April 10, 1951 H. F. VACHÉ 2,548,411

MOTION CONVERTER

Filed May 22, 1948 3 Sheets-Sheet 1

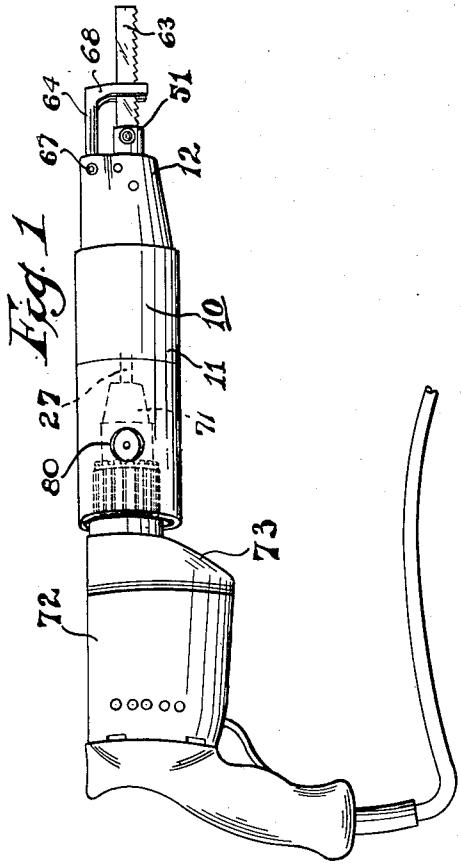

Fig. 1

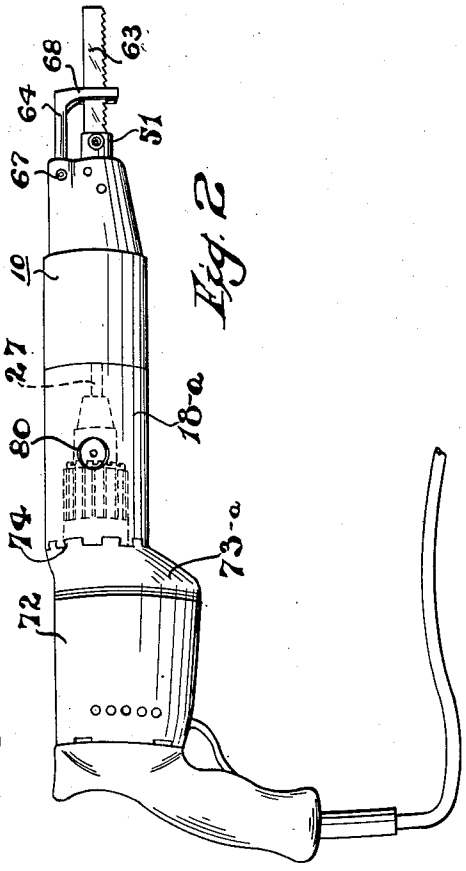

Fig. 2

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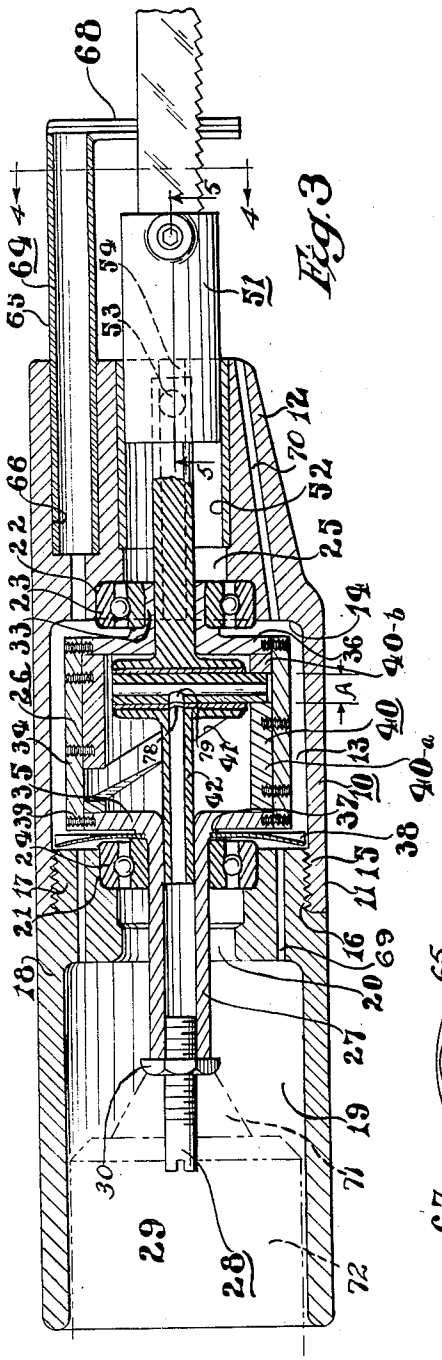

Fig. 3

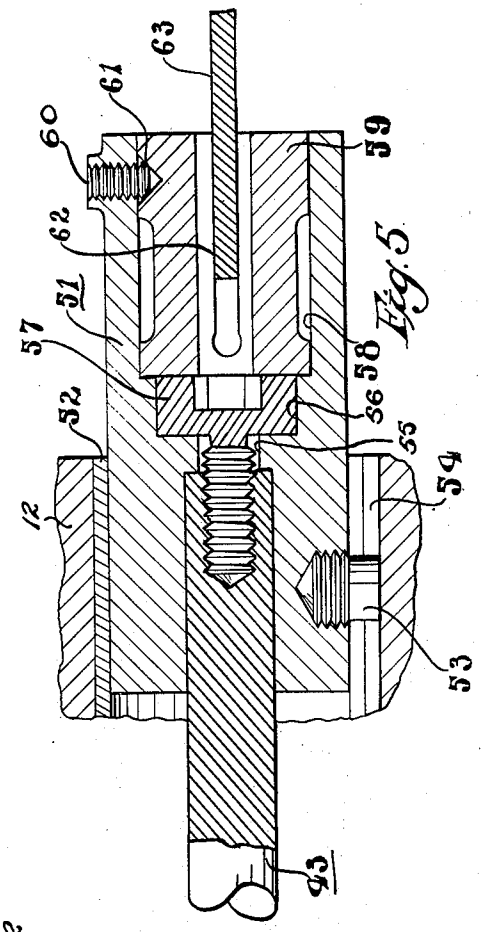

Fig. 5

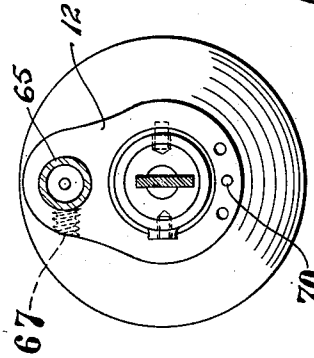

Fig. 4

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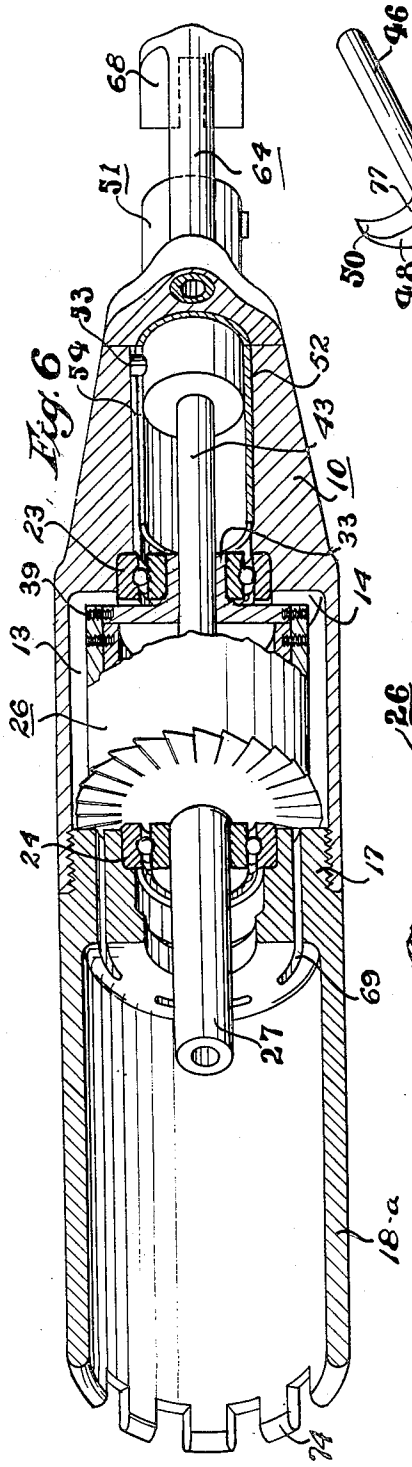

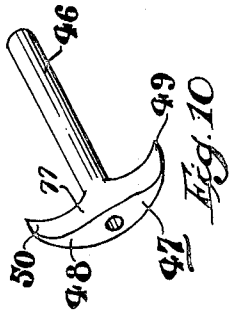

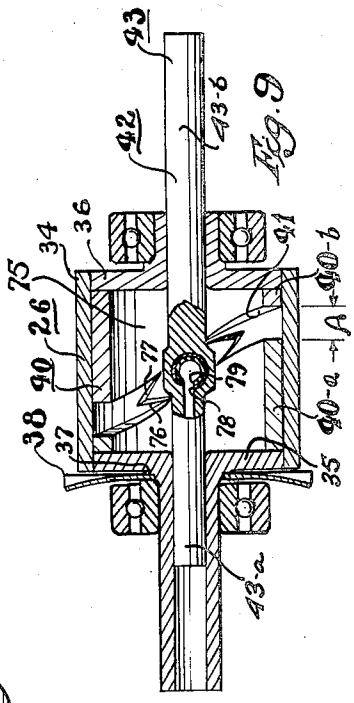

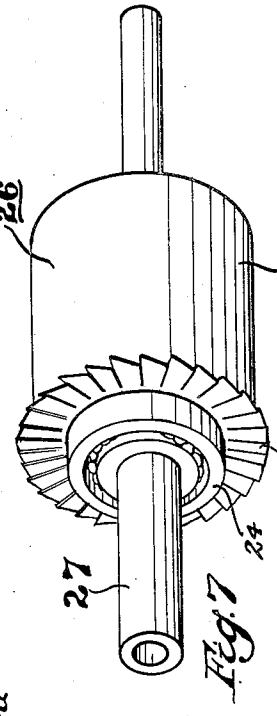

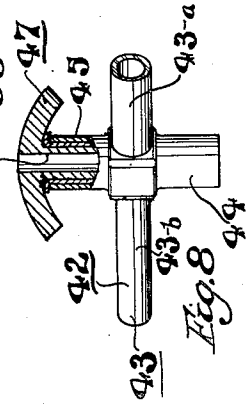

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MOTION CONVERTER

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Application May 22, 1948, Serial No. 28,569

4 Claims. (Cl. 74—57)

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The present invention relates to a certain new and useful instrument for converting rotary motion into reciprocating or oscillating motion.

An object of the present invention is to provide a small, portable and convenient instrument to be used with a source of rotary power, thereby to impart an oscillating motion to a tool-holder and tool supported in said holder with a minimum of effort by the user of the present invention.

Another object of the present invention is to provide an integral unit containing an electric motor, or similar rotary power unit, and a converter for changing the rotary motion to reciprocating motion.

In the past there have been shown various methods and means of converting circular or rotary motion so as to impart an oscillating or reciprocating motion to a driven instrument. However, these tools or machines have been, for the most part, cumbersome and heavy and complicated in their construction and operation. It is contemplated that this invention will provide a light-weight, inexpensive and easily-operated, easily transported instrument which will provide the user with a rapidly-oscillating power tool. Thus it is contemplated that the user of the present invention will have available a convenient small-size power-driven tool-holder to which he can attach a file, saw, rasp, sandpaper, emery cloth, buffer or similar tool which requires reciprocating motion for its use. This instrument will be superior in construction and ease of operation to any previously-disclosed method of converting rotary motion to reciprocating motion.

The present invention contemplates a tool which has a wide range of uses and can be used for burring, chamfering, slotting, cutting, filing, polishing, honing and sawing wood, metal, plastic, fiber, rubber and other materials.

It is contemplated that the present invention can be adapted either for use in conjunction with a remote, independent or separable source of rotary power or can be used in conjunction with a power-source supported within the housing of the present invention.

With the above and other objects in view, the present embodiment of my invention consists of a light-weight metal housing enclosing a rotatable cam-track, one end of which is adapted to be secured to the chuck or gripping surfaces of a rotating shaft or tool such as a hand-power drill, or upright bench-type power drill or to any other flexible or fixed rotating shaft or the like. A non-rotatable, axially-movable plunger

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is adapted to fit inside the rotatable cam-track member in such manner that the said plunger and cam-track follower attached thereto will oscillate axially within the housing member when the cam-track member revolves. A suitable tool-holder is operatively connected to the plunger so as to detachably engage a saw, file or other tool which requires oscillating motion for its use or operation. All the above arrangements are made in a compact convenient size, permitting manual operation of the tool by the user and furnishing a long-lasting, reliable, safe and effective mechanism for translating rotary motion into oscillating or reciprocating motion.

The above and other objects in view will appear more fully from the following description and drawings.

For the purpose of illustrating the invention, there are shown in the accompanying drawings forms thereof which are at present preferred, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

Referring to the accompanying drawings wherein like reference characters refer to like parts:

Figure 1 represents a perspctive view of one embodiment of the present invention.

Figure 2 represents a perspective view of a second embodiment of the present invention.

Figure 3 represents a vertical cross-sectional view of the embodiment shown in Figure 1.

Figure 4 represents a front elevational view, partly in cross-section, taken generally along lines 4—4 of Figure 3.

Figure 5 represents a horizontal cross-sectional view taken along lines 5—5 of Figure 3.

Figure 6 represents a perspective view of the embodiment shown in Figure 2, partly in section, and with parts broken away, better to reveal the construction thereof.

Figure 7 represents an external perspective view of the rotating cam-track element.

Figure 8 represents a perspective view, partly in section, showing the cam-track follower and associated parts.

Figure 9 represents a horizontal cross-sectional view of the rotating cam-track element, better to reveal the relation of cam-track to cam-track follower.

Figure 10 represents a perspective view of the cam-track follower-shoe or sled.

Referring now to the drawings, and particularly to Figures 1, 3 and 6, there is shown a housing consisting of body-member 10 which is generally cylindrical in cross-section at its rear end 11 and which tapers to a smaller, irregularly-shaped front end 12. An internal cavity 13 is formed within the body 10 extending from the rear end 11 to a shoulder or wall 14 approximately half-way from front to rear of the body 10. An internal thread 15 is formed at the rear end of the cavity 13 so as to engage an external thread 16 formed on a reduced diameter of the front end 17 of a cap-member 18. This cap-member 18 has the same external diameter as the body-member 10, and generally acts as a rearward extension of the body-member 10 when the said body-member and the said cap-member are fastened together by the internal and external screw threads 15 and 16, as shown particularly in Figures 3 and 6.

A cavity 19 is formed in the rear end of the cap-member 18, and a small diameter passageway 20 inter-connects the cavity 19 of the cap-member 18 and the cavity 13 of the body-member 10. A countersunk shoulder 21 in passageway 20, and a similar countersunk shoulder 22 in the front wall 14 of body-member 10 are adapted to receive front and rear ball-bearing members 23 and 24, respectively. A second opening or passageway 25 extends forwardly from the wall 14 to the extreme front of body-member 10. Thus is provided a housing unit consisting of body 10 and cap-member 18 having internal cavities and passageways adapted to receive rotating and oscillating members hereinafter to be described.

Journaled in the ball-bearing members 23 and 24 is a rotating cam-track housing 26 which has a rearwardly-extending tubular axle 27 and a forwardly-extending tubular axle 33. A coupling member 28, consisting of a threaded stud 29 and a lock-nut 30, serves to seal off the end of axle 27, and also provide a reduced-diameter extension thereof.

The looking nut 30 prevents rotation of the stud 29 with respect to the axle 27. This stud provides a suitable extension of the axle 27, of a reduced diameter, which is more readily engaged by a chuck (or other gripping surfaces) 71 of the rotary power source 72. However, it is obvious that the axle 27 (instead of stud 29) could be engaged by the chuck 71 if the jaws of the chuck opened sufficiently to permit the insertion of the axle 27 or, on the other hand, if the axle 27 was small enough to permit its ready insertion into the chuck 71. The axle 27 is journaled within the inner race of ball bearing member 24 while the axle 33 is adapted to fit within the inner race of ball bearing member 23.

From the above, it can be readily seen that when a rotating force is applied to a stud 29 or axle 27, the cam-track housing member 26 is free to rotate within cavity 13 upon the ball bearing members 23 and 24.

The cam-track housing 26, in the present form as shown particularly in Figure 7, consists of a cylindrical external shell 34, a rear end plate 35 and a front end plate 36. As is shown particularly in Figure 3, the end plate 35 may be formed integrally with the axle 27, or, if desired, the axle 27 and the end plate 35 may be separate pieces suitably fastened together so that the end plate 35 will revolve when the axle 27 is turned. A shoulder or step 37, of greater diameter than the axle 27, is formed at the junction between the axle 27 and the plate 35. This shoulder or step 37

serves as a stop-member against which a fan blade 38 may be seated. The fan is held securely in place against the step 37 by the inner race of the ball bearing member 24. Since the inner race of the ball bearing member 24 is press-fitted onto the shaft 27, the fan 38 is securely held in place against the step 37 and will be rotated along with the axle 27. The end plate 35 is securely held to the outer shell 34 of the cam-track housing 26 by a series of screws 39. In like manner, axle 33 is secured to front end-plate 36 and to the outer shell 34. In the preferred form, the axles 27 and 33 are integral with the end-plates 35 and 36 respectively.

Between the end plates 35 and 36, and within the shell 34, a double-faced cam-track is formed as follows. A hollow cylinder 40 (having an outside diameter equal to the inside diameter of the shell 34 and having a length somewhat less than the distance between the inside face of plate 35 and the inside face of plate 36, and having a radial thickness equal to the desired width of the cam-track) is cut into two pieces 40—*a* and 40—*b* in such a manner that the line of separation forms an endless, undulating curve around the periphery of the cylinder with an axial traverse somewhat less than the length of cylinder 40 and with one axial reversal point displaced 180° from the other axial reversal point so as to form a generally sinusoidal curve. When these two sections 40—*a* and 40—*b* are axially separated a distance A (equal to the desired height of the cam-track) the ends of the sections 40—*a* and 40—*b* abut, and are adjacent to, the end plates 35 and 36 respectively. In this manner a double-faced sinusoidal cam-track 41 is formed within the shell 34 of the cam-track housing 26 so as to provide a rotating track for a cam-follower hereinafter to be described.

Within the hollow axles 27 and 33 is journaled a slidable plunger 42 (shown in detail in Figure 8). The plunger consists of an axially-extending shaft 43 and a radially extending hollow crossbar 44.

A co-axial hole extends through one end 43—*a* of shaft 43 from the crossbar 44 to the rear extremity thereof, which distance is slightly less than half the length of shaft 43. The other end 43—*b* of shaft 43 is a solid shaft journaled within the axle 33. Within the hollow crossbar 44 is a bronze bearing sleeve 45 adapted to receive the shank or sleeve 46 of the cam follower sled 47 (shown in detail in Figure 10).

The cam sled 47 is generally T-shaped, with the head of the T forming a circular segment having the same curvature as the cam-track 41. The shank 46 and the head 48 are preferably formed from one piece of metal and the ends of the head 48 are tapered to points, as at 49 and 50 for a purpose hereinafter to be described.

Thus it can be seen that when the T-shaped sled 47 is journaled within the bronze bearing member 45 of the crossbar 44, an axially oscillating motion will be imparted to the shaft 43 when the cam-track housing member 26 is rotated and the shaft 43 is secured against rotation but permitted to move axially.

Therefore, it is obvious that a rotary motion imparted to shaft 27 will cause the shaft 43 to oscillate back and forth a distance equal to the axial traverse of the cam-track 41.

As is seen in Figures 3 and 5, the front end 43—*b* of shaft 43 is operatively connected to a sliding tool-holder 51. The holder 51 is cylindrical in shape and moves axially within a bear-

ing sleeve 52 securely fastened within the passageway 25 in the front end of the body member 10. The holder 51 is secured against rotary movement by a pin or key 53 (fastened to one side of the housing 51) which travels in a slot 54 formed in one side of passageway 25 and sleeve 52. Thus, as shaft 43 oscillates back and forth, it causes the holding member 51 to oscillate with the same amplitude, but both the shaft 43 and the holder 51 are restrained from rotary movement by the key 53 riding in the slot 54.

The cylindrical holder 51 has a passageway 55 and a countersunk hole 56 to receive a screw-thread member 57 which securely binds the shaft 43 to the holding member 51. The threads on the screw 57 are "right-hand" threads so that any torque applied to shaft 43 will tend to bind the shaft 43 and the holding member 51 more tightly together.

At the outer end of the holding member 51, a second larger countersunk recess 58 is formed to receive a spring-collet 59. A set-screw 60 is adapted to be turned into a V-slot 61 in the spring-collet 59 in such a manner that the shank 62 of a tool 63 will be firmly held within the collet 59. The set-screw 60 serves to retain the collet 59 in the recess 58, as well as to fasten the collet to the tool 63. In this manner, the reciprocating motion of shaft 43 and holder 51 is imparted to the tool held by the spring-collet 59.

A guide-member 64 has a shank 65 slidably mounted in a recess 66 which is parallel to the passageway 25. The shank 65 of the guide-member 64 is held in place within the recess 66 by a set-screw 67 in such a manner that the foot 68 of the guide-member 64 can be moved axially toward or away from the body member 10 to such a position as the user deems most desirable to properly guide the tool 63 when in operative position.

As previously stated, a fan 38 rotates with the cam-track housing 26, drawing air through a plurality of axial openings 69 in the body cap-member 18. This blast of air is forced through the cavity 13 in the body-member 10 and is blown toward the working edge of the tool 63 through a plurality of air ducts 70. These air ducts 70 are so positioned within the body 10 that the blast of air will cause the chips or filings removed by tool 63 to be blown away from the working surface, thereby keeping the surface free for inspection and efficient operation at all times.

As is shown particularly in Figure 2, I may alter the shape of the cap-member 18—*a* by extending the rear end thereof so that it engages the cover 73—*a* of the power drill or other prime mover 72. The front end of cover 73—*a* is adapted to receive the toothed projections 74 formed in the rear edge of the cap-member 18—*a*. The interlocking of the teeth 74 and the cover 73—*a* prevents the body-member 10 and the cap-member 18—*a* from rotating, and only a slight force is required to be exerted by the user to keep the teeth 74 interlocked with the cover 73—*a*.

With reference to the embodiment shown in Figure 1, the cap-member 18 and the body-member 10 are guided by one hand of the user while the grip of the drill 72 is held in the user's other hand. Thus the operator can use the embodiment shown in Figure 1 to cut irregular or curved lines simply by altering the angular relation of the body-member 10 with respect to the cover 73. The controlling force (which the user exerts to guide the path of the cutting blade in the embodiment shown in Figure 1) also prevents the body member 10 from rotating with respect to the chuck 71 of the drill 72.

In the embodiment shown in Figure 2, the cap-member 18—*a* and the body-member 10 are locked against rotation with respect to the cover 73—*a* of the drill 72. Therefore, although no effort need be exerted to prevent the rotation of the body-member 10 with respect to the drill 72, the entire drill and tool assembly must be turned or rotated whenever it is desired to cut a curved or irregular line with the cutting member.

In the embodiment shown in Figure 1 as well as the embodiment of Figure 2, the cap-members, 18 and 18—*a* respectively, are adapted to overlie the rapidly-rotating chuck 71 of the power-source 72. In this manner, a shield is provided which protects the user's hands from the rotating chuck and prevents his clothing from becoming ensnarled in the tool. An appropriately-placed hole 80 permits ready insertion of a key or tool necessary to lock the chuck 71 to the stud 29 or axle 27.

It is obvious that the cap-member 18—*a* and the cover 73 might be a single unit (or non-separably fastened together) so as to provide a unitary oscillating tool-holder which has a self-contained power source. Other methods of permanently attaching a motor or power source to the cap-member 18—*a* and the shaft 27 will be apparent to those skilled in the art.

Similarly, the embodiment shown in Figure 1 easily may be adapted for operation with a non-portable bench-supported power drill or the like. This type of drill, in its most common form, is supported with a rotating axis in a vertical direction and is usually permanently attached to a bench or some other support. With the embodiment shown in Figure 1 attached to the chuck of such a bench-supported drill, a vertically-oscillating tool-holder is provided. Since the embodiment shown in Figure 1 may be clamped against rotation by any suitable bracket fastened to the bench or to the drill-support, the vertically-oscillating tool need not be supported by the operator, and both the operator's hands will be free to handle the material being sawed or filed or otherwise treated by the vertically-oscillating tool.

The operation of the present invention is as follows:

With the cam-track assembly journaled within the ball bearing members 23 and 24 in cavity 13 and body-member 10, and with the cap-member 18 firmly attached to said body-member, the stud 29 on shaft 27 is inserted into the open jaws of the chuck 71 of the power-source 72. Then the jaws of the chuck 71 are securely clamped against rotation of the stud 29 in a manner well known to those skilled in the art. A saw (or other tool), is inserted into the spring collet 59 of the sliding holder 51 and secured in place by proper adjustment of the set-screw 60. After this, the guide-member 64 is properly adjusted so that the tool 63 may be supported against the work in proper operating position, after which the set-screw 67 is secured against the shank 65 to hold the guide-member 64 against movement. With the body-member 10 securely held in one hand, the power-source 72 (securely held in the other hand) is set in motion and chuck 71 caused to rotate at high speed. This rotation is transmitted to the cam-track housing 26 and its associated elements, imparting a rapid oscillating motion to the shaft 43, the holder mem-

ber 51 and the tool 63. The fan 38 draws air into cavity 13 through the slots 69, and forces it out through air ducts 70, thereby blowing away all chips or filings from the cutting edge of the tool 63.

As previously described, the shaft 43 does not rotate (since the key 53 in slot 54 restrains any rotary motion) and, therefore, the sled 47 is forced to travel around the cam-track formed by the cam-track members 40—*a* and 40—*b*. The internal cavity 75 of the cam-track housing 26 is filled with oil or other lubricant so as to permit ease in passage of the sled 47 along the cam-track. As is best shown in Figure 9, the edges 49 and 50 of the head 48 of the sled 47 are tapered. Thus, when the cam-track 41 is rotated past the sled 47, the lubricant is trapped between the inclined surfaces 76 and 77 of the sled-follower 48, forcing lubricant between the surfaces of the sled-follower and the surfaces of the cam-track 41.

The faces 76 and 77 of sled 47 are opposed convex surfaces, each having a radius of curvature generally the same as the radius of curvature of the cam-track 41 at its points of reversal. Thus, the follower can absorb the shock imposed thereon when the plunger 43 reaches the end of its axial movement and reverses direction. The head of the follower tends to "plane" or sled around the reversal-curve on a film of lubricant forced between the track 41 and the faces 76 and 77.

In addition, the reciprocating action of shaft 43—*a* within the rotating axle 27 causes a pumping action and lubricant is circulated from the internal cavity 75 through the hollow shaft 46 and the hollow shaft 43—*a* thereby insuring that all moving parts are adequately lubricated at all times. Appropriately-placed openings 78 and 79 in sleeve 45 and shank 46 respectively, provide passages through which the lubricant can flow from shank 46 to shaft 43—*a*. Because of the high speed at which the cam-track housing rotates, the oil contained in the housing circulates rapidly and has a tendency to vaporize. This vaporization, plus the high-speed pumping action described above, forces oil between the shaft 43—*b* and the axle 33, depositing a film of oil on the bearing-sleeve 52 and the ball-bearing 23, whereby these elements are properly lubricated.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiments be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having described my invention, I claim as new and desire to protect by Letters Patent, the following:

1. A converter for changing rotary motion to reciprocating motion including a housing, a hollow cam-track member rotatably mounted within the housing and having at each opposite end a hollow axle journaled within the housing, a reciprocable plunger within said cam-track member and having at each opposite end a shaft section axially slideably mounted in one of said hollow axles, said cam-track member having an endless cam-groove in its inner face describing a path which travels axially from one axially extreme position to another and back again in a revolution of the member, a cam-follower journaled on said plunger, extending therefrom generally at a right angle to the axis of the plunger and slideable in said cam-groove for oscillation to and fro about its journal as it travels in said cam-grove, and a key operatively interposed between said plunger and said housing to prevent rotation of said plunger relatively to said housing.

2. A converter for changing rotary motion to reciprocating motion including a housing, a hollow cam-track member rotatably mounted within the housing and having at each opposite end a hollow axle journaled within the housing, a reciprocable plunger within said cam-track member and having at each opposite end a shaft section axially slideably mounted in one of said hollow axles, said cam track member having an endless cam-groove in its inner face describing a path which travels axially from one axially extreme position to another and back again in a revolution of the member, a cam-follower pivot member journaled on said plunger and slideable in said cam-groove for oscillation to and fro about its journal as it travels in said cam-groove, said cam-follower pivot member having oppositely curved convex cam-groove engaging faces which intersect each other near the opposite ends of said member, the radius of curvature of said faces being substantially the same as that of the cam-groove at the axially extreme ends thereof, and a key operatively interposed between said plunger and the housing to prevent rotation of the plunger relatively to the housing.

3. A converter for changing rotary motion to reciprocating motion including a housing, a hollow cam-track member rotatably mounted within the housing and having at each opposite end a hollow axle journaled within the housing, a reciprocable plunger within said cam-track member and having at each opposite end a shaft section axially slideably mounted in one of said hollow axles, said cam-track member having an endless cam-grove in its inner face describing a path which travels axially from one axially extreme position to another and back again in a revolution of the member, a hollow cross-bar journaled in the plunger, extending substantially radially therefrom and having at its outer end a cam-follower pivot member having a hollow bore communicating with the hollow of the cross-bar and positioned in said cam-groove for oscillation to and fro as the cam-track member rotates, and a key operatively interposed between the plunger and the housing to prevent rotation of the plunger relatively to the housing, said plunger having an internal passage communicating with the hollow of the cross-bar for conducting lubricant to the cam-follower pivot member and cam-groove.

4. A converter for changing rotary motion to reciprocating motion including a housing, a hollow cam-track member rotatably mounted within the housing and having at each opposite end a hollow axle journaled within the housing, a reciprocable plunger within said cam-track member and having at each opposite end a shaft section axially slideably mounted in one of said hollow axles, said cam-track member having an endless cam-groove in its inner face describing a path which travels axially from one axially extreme position to another and back again in a revolution of the member, a hollow cross-bar journaled in the plunger, extending substantially radially therefrom and having at its outer end a cam-follower pivot member having a hollow bore communicating with the hollow of the cross bar and positioned in said cam-grove for

oscillation to and fro as the cam-track member rotates, said cam-follower pivot member having oppositely curved convex cam-groove engaging faces which intersect each other near the opposite ends of said member, the radius of curvature of said faces being substantially the same as that of the cam-groove at the axially extreme ends thereof, and a key operatively interposed between the plunger and the housing to prevent rotation of the plunger relatively to the housing, said plunger having an internal passage communicating with the hollow of the cross-bar for conducting lubricant to the cam-follower pivot member and cam-groove.

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