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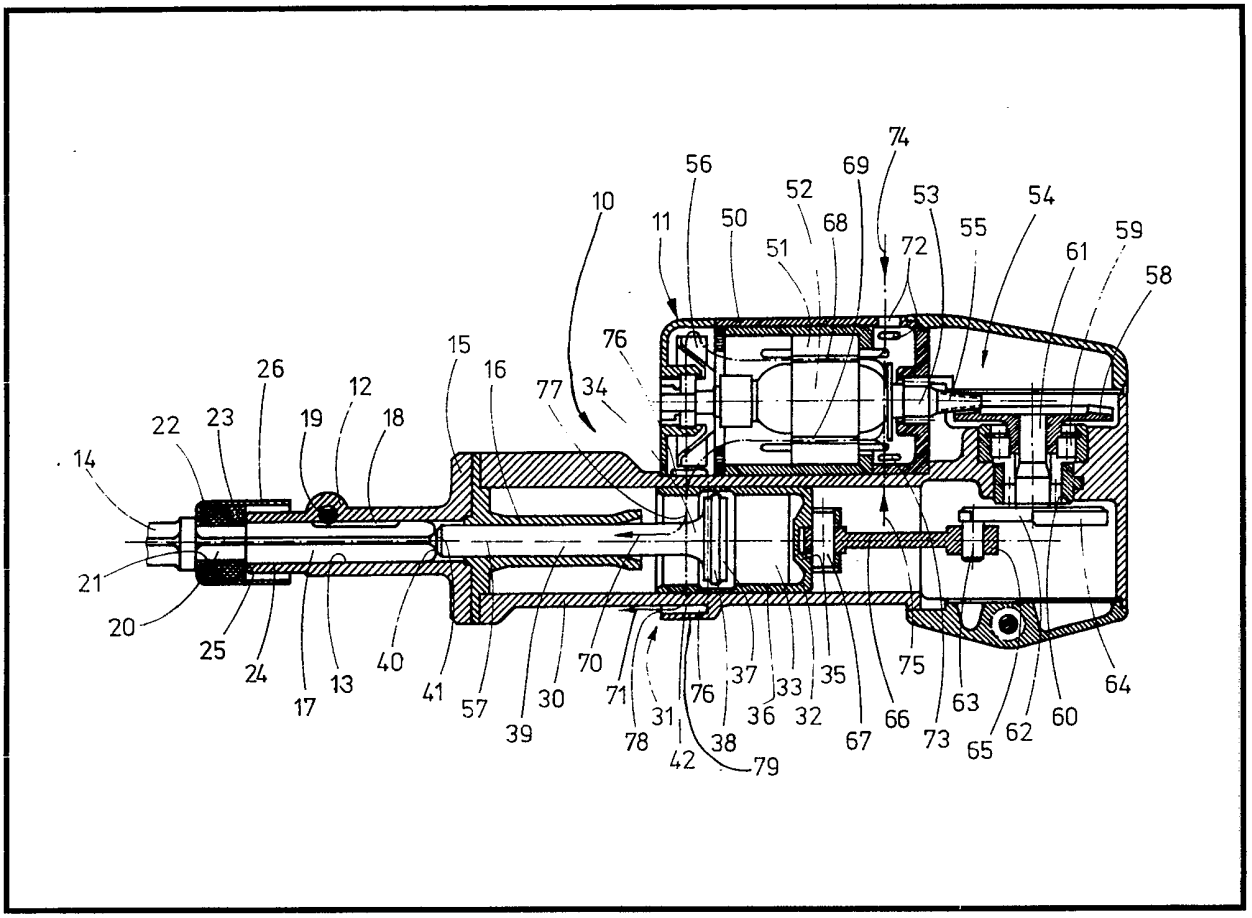
(54) Powered percussion hand tool

(57) An air cushion percussion hammer (10) has a single stage crank drive (54) comprising a motor pinion (55) and a crown wheel (58) on a driving shaft (61) which carries the crank disc (62 and 60) for the connecting rod (66) operating from the back of the driving piston (32). The driving motor (51) extends axially parallel with respect to a percussion mechanism (31) and is laterally adjacent thereto. A fan (56) is located at the axial level of the percussion mechanism (31) sucks fresh air through the driving motor (51) in a direction towards the tool holder (12) and blows the air in a stream (70, 71) directed towards the tool holder (12). The percussion mechanism (31) is cooled by a partial flow of the inspired fresh air and/or by the exhaust air flow (70, 71).



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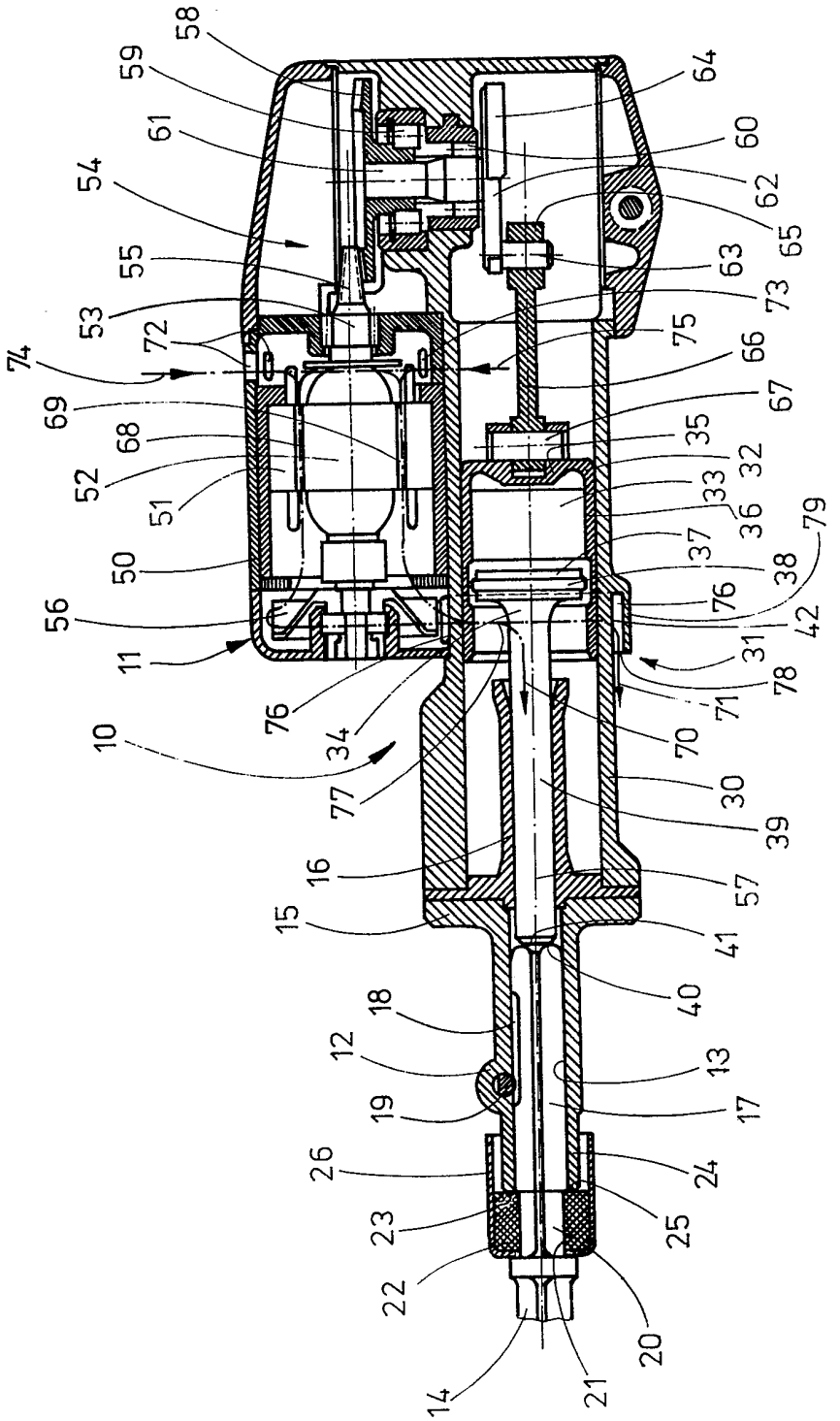
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SPECIFICATION

A handtool maching, especially a percussion hammer

State of the art

The invention originates from a hand tool machine, especially a percussion hammer, according to the type set forth in the main claim. In one known hand tool machine the air cushion percussion mechanism is driven by an electric motor through a crank drive. In itself, this machine works satisfactorily. However, the necessary conversion of the rotary driving movement of the electric driving motor into an axial reciprocating movement of the percussion mechanism, with the aid of the drive, especially a crank drive, is comparatively expensive. The drive has a plurality of driving stages. A large number of individual driving parts are necessary, for example four shafts, a plurality of gear wheels and also a plurality of bearings for the individual parts of the drive. Thus, the machine is relatively complicated, prone to breakdown, expensive, heavy and therefore relatively unwieldly together with an unfavourably located centre of gravity. Moreover, the drive together with the motor forms a relatively large structure.

Advantages of the invention

As opposed to this, the hand tool machine in accordance with the invention, especially the percussion hammer in accordance with the invention, comprising the characterising features of the main claim has the following advantages. Due to the special, single stage crank drive, the drive requires only a few parts, namely only a single driving shaft, a driving pinion at the motor end and the crown wheel at the drive end, thus, only two gear wheels in total and furthermore only a small bearing requirement. The construction in accordance with the invention permits a compact, short, viewed in the axial direction, method of constructing the machine. All this permits a favourable location of the centre of gravity. Using the maching in accordance with regulations, in which the machine is held somewhat perpendicularly with respect to its axial length, the centre of gravity is located extremely low which leads to a correspondingly easier handling of the machine. Moreover, due to the small number of parts on the driving side, the machine is simple and robust as well as low in maintenance costs. Above all, it is relatively cheap and very light in weight which also improves the handling. All this is achieved with a greater power output than previously.

Advantageously further developments and improvements of the hand tool machine set forth in the main claim are made possible by the measures set forth in the sub-claims. Thus, embodiments according to claims 2 to 4 are especially advantageous.

A further, expecially advantageous embodiment is provided by claim 5 as well as the following claims 6 to 8. In that manner, fresh air is not sucked in from the front where the tool holder is located, but at the substantially opposite end region of the hand tool machine. During proper use of the machine, this means that the fresh air is sucked substantially downwards. The air is blown out in the exhaust flow directed forwardly towards the tool holder and the tool held therein. This leads to the blowing away of dirt and dust from the tool and above all to a minimum annoyance of the operator by the dust. In addition, this prevents dirt and dust from being able to enter through the tool holder into the interior of the machine during operation. Furthermore, there is an advantage in a simultaneously achieved cooling of the percussion mechanism by, for example, directing a partial flow of the fresh air sucked in by the suction fan as cooling air over the cylindrical sleeve, which contains the percussion mechanism, in the axial region of the percussion mechanism. In addition to this or instead of this, the percussion mechanism also experiences good cooling due to the fact that, before leaving the annular duct, the exhaust air directed through the annular duct flows over the outer surface of the cylindrical sleeve located in the axial region thereof with the percussion mechanism contained therein and thus also cools the percussion mechanism.

Drawing

The invention is described in more detail in the following with the aid of an embodiment illustrated in the drawing. The drawing shows a diagrammatic, axial longitudinal section through a percussion hammer.

Description of the embodiment

The illustrated hand tool machine is formed as a percussion hammer 10 which has a housing 11 onto which, in the forward region, a forward tool holder 12 is screwed with an internal plug-in receiver 13, by means of a flange 15 and by means of bolts not shown in detail. The plug-in receiver 13 extends coaxially and as an extension of an interior guiding sleeve 16 inside the housing 11. The plug-in receiver 13 is formed as, for example, a polygonal bore, especially an hexagonal bore. A tool 14 provided with a shank section 17 which is correspondingly formed as a polygonal section, especially an hexagonal section, can be inserted in the plug-in receiver 13. In that manner, the tool 14 is non-rotatably held in the tool holder 12. The shank section 17 has a longitudinal groove 18. A locking pin 19 held in the tool holder 12 transversely of the longitudinal groove 18 engages in the longitudinal groove 18 axially securing the tool 14 against falling out and axially limiting

the reciprocating motion of the tool 14.

A moulding 22 of rubber elastic material is fixedly mounted within a recess 21, especially an annular groove, at an outer shank section 20 of the tool 14, but is exchangeable and is in any case secured against axial displacement. In cross-section, the moulding 22 has, for example, the shape of a thick cylindrical sleeve with rounded end surfaces. On that end directed towards the axial end surface 23 of the forward end extension 24 of the tool holder 12, it has an axial annular surface 25 in the form of an abutment surface. The latter extends radially beyond the end surface 23 and thus acts as a simultaneous dust protection. Above all, by means of its annular surface 25, the moulding 22 can abut the associated end surface 23 of the end projection 24 of the tool holder in a percussion damping and also noise damping manner, and indeed, on the one hand, as a so-called B-percussion damping and on the other hand, for the necessary axial support of the tool 14 with respect to the percussion hammer 10 with oscillation damping between the tool 14 and the tool holder 12. At its outer peripheral surface, the moulding 22 carries a somewhat cup-shaped covering 26 made of metal or plastics which can also be effective as a reinforcement for the moulding 22 and prevents an excessive outward bulging of the moulding 22 during percussion. The covering 26 extends in an insert direction of the tool 14 towards the forward end extension 24 and overlaps the latter on the outside over a relatively large axial length with movement clearance and somewhat cap-like. Thus, the covering 26 acts as a somewhat shield-like overlapping dust protection for the end extension 24 and as a simultaneous additional noise damping. The grease or oil lubricated interior of the percussion hammer 10 is protected from dirt entering from the outside by the dust protection.

The housing 11 of the percussion hammer 10 is formed, in part, as a tubular elongate cylindrical sleeve 30. Within the latter there is a percussion mechanism 31 which has a reciprocatingly driven driving piston 32 and moveover a striker 34 influenced by the driving piston 32 through an air cushion 33. The driving piston 32 and the striker 34 are both arranged coaxially and behind one another. The driving piston 32 is formed as a hollow piston with a piston base 35 and a piston skirt 36 open towards the left in the drawing and made integral therewith. The latter is slidably arranged in the cylindrical sleeve 30. In its turn, the interior of the piston skirt 36 serves for the reception and sliding and sealing guiding of the striker 34. The latter consists of a plate 37 with a sealing ring 38 and a striker shaft 39 integral with the plate 37 and extending towards the left in the drawing, the shaft 39 being made long and slender and having substantially the same diameter as the shank section 17 of the tool 14. The striker shaft 39 is slidably guided inside the guide sleeve 16 and according to its position, its end penetrates into the plug-in receiver 13 without striking the polyhedral. With its free end surface 40 on the left in the drawing, the striker shaft 39 directly influences the free end 41 of the tool 14 facing it without an intermediate member in the form of an intermediate dolly. Thus, the percussive energy applied by the striker 34 is transmitted directly to the tool 14 which leads to the optimum use of the available power and the optimal transmission of the percussive energy.

An electric driving motor 51, for example a universal motor, the rotor 52 of which is mounted on a motor shaft 53 guided at both ends, is arranged within a housing cover 50 extending over substantially 180° peripheral angle and is seated on the cylindrical sleeve 30 downwards with respect to the drawing. The driving motor 51 operates on the percussion mechanism 31 through a crank drive 54. As can be appreciated, the driving motor 51 is substantially axially parallel with respect to the cylindrical sleeve 30 and is arranged laterally adjacent to the latter and above the latter in the drawing. Moreover, that end of the motor shaft 53 which carries a driving pinion 55 is directed away from the tool holder 12, thus towards the right in the drawing. A fan 56, for example in the form of a fan wheel or ventilator fan, is mounted on the opposite end of the motor shaft 53, thus on the left in the drawing.

The motor shaft 53 is mounted in the housing in the region of both ends.

The crank drive 54 is formed as a single stage. It is arranged behind the piston head 35 of the driving piston 32 with a single gear train extending transversely with respect to the longitudinal central axis 57 of the cylindrical sleeve 30. The gear train comprises a bevel toothed crown wheel 58 meshing with the driving pinion 55, a driving shaft 61 mounted in the housing by means of two bearings 59 and 60 and carrying the crown wheel 58 for rotation therewith and furthermore a crank disc 62 which is fixed on the end of the driving shaft 61 opposite to the crown wheel 58 and for rotation therewith. The crank disc 62 carries a crank pin 63 and a counter-weight 64 diametrally opposite the latter. The small end 65 of a connecting rod 66 pivotally engages the crank pin 63, the connecting rod being pivotally connected by a gudgeon pin 67 to the rear of the piston head 35 of the driving piston 32.

The transmission ratio of the crank drive 54 from the driving pinion 55 towards the straight line drive for the driving piston 32, amounts to about 10:1. This means that, as is usual with such percussion hammers, the driving motor 51 rotates at a speed under load of

about 12,000 to 16,000 revolutions per minute and consequently the percussion mechanism 31 then strikes at about 1,000 to 1,600 impacts per minute.

The arrangement is so designed that the driving pinion 55 extends behind the driving piston 32 by about the axial length of the connecting rod 66. The fan 56 on the driving motor 51 is arranged substantially at the axial level of the striker 34, at least at the axial level of the axial stroke performed by the plate 37.

The percussion hammer 10 is further characterised by a cooling air guide passage for the driving motor 51 passing through the latter and indicated by lines 68 and 69 and arrows and an air flow directed towards the outer surface 42 of the cylindrical sleeve 30 in the axial region of the percussion mechanism 31 and directed towards the tool holder 12, especially an exhaust flow, which, in that location, is indicated by outlet arrows 70, 71. The fan 56 is formed as a suction fan. At the end region of the driving motor 51, thus at the right-hand end region in the drawing, lying opposite the fan, it sucks in external air through outer suction openings 72, 73 in the housing cover and which is indicated at that location by arrows 74, 75. The inspired external air is sucked through the driving motor 51 axially by the fan 56 as shown by the lines 68, 69. Then, the air is directed as exhaust air in the region of the fan radially into an annular duct 76 which is indicated by the line 77. The annular duct 76 surrounds the outer surface 42 of the cylindrical sleeve 30 over a large peripheral angle, for example of more than 180°, over which the exhaust air flows along the line 77. The annular duct 76 has exhaust air openings directed in an axial direction and moreover towards the tool holder 12 and formed, in this instance, for example by a single circular annular opening 78 which is open towards the left in the drawing over the entire peripheral angle over which the annular duct 76 extends around the outer surface 42 of the cylindrical sleeve 30 insofar as it does not extend within the housing cover 50. The exhaust air flows through the annular opening 78 in the direction of the arrows 70, 71 in a flow directed along the outer surface 42 of the cylindrical sleeve 30 and towards the tool holder 12. In so doing, the said exhaust air flow 70, 71 cools the percussion mechanism 31. Moreover, during proper use of the percussion hammer 10, the dust which is annoying to the operator is reduced to a minimum because the exhaust air 70, 71 is blown towards the tool 14. In addition, a layer of air is provided thereby to a certain extent which also prevents a possible ingress of dirt and dust into the tool holder 12 and moreover into the interior of the percussion hammer 10. The annular duct 76 is located at about the axial level of the striker 34, at least at the level of the axial stroke performed by the plate 37. In the region of the cylindrical sleeve 30, the annular duct 76 is bounded over its peripheral extent at that location by the outer surface 42 of the cylindrical sleeve 30 on the one hand and by an annular cover 79 surrounding the said outer surface 42 at a radial distance on the other hand and which is moulded, for example, onto the cylindrical sleeve 30.

The external suction openings 72, 73 in the housing cover 50 are located substantially at the level at the rear axial region of the piston head 35. A partial flow of the fresh air sucked in by the fan 56 in accordance with the arrows 74, 75 is likewise guided over the cylindrical sleeve 30 as cooling air and indeed likewise in the axial region of the percussion mechanism 31, for example behind the piston head 35 and in an axial direction along the piston skirt 36.

The percussion hammer is simple, robust, needs little maintenance and in practice is not prone to breakdown. On the driving side, it has only a few parts and indeed only the single driving shaft 61 with two bearings 59 and 69, furthermore only the two gearwheels, namely the driving pinion 55 and the crown wheel 58. Thus, expenditure on the driving side is extraordinarly low. Thus, the percussion hammer 10 is cheap and light whereby it is also very easy to handle. Furthermore, due to the arrangement of the driving motor 51, the percussion hammer 10 is very short. This leads to a favourable location of the centre of gravity together with an extremely low lying centre of gravity during proper use, in which the longitudinal central axis 57 extends substantially perpendicular, whereby the handling is still further improved. In addition, the dust which is annoying to the operator is reduced and the percussion mechanism 31 is cooled by the fresh air flow and also the exhaust air flow which increases the stability and working life of the percussion mechanism 31 still further.

CLAIMS

1. A hand tool machine, expecially a percussion hammer, comprising an, especially, electric driving motor which operates through a gear drive on a subsequent percussion mechanism which has a driving piston driven and guided with an axial reciprocating movement in a cylindrical sleeve and a coaxial striker which can be influenced by the driving piston preferably over an air cushion for generating the percussive energy for a tool insertable by its shank in a forward tool holder, wherein the driving motor is arranged substantially axially parallel to the cylindrical sleeve and laterally adjacent thereto and the driving pinion on the motor shaft points in a direction away from the tool holder whilst the fan on the motor shaft points towards the tool

holder, characterised by a single stage crank drive which is arranged behind the driving piston with a gear train extending transversely with respect to the longitudinal central axis of the cylindrical sleeve and has a crown wheel meshing with the driving pinion, a drive shaft rotatably mounted in the housing for rotation by the crown wheel and a crank arm, especially a crank disc with a crank pin, fixedly arranged on the end of the driving shaft opposite to the crown wheel, the small end of a connecting rod pivoted behind the driving piston by a gudgeon pin, pivotally engaging the crank arm.

2. A hand tool machine according to claim 1 characterised in that the transmission ratio of the drive from the driving pinion to the straight line drive of the driving piston is so selected that the percussion mechanism is driven at about 1,000 to 1,600 impacts per minute.

3. A hand tool machine according to claim 1 or 2 characterised in that the driving pinion extends rearwardly of the driving piston by substantially the axial length of the connecting rod.

4. A hand tool machine according to one of claims 1 to 3 characterised in that the fan of the driving motor is arranged at substantially the axial level of the striker at least at the level of the axial stroke performed by the striker.

5. A hand tool machine, especially according to one of claims 1 to 4, characterised by a cooling air supply for the driving motor passing through the latter and towards the outside of the cylindrical sleeve in the axial region of the percussion mechanism comprising an air flow, especially an exhaust air flow, directed towards the tool holder.

6. A hand tool machine according to one of claims 1 to 5 characterised in that the fan is formed as a suction fan which inspires at the end region of the driving motor opposite to the fan, through external suction openings external air and draws it axially through the driving motor and in the region of the fan discharges the air radially into an annular duct which surrounds the outside of the cylindrical sleeve over a large peripheral angle and in an axial direction and has discharge air openings directed towards the tool holder and through which the exhaust air flows away in a stream directed towards the tool holder.

7. A hand tool machine according to claim 6 characterised in that the external suction openings are arranged substantially at the level of the rear axial region of the driving piston and that a partial flow of the fresh air sucked in by the suction fan is guided as cooling air over the cylindrical sleeve in the axial region of the percussion mechanism.

8. A hand tool machine according to claim 6 or 7 characterised in that the annular duct is arranged substantially at the axial level of the striker, at least at the level of the axial stroke performed by the striker, and is bounded in the region of the cylindrical sleeve over its peripheral extent on the one hand by the outer surface of the cylindrical sleeve and on the other hand by an annular cover surrounding the cylindrical sleeve at a radial distance, wherein, over the said peripheral extent, the annular duct is open towards the tool holder whilst forming the exhaust air opening.

9. A hand tool machine substantially as herein described with reference to the accompanying drawing.

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