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(54) Powered tool.

(57) A tool in which the operating head is given an improved, controlled linear reciprocatory action includes a cam member (13; 44) and a cam follower (32; 40) mounted within a housing (10). Either the cam member or the cam follower is rotated by a drive means (12) and either the cam follower or the cam member is mounted for linear reciprocatory movement. The cam follower includes a rotary bearing (33; 41, 42) and a spring means (30) is provided to urge the cam member and cam follower out of interengagement. The tool operating head, for example a chisel bit, is given a pulsed and/or reciprocatory action under the ready control of the user.

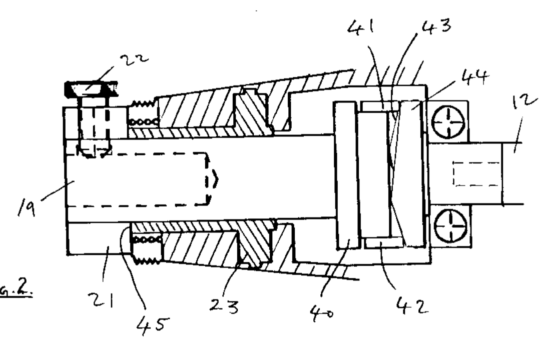

Fig.2.

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The present invention is concerned with tools, in particular, but not exclusively, of the portable hand-held type. The invention affords the possibility of providing a reciprocating drive to such tools.

While some available power tools, for example rotary drills, have provision for assisting the action of the tool by applying a reciprocatory linear force to the tool bit, there are many, conventionally unpowered, tools for which any linear force is normally applied either by simple manual pressure or with the aid of a hammer or other impacting means. Such tools include chisels used for cutting wood or masonry. Although many craftsmen prefer to use a hammer when working with a chisel in the belief that they can thereby better control the cutting action of the tool, the physical effort and skill involved in wielding a hammer, and the risk of injury associated with hammering a metal tool, are serious disadvantages associated with that use.

Many other tools which are not usually subjected to hammering in this way, for example paint scrapers, spades and hoes, would nonetheless be assisted in their action if a controlled reciprocatory drive could be applied to the working head of the tool. However such a controlled device is not available and tools of this type continue to be used without the benefit of such assistance.

In the few cases where a powered hammering action is applied to a tool, for example in the case of pneumatic road-drills or of hand drills with a hammer bit, the hammer action involves a succession of discrete impacts. That is, the power to be applied to the tool is built up over a short period and then suddenly released, so as to drive the tool in the direction of the workpiece with a sudden surge of power. The resulting hammering action is difficult to control and has little place in the operation of a tool which needs to be used in a controlled manner.

It is an object of the present invention to provide a powered tool in which an improved, controlled linear reciprocatory action is applied to the operating head of the tool in the direction of the workpiece.

The tool according to the present invention comprises a housing, a cam member and a cam follower mounted within the housing along a common axis therein for relative axial movement into and out of mutual engagement, said cam member having a surface which, in a direction parallel to said common axis, varies in height around the perimeter of that surface, said cam follower comprising a rotary bearing for engaging said cam member surface, drive means to rotate one of said cam member and said cam follower about said common axis, the other of said cam member and cam follower being mounted for linear movement in the direction of said axis, a tool operating head, mounted for linear movement with said linearly movable cam member or cam follower, and spring means for resiliently urging said cam member and cam follower out of mutual engagement.

The desired controlled linear reciprocatory action is brought about by engagement of the cam follower and the surface of the cam member, as these two components are brought into progressive mutual engagement under increasing pressure of the user upon the housing when the tool is in contact with the workpiece. Initial intermittent contact of the cam follower with the high point or points of the cam surface gives rise to a corresponding pulsed axial action of the tool. As the pressure applied to the tool by the user increases, the cam follower follows an increased proportion of the cam surface and the action of the tool approaches progressively a more smooth reciprocatory action. Thus the nature of the driving force applied to the tool at the workpiece is variable in a controlled manner under the control of the user of the tool. The detailed form of the eventual reciprocatory action is set by the profile of the cam surface and the frequency of the reciprocation can be varied by varying the speed of rotation of the rotated component.

The housing is preferably generally cylindrical in shape and preferably tapers somewhat towards the tool operating head. It may conveniently be made in two parts, joined together along the length of the tool so as to permit ready assembly and optionally subsequent dismantling for maintenance purposes. The housing parts may be made in metal or moulded in a plastics material.

The cam member is mounted within the housing along a common axis with the cam follower. Conveniently that axis is coaxial with that of the housing. The cam surface which controls the reciprocation of the tool head faces in a direction parallel to that axis. Thus the cam member may be generally disc-shaped and then the cam surface is one of the faces of the disc. Whatever the form of the cam member, the cam surface varies in a continuous manner around at least the perimeter of the surface. The cam profile may be repeated at least once around the periphery of the cam surface or one cycle of the cam profile may correspond to one complete circuit of the surface.

In a preferred form of the present invention, the cam surface comprises one or more flat surfaces inclined at an angle of less than 90 degrees to the common axis of the cam member and cam follower. Preferably the angle of inclination of the surface(s) to the perpendicular to that axis lies within the range from 2. 5 to 15 degrees, more preferably of the order of 6 to 7 degrees.

The cam follower incorporates a rotary bearing for engaging the surface of the cam member . By means of this interengagement, the relative rotary movement of the cam member and cam follower is converted into the desired relative axial movement of these two components, with the minimum loss of power attributable to friction between them. The bearing may be mounted ted with its axis coaxial with that of the cam member or may be inclined to that latter axis. An advantage of such an inclined bearing is that it may be of larger diameter than the interior diameter of the housing and may thus rotate at a lower speed. However that advantage must be weighed against the disadvantage that the load on the bearing is off-set as a result.

In general, it is preferred that there are at least two points of contact of the cam follower with the cam surface, disposed symmetrically about the common axis of the two components. In that case, the cam profile should be multiplied a corresponding number of times around the cam surface.

The relative rotary movement of the cam member and cam follower may be achieved by rotation of either of these two components. That is, either the cam member may be rotated and the cam follower be mounted for linear movement towards and away from the cam surface, or the cam follower may be rotated and the cam member be mounted for linear movement towards and away from the cam follower. The rotation of whichever component is rotated is effected by drive means. Preferably the drive means takes the form of an electric motor contained within the housing. The motor may be powered from the electricity mains supply but in a preferred form of the invention, one or more batteries are disposed within the housing to drive the motor. It is especially preferred that the battery or batteries be rechargeable. Thus the powered tool according to the invention may be not only portable but also completely self-contained.

Spring means are provided for resiliently urging the cam member and cam follower out of mutual engagement. Thereby, these two components only engage each other when the user applies pressure to the housing in order to apply the operating head of the tool to the workpiece. This pressure by the tool user overcomes that of the spring means and the cam follower and cam surface will progressively engage each other as the pressure applied is increased. Thus the initial interengagement, as described above, will comprise an intermitent regular contact between the cam follower and the high point or points of the cam surface. Progressively increasing pressure progressively increases the extent of interengagement of the cam follower with the cam surface. If the dimensions and structure of the tool permit, then the cam follower may eventually remain in engagement with the cam surface throughout the cycle of relative rotation of these components. However, in one preferred form of the present invention, a stop is provided within the housing to limit the extent of this interengagement, such that the engagement remains intermittent and the action of the tool operating head remains pulsed rather than smoothly reciprocal.

The spring means preferably comprises one or more compression springs, which conveniently may be disposed between the interior of the housing and the linearly-movable component, for example the cam follower.

The tool operating head, for example a chisel or hoe blade, may be fixedly secured to the linearly-movable component, in which case the tool is dedicated to a given activity using that fixed operating head. However, it is preferred to provide a chuck or other form of socket into which a tool bit may be removably and interchangeably securable; the chuck or other socket may conveniently be directly linked to the linearly-movable component, for example the cam follower. Thus, by way of example, a range of chisel bits may be made available and/or one or more chisel bits may be interchangeable with, say, a paint scraper or wallpaper scraper bit.

As indicated above, the invention may be applied to tools of a wide range of kinds and functions. Thus the tool may be a wood or masonry chisel or may have a hammer bit. It may be a scraper for paint or wallpaper or for the removal of textured plaster surfaces or of barnacles. It may be a file or may have an operating head specifically for fettling castings of aluminium or another metal or alloy. The tool may be adapted for chasing out mortar between bricks. In another form, it has proved to be highly effective in removing putty from window frames, using a chisel bit. It may further be used for horticultural purposes such as hoeing, forking and digging.

The invention will now be further described with reference to the accompanying drawings, which illustrate, by way of example only, three preferred embodiments of the tool according to the present invention and wherein: -

Fig. 1 is a vertical sectional view of the operating parts of a first embodiment of the tool;

Fig. 2 is a corresponding view of a second embodiment of the tool; and

Fig. 3 is a corresponding view of a third embodiment of the tool.

The tool illustrated in Fig. 1 comprises a housing 10 formed in two longitudinal halves, of which only one is visible in the drawing. The housing is essentially cylindrical in shape and tapers towards a flat end 11. Secured axially within the housing 10 is a rechargeable DC electric motor, which drives, via reduction gears, a cam member 13 mounted upon its output shaft 12.

The cam member 13 is of a stepped, generally cylindrical structure and the cam surface in this embodiment is a plane surface 14, inclined at a shallow angle (about 7 degrees) across the axis of rotation of the member 13. Thus, as the cam member rotates, the foremost point 15 on the cam surface follows a circular path around the axis of rotation.

Also retained within the housing 10 is a cam follower 32, which carries a single rotary bearing 33 and, by running upon the cam surface 14, converts the rotary motion of the cam member 13 into the desired linear motion of the cam follower. The cam follower 32 is mounted in a bearing 23 and is free to move axially by a short distance but cannot rotate.

An operating tool bit such as a chisel bit (not shown) is received in a socket 19 in the shaft 20 of the cam follower 32 and is retained in place by a collar 21 and screw 22. The tool bit therefore moves linearly with the cam follower. A compression spring 30 disposed between the end face 11 of the housing 10 and the collar 21 urges the cam follower 32 out of contact with the cam surface 14 until the spring pressure is overcome by pressure applied by the tool user when the tool engages a worrkpiece. The spring 30 is enclosed by a rubber sealing boot 31.

In use of the tool, the cam member 13 is rotated at a predetermined speed determined by the rate of rotation of the electric motor shaft 12. Provision may be made for varying that speed electrically, for example via a rheostat, to enable the rate of repetitive linear movement of the tool bit to be varied in turn.

Since the cam follower 32 and cam member 13 are maintained out of mutual contact until the tool is applied to a workpiece, the tool bit remains stationary, even when the motor is running, until the tool is required to be used. When the tool is withdrawn from the workpiece, the tool bit stops again. The nature of the movement of the tool bit is determined by the extent to which the bearing 33 and cam surface 14 are interengaged and may be varied progressively from a pulsed action to smooth reciprocation. The frequency of the action is determined by the motor speed.

The tool shown in Fig. 2 is similar to that of Fig. 1 except in two important respects. Fiurstly, the cam follower 40 carries two bearings 41 and 42, set at diagonally opposite points of the cam follower. The surface 43 of the cam member 44 has a peripheral profile which comprises two inclined cams in series. The bearings 41, 42 are thus at identical "levels" on the respective cams at any given moment and the resulting linear thrust is in balance across the diameter of the cam follower.

Secondly, the bearing 23 is extended somewhat what to provide a stop 45, which by abutting the collar 21 when the cam follower has moved about halfway into full engagement with the cam surface 43, prevents the cam follower from becoming fully engaged with that surface. In this way, while increasing pressure on the workpiece increases the extent of engagement, the action will remain a pulsed action and will not progress to the stage wherein a smooth reciprocating action of the tool bit is reached.

Referring now to Fig. 3 of the accompaying drawings, the third embodiment, shown therein, of the power tool according to the present invention corresponds in many ways to that shown in Fig. 2 but the mounting of the cam follower 40 and cam member 44 has been reversed. That is, the cam follower 40 is mounted on the motor drive shaft 12 for rotation therewith, while the cam member 44 is mounted on the shaft 20 for linear movement in the bearing 23. In other respects, the illustrated tool ressembles that of Fig. 2 and in use the method of operation and the operating benefits are the same.

As will readily be understood, the form of the power tool according to the present invention is such that the user is able to apply a well-controlled pulsed or smooth reciprocating action to a tool bit applied to a workpiece, such as has not been possible with prior comparable tools. The disadvantages and risks associated with manual hammering and with hammer-powered tools are greatly reduced or eliminated.

Claims

1. A powered tool comprising a housing (10), a cam member (13; 44) and a cam follower (32; 40) mounted within the housing along a common axis therein for relative movement into and out of mutual engagement, said cam member having a surface (14; 43) which, in a direction parallel to said common axis, varies in height around the perimeter of that surface, drive means (12) to rotate one of said cam member and said cam follower about said common axis, the other of said cam member and cam follower being mounted for linear movement in the direction of said axis, and a tool operating head, mounted for linear movement with said linearly movable cam member or cam follower, characterised in that said cam member (13; 44) comprises a rotary bearing (33; 41, 42) for engaging said cam member surface (14; 43) and characterised further by spring means (30) for resiliently urging said cam member and cam follower out of mutual engagement.

2. A tool according to claim 1, characterised in that the cam member (13; 44) is generally disc-shaped and the cam surface (14; 43) is one of the faces of the disc.

3. A tool according to either of the preceding claims, characterised in that the drive means is an electric motor powered by one or more batteries disposed within the housing.

4. A tool according to any of the preceding claims, characterised in that the cam surface comprises one or more flat surfaces inclined at an angle of less than 90 degrees to the common axis of the cam member and cam follower.

5. A tool according to claim 4, characterised in that said flat surface(s) is/are inclined to the perpendicular to the common axis by an angle within the range from 2. 5 to 15 degrees.

6. A tool according to any of the preceding claims, characterised in that the cam profile is repeated at least once around the cam surface.

7. A tool according to any of the preceding claims, characterised in that the cam follower (32; 40) contacts the cam surface (14; 43) at at least two points (41, 42) disposed symmtrically about the common axis of the cam member and cam follower.

8. A tool according to any of the preceding claims, characterised by a stop (45) within the housing to limit the extent of mutual engagement of the cam member and cam follower.

9. A tool according to any of the preceding claims, characterised in that the drive means (12) rotates the cam member (44) and the cam follower (40) is mounted for said linear axial movement.

10. A tool according to any of the preceding claims, characterised by a cluck or other form of socket (19) into which a tool operating head in the form of a tool bit is removably secured.

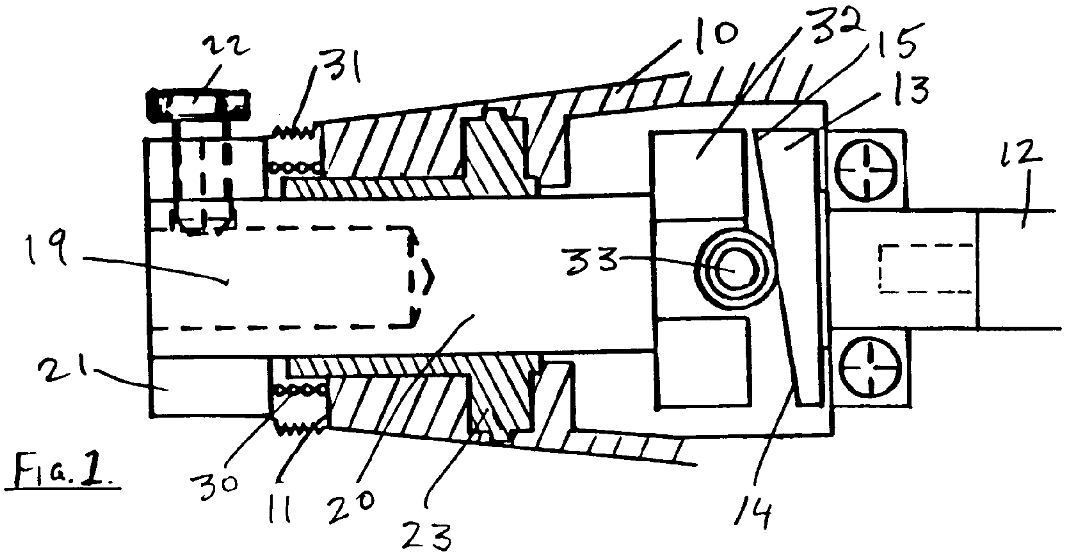

Fig. 1.

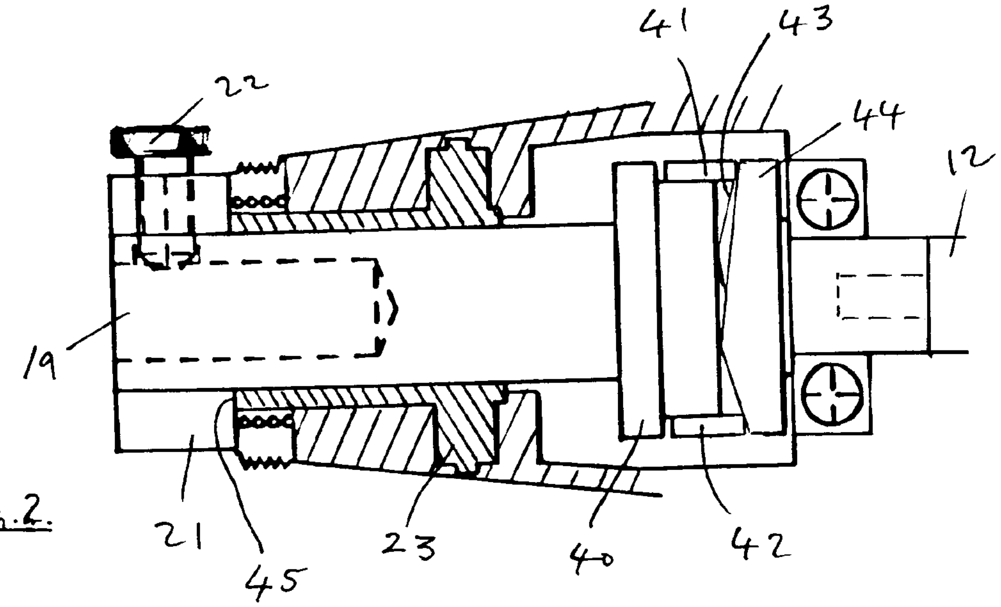

Fig. 2.

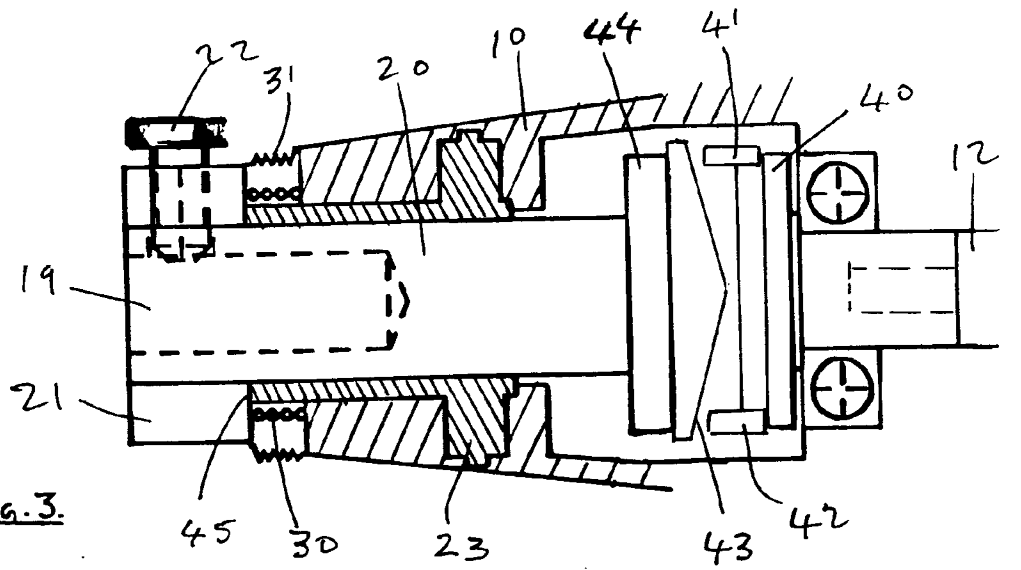

Fig. 3.