, and the power tool further includes a striking element which is linearly driven by the motor and strikes the tool bit, and the high-temperature region comprises a striking region in which the striking element applies a striking force to the tool bit.

35 3. The power tool as defined in claim 1 or 2, wherein the motor is disposed such that an extension of an output shaft of the motor extends in a direction transverse to the axial direction of the tool bit, and the motor cooling air passage is formed toward one end of the output shaft in its axial direction which is nearer to an axis of the tool bit and the cooling air for cooling the motor flows through the motor cooling air passage.

45 4. The power tool as defined in any one of claims 1 to 3, wherein the motor cooling air passage is defined by a radiating fin.

50 5. The power tool as defined in any one of claims 1 to 3, wherein the motor cooling air passage and the high-temperature region are connected by a plurality of heat pipes.

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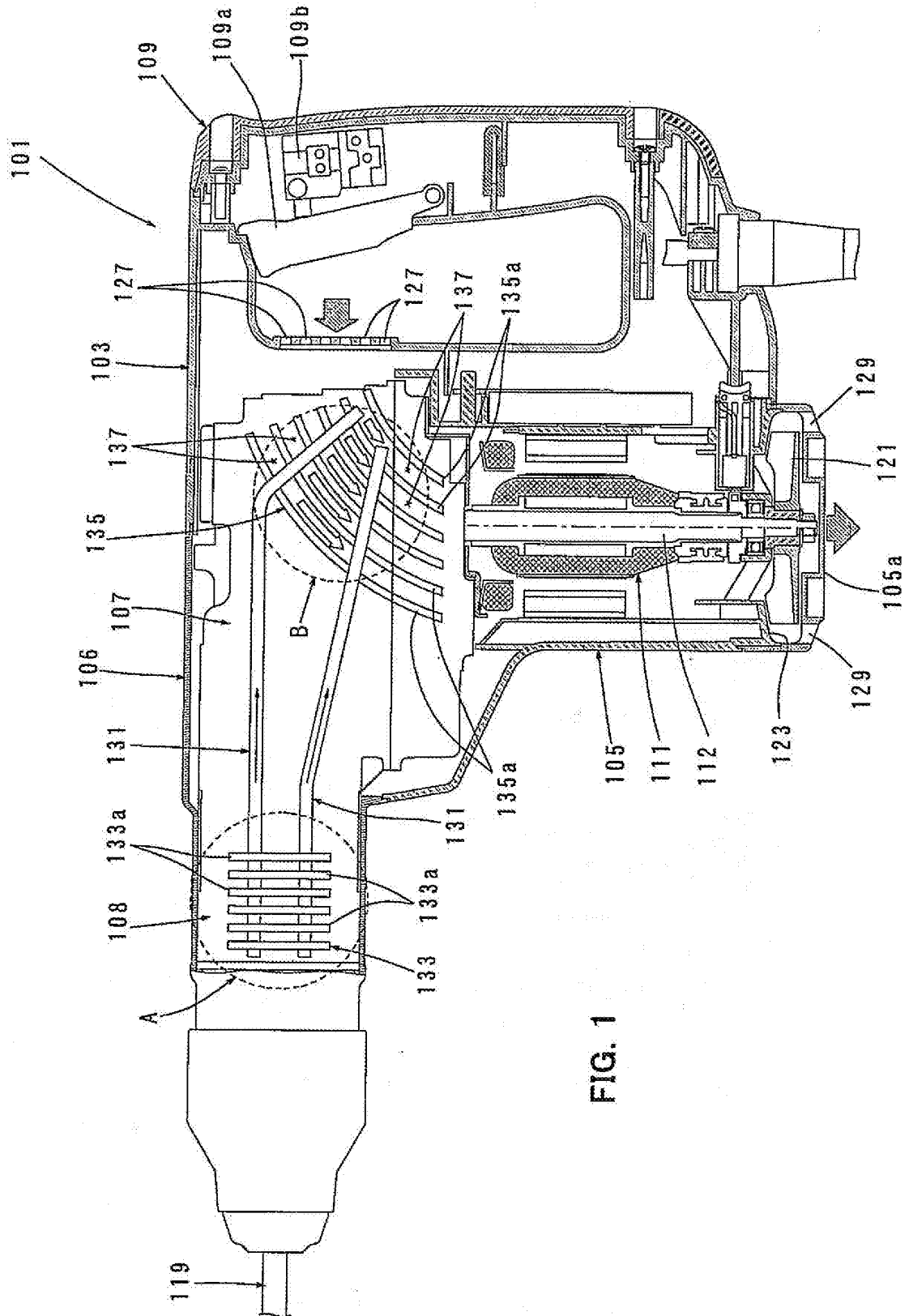


FIG. 1

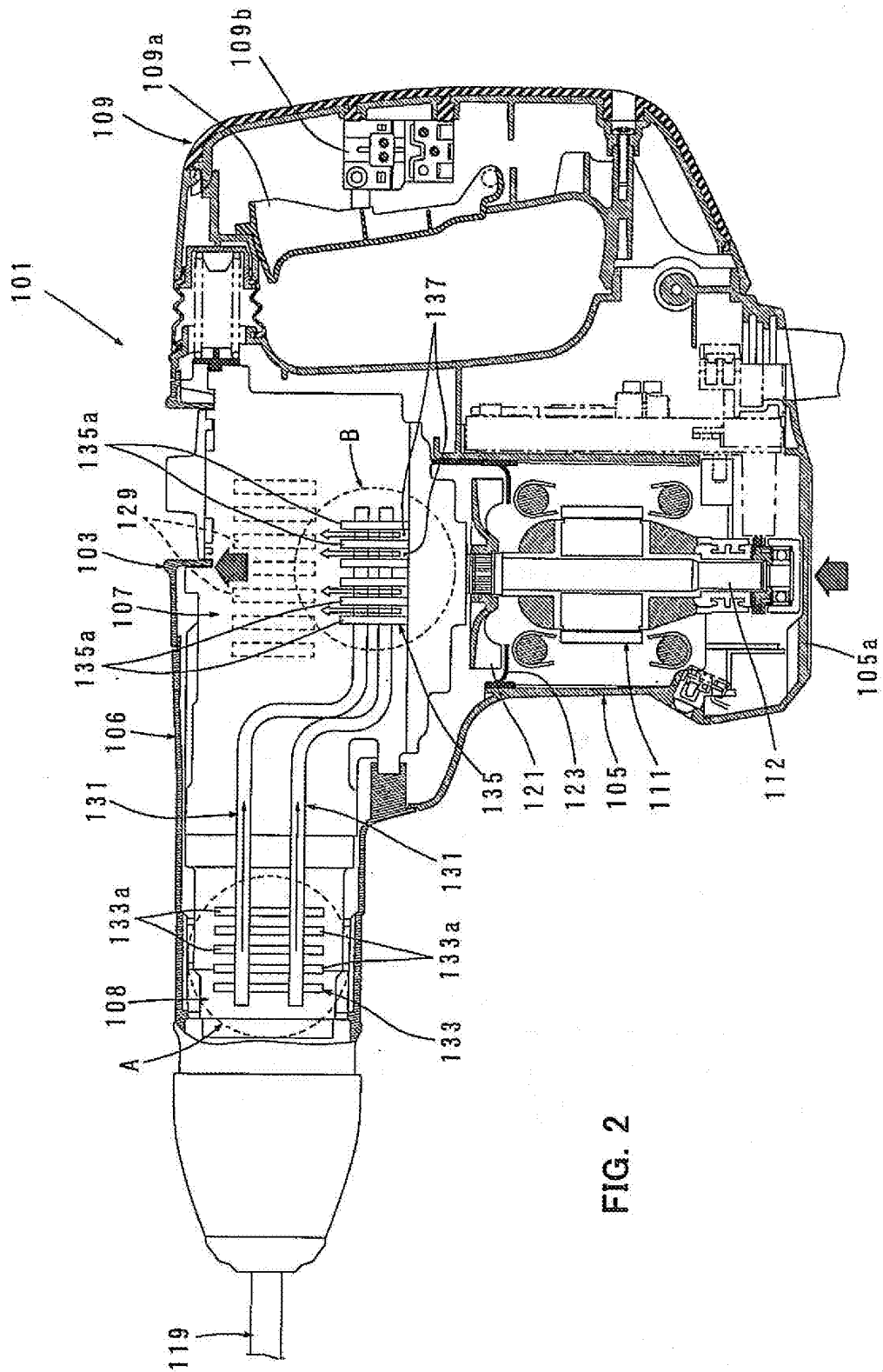


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/071175

A. CLASSIFICATION OF SUBJECT MATTER <i>B25D17/20 (2006.01) i, B25F5/00 (2006.01) i</i>										
According to International Patent Classification (IPC) or to both national classification and IPC										
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>B25D17/20, B25F5/00</i>										
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched <table border="0"> <tr> <td>Jitsuyo Shinan Koho</td> <td>1922-1996</td> <td>Jitsuyo Shinan Toroku Koho</td> <td>1996-2010</td> </tr> <tr> <td>Kokai Jitsuyo Shinan Koho</td> <td>1971-2010</td> <td>Toroku Jitsuyo Shinan Koho</td> <td>1994-2010</td> </tr> </table>			Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010	Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010
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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)										
C. DOCUMENTS CONSIDERED TO BE RELEVANT										
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.								
X A	JP 2006-155989 A (Daiya Serutekku Kabushiki Kaisha), 15 June 2006 (15.06.2006), claim 1; paragraphs [0018] to [0019]; fig. 3 (Family: none)	1, 4, 5 2-3								
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.										
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Date of the actual completion of the international search 16 March, 2010 (16.03.10)		Date of mailing of the international search report 23 March, 2010 (23.03.10)								
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Patent documents cited in the description

- JP 2000084868 A [0002]