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(54) A DRIVE ARRANGEMENT FOR A PORTABLE POWER TOOL

(71) I, SAKUJI YAMADA, a Japanese citizen, of No. 1, Aza Okunishiyama, Kuruma, Sumaku, Kobe, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a drive arrangement for a portable power tool which can be carried on an operator's back.

In order to alleviate the disadvantages of conventional power mowers I disclosed in the specification forming part of my British Letters Patent Letters No. 1,008,015 a portable type of mower which permits an operator to orient the cutting blade in any desired direction, the mower being so constructed that an operator is able to work by connecting a rotary cutter, by means of a flexible shaft, to a driving mechanism rotatably mounted on a supporting frame on his back.

However, it has been found that this mower is not always easy to use because a rotary cutter supporting means used for manipulating the rotary cutter is heavy, and the hand grips of the support are held in a predetermined position making it impossible for an operator to alter his gripping position to suit his physical constitution and to obtain a comfortable grasp of the hand grips.

According to my British Letters Patent No. 1,008,015, and as shown in Figure 3 to be later described, use is made of a flexible tube covering a flexible shaft that is adapted to transmit the power to the rotary cutter from a power unit. The shaft is concentrically covered with a rigid metal pipe throughout the intermediate portion thereof. The forward end of the rigid metal pipe is covered by a rigid metal sleeve and the rotary cutter can be oriented at any desired angle by sliding the sleeve on the pipe either forwards or backwards. Thus it is necessary for a relatively long sleeve to be used, which is consequently heavy in weight, and has to be disposed adjacent the rotary cutter. In consequence the cutter cannot be oriented in desired directions without extremely careful hand control, and the load imposed upon the operator's hands exhausts him in a relatively short length of time, with the result that he cannot continue mowing for longer than an hour or so.

In addition to the fact that the sleeve is of a relatively long length, the rigid pipe is limited in length so that the range of sliding movement available is limited, the result being that an operator in many cases cannot select a suitable interval between the hand grips to enable him to grasp them in a comfortable posture and to selectively orient the rotary cutter in any desired direction. Furthermore, the sleeve cannot rotate about the rigid pipe. These limitations cause difficulties if the operator wishes to use the mower on any terrain excepting flat surface portions of horizontal ground or gentle slopes.

According to a first aspect of the present invention there is provided a drive arrangement for a portable power tool, comprising a flexible drive shaft for connection at one end to a power unit of the power tool and connected at the other end to a holder for a tool of the power tool, a flexible tube covering the drive shaft, an elongate member having one end pivotally connected to the holder and the other end connected to a rigid tube covering the flexible tube over part of its length, and first and second sleeves overlying the rigid tube and having respective hand grips, the first sleeve overlying the end of the rigid tube remote from the holder and being rigidly connected to the flexible tube, the relative axial and angular positions of the rigid tube and the the first and second sleeves being adjustable.

According to a second aspect of the invention there is provided a portable power tool comprising a power unit for carrying on the operator's back, a holder for a tool of the power tool, and a drive arrangement as defined in the preceding paragraph.

The invention will now be described in more detail, by way of example, and with reference to the accompanying drawing, in which:—

FIGURE 1 is a perspective view showing a portable mowing apparatus;

FIGURE 2 is a fragmental vertical section schematically showing the construction of a cutter holding means of the moving apparatus shown in Figure 1, illustrating somewhat exaggeratedly for the purpose of more clarity, and;

FIGURE 3 is a vertical section similar to Figure 2, schematically showing the construction of a cutter holding means in accordance with the prior art taught by my previous U.K. Patent No. 1 008 015.

In Figure 1 is shown a mowing apparatus including a frame 11 in which a power unit comprising a driving mechanism 12 is supported so as to be moveable about a vertical pivot axis. The frame 11 is carried on an operator's back. To the driving mechanism 12 is detachably connected a flexible tube 13 reinforced with a spiral spring 13*a* and which covers the whole length of a flexible drive shaft 22, as shown in Figure 2, for transmitting power from an output pulley 14 of the driving mechanism 12 to a rotary cutter 15 which is carried by the free end of the flexible tube 13. An inflexible pipe 16 covers a middle portion of the flexible tube 13. The pipe 16 may be made of steel or a plastics material. A rigid sleeve 17 covering the end of the pipe 16 nearest the power unit has a hand grip 18. The end portion of the sleeve 17 nearest the power unit is rigidly fixed to the flexible tube 13 by means of a compressed portion 17'. A sleeve 19 if a relatively short length has a hand grip 20 and is slidable on the pipe 16 so as to adjust the distance between the hand grips 18 and 20.

An elongate leg 21 is rigidly secured, for example by welding, to the end of the pipe 16 nearest the cutter 15 and extends obliquely to a pivot 23 which is formed on a rotary cutter holder 24 for detachably and rotatably holding the rotary cutter 15, thereby serving as a cutter angle change fulcrum when the cutter 15 is to be changed in orientation.

The hand grip 20 is threaded onto a stub shaft 20a perpendicularly to the axis of the sleeve 19, and when the hand grip 20 is screwed tightly on to the shaft 20a the sleeve 19 is clamped to the pipe 16. The pipe 16 can then be slid along the tube 13, relative to the sleeve 17, by moving the hand grip 20 forwards and backwards.

When the tightly screwed engagement of the hand grip 20 with the pipe 16 is loosened, the fixed relation between the sleeve 19 and the pipe 16 is released and the sleeve 19 and the hand grip 20 are then slidable axially of the pipe 16 and also moveable angularly thereabout, so making it possible for an operator to set the hand grip 20 in any position relative to the hand grip 18 so that he can work in the most comfortable posture.

The hand grip 18 is threaded onto a stub shaft 18a perpendicular to the axis of the sleeve 17. When the hand grip 18 is screwed tightly onto the shaft 18a, the sleeve 17 is clamped to the pipe 16. Therefore, when the sleeve 19 is fixed to the pipe 16 by screwing the hand grip 20 tightly onto the shaft 20a, and when the sleeve 17 is clamped to the pipe 16 by screwing the hand grip 18 tightly onto the shaft 18a, an operator is able to mow in a desired direction of the rotary cutter 15 with the hand grips 18 and 20 set at the most suitable positions.

When the tightly screwed engagement of the hand grip 18 is loosened, the clamping of the sleeve 17 to the pipe 16 is also released to permit relative axial and angular movement of the pipe 16 and sleeve 17 so that an operator is able to adjust the hand grip 18 in three directions, to suit the terrain where mowing is to be carried out, and so that the exposed portion of the flexible tube 13 between the foremost end of the pipe 16 and the rotary cutter holder 24 is changed in length, thereby to change the inclination of the rotary cutter 15, as shown in phantom outline in Figure 2.

On comparing the mowing apparatus of Figures 1 and 2 with the prior art apparatus of Figure 3 it will be noticed that in the latter the construction of the rotary cutter holding shaft 10b is such that the rotary cutter 15b can be changed in direction by moving the hand grip 20b mounted on the outer pipe 19b whereas the hand grip 18b of the inner pipe 16b is rigidly fixed. Thus, when the rotary cutter 15b is downwardly directed by moving the hand grip 20b to such a position as shown in phantom lines in Figure 3, the distance between the hand grips 18b and 20b is limited to such an extent that an operator cannot easily grasp these hand grips and manipulate the apparatus in a comfortable posture. Further, the outer pipe 19b of Figure 3 substantially constitutes the main body of the rotary cutter holding shaft 10b which is relatively long in length and made of metallic material so that, as a whole, the mowing apparatus is much heavier than that shown in Figures 1 and 2 and is longer than the combined lengths of the pipe 19 and the sleeve 17 in the apparatus of Figures 1 and 2.

An operator, using a mower shown in figures 1 and 2 can adjust the hand grips in three dimensions and work in a comfortable posture, irrespective of the operator's sex and physical constitution, or the terrain where the mowing is carried out.

WHAT I CLAIM IS:—

1. A drive arrangement for a portable power tool, comprising a flexible drive shaft for connection at one end to a power unit of the power tool and connected at the other end to a holder for a tool of the power tool, a flexible tube covering the drive shaft, an

FIGURE 1 is a perspective view showing a portable mowing apparatus;

FIGURE 2 is a fragmental vertical section schematically showing the construction of a cutter holding means of the moving apparatus shown in Figure 1, illustrating somewhat exaggeratedly for the purpose of more clarity, and;

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In Figure 1 is shown a mowing apparatus including a frame 11 in which a power unit comprising a driving mechanism 12 is supported so as to be moveable about a vertical pivot axis. The frame 11 is carried on an operator's back. To the driving mechanism 12 is detachably connected a flexible tube 13 reinforced with a spiral spring 13*a* and which covers the whole length of a flexible drive shaft 22, as shown in Figure 2, for transmitting power from an output pulley 14 of the driving mechanism 12 to a rotary cutter 15 which is carried by the free end of the flexible tube 13. An inflexible pipe 16 covers a middle portion of the flexible tube 13. The pipe 16 may be made of steel or a plastics material. A rigid sleeve 17 covering the end of the pipe 16 nearest the power unit has a hand grip 18. The end portion of the sleeve 17 nearest the power unit is rigidly fixed to the flexible tube 13 by means of a compressed portion 17'. A sleeve 19 if a relatively short length has a hand grip 20 and is slidable on the pipe 16 so as to adjust the distance between the hand grips 18 and 20.

An elongate leg 21 is rigidly secured, for example by welding, to the end of the pipe 16 nearest the cutter 15 and extends obliquely to a pivot 23 which is formed on a rotary cutter holder 24 for detachably and rotatably holding the rotary cutter 15, thereby serving as a cutter angle change fulcrum when the cutter 15 is to be changed in orientation.

The hand grip 20 is threaded onto a stub shaft 20a perpendicularly to the axis of the sleeve 19, and when the hand grip 20 is screwed tightly on to the shaft 20a the sleeve 19 is clamped to the pipe 16. The pipe 16 can then be slid along the tube 13, relative to the sleeve 17, by moving the hand grip 20 forwards and backwards.

When the tightly screwed engagement of the hand grip 20 with the pipe 16 is loosened, the fixed relation between the sleeve 19 and the pipe 16 is released and the sleeve 19 and the hand grip 20 are then slidable axially of the pipe 16 and also moveable angularly thereabout, so making it possible for an operator to set the hand grip 20 in any position relative to the hand grip 18 so that he can work in the most comfortable posture.

The hand grip 18 is threaded onto a stub shaft 18a perpendicular to the axis of the sleeve 17. When the hand grip 18 is screwed tightly onto the shaft 18a, the sleeve 17 is clamped to the pipe 16. Therefore, when the sleeve 19 is fixed to the pipe 16 by screwing the hand grip 20 tightly onto the shaft 20a, and when the sleeve 17 is clamped to the pipe 16 by screwing the hand grip 18 tightly onto the shaft 18a, an operator is able to mow in a desired direction of the rotary cutter 15 with the hand grips 18 and 20 set at the most suitable positions.

When the tightly screwed engagement of the hand grip 18 is loosened, the clamping of the sleeve 17 to the pipe 16 is also released to permit relative axial and angular movement of the pipe 16 and sleeve 17 so that an operator is able to adjust the hand grip 18 in three directions, to suit the terrain where mowing is to be carried out, and so that the exposed portion of the flexible tube 13 between the foremost end of the pipe 16 and the rotary cutter holder 24 is changed in length, thereby to change the inclination of the rotary cutter 15, as shown in phantom outline in Figure 2.

On comparing the mowing apparatus of Figures 1 and 2 with the prior art apparatus of Figure 3 it will be noticed that in the latter the construction of the rotary cutter holding shaft 10b is such that the rotary cutter 15b can be changed in direction by moving the hand grip 20b mounted on the outer pipe 19b whereas the hand grip 18b of the inner pipe 16b is rigidly fixed. Thus, when the rotary cutter 15b is downwardly directed by moving the hand grip 20b to such a position as shown in phantom lines in Figure 3, the distance between the hand grips 18b and 20b is limited to such an extent that an operator cannot easily grasp these hand grips and manipulate the apparatus in a comfortable posture. Further, the outer pipe 19b of Figure 3 substantially constitutes the main body of the rotary cutter holding shaft 10b which is relatively long in length and made of metallic material so that, as a whole, the mowing apparatus is much heavier than that shown in Figures 1 and 2 and is longer than the combined lengths of the pipe 19 and the sleeve 17 in the apparatus of Figures 1 and 2.

An operator, using a mower shown in figures 1 and 2 can adjust the hand grips in three dimensions and work in a comfortable posture, irrespective of the operator's sex and physical constitution, or the terrain where the mowing is carried out.

WHAT I CLAIM IS:—

1. A drive arrangement for a portable power tool, comprising a flexible drive shaft for connection at one end to a power unit of the power tool and connected at the other end to a holder for a tool of the power tool, a flexible tube covering the drive shaft, an

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elongate member having one end pivotally connected to the holder and the other end connected to a rigid tube covering the flexible tube over part of its length, and first and second sleeves overlying the rigid tube and having respective hand grips, the first sleeve overlying the end of the rigid tube remote from the holder and being rigidly connected to the flexible tube, the relative axial and angular positions of the rigid tube and the first and second sleeves being adjustable.

2. A drive arrangement as claimed in Claim 1, wherein the hand grips each include a screw clamp for securing the sleeves relative to the rigid tube.

3. A drive arrangement as claimed in Claims 1 or 2, wherein a coil spring covers portions of the flexible tube not covered by the rigid tube.

4. A drive arrangement for a portable power tool, substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.

5. A portable power tool comprising a power unit for carrying on the operator's back, a holder for a tool of the power tool, and a drive arrangement as claimed in any one of Claims 1 to 4.

6. A portable power tool substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.

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