This invention relates to vibrating drills and particularly to such a tool whose impact can be adjusted between wide limits.

The primary object of this invention is to provide an electric drill that is a combination continuous or impact drill.

Another object is to provide an electric or motor driven drill of the type stated that can be progressively adjusted to operate between stages of maximum impact and no impact at all.

Another object is to provide a device of the type stated whose impact force can be changed while the drill is in operation, if it is so desired.

A further object is to provide such a device whose impact force can be varied between zero and the maximum, by rotating its control member less than one-half a turn.

Another object is to provide a device that is rugged in structure, reliable in operation and relatively inexpensive to manufacture.

These and other objects of the invention will become apparent from a reading of the following specification and claims, together with the accompanying drawing, wherein:

- Figure 1 is a side elevation of the variable impact vibrating drill that is the subject of this invention;
- Figure 2 is a longitudinal sectional view of the same, showing the impact hammer at the end of its maximum stroke;
- Figure 3 is a front view of the device with the drill chuck removed;
- Figure 4 is a longitudinal sectional view showing the impact hammer positioned at its maximum position just prior to delivering its maximum impact stroke;
- Figure 5 is a longitudinal sectional view showing the impact hammer in its operative position, with the device acting as a continuous drill;
- Figure 6 is an exploded view of the device;
- Figure 7 is a perspective view of the spindle housing with its cap removed;
- Figure 8 is a perspective view of the hammer; and
- Figure 9 is a perspective view of the anvil with the cam pins removed.

Referring more particularly to the drawings, there is seen in Figure 1 the variable impact vibrating drill that is the subject of this invention, broadly indicated by reference numeral 10.

Conductive to a better understanding of the invention, it may be well to point out that the drilling of holes in stone, concrete, cinder-block and similar granular materials requires that the drill bit be given a hammering or impact action, as well as a rotary one.

Again, different materials and different size bits require various degrees of impact for the most efficient operation of the drill.

In the instant device the impact is created by moving a hammer element 40 sharply against an anvil member 35 mounted on a rotating spindle 20, at the end of which the drill bit holding chuck 50 is mounted. The manner of varying the force of the hammer blows between zero and the maximum and the mechanical structure employed to effect the desired result will be explained hereinafter.

Again referring to the drawings, reference numeral 11 indicates the case of portable electric motor of the type capable of being held in the hands in the manner of a conventional electric drill and has the usual hard grip 52, as seen in Figure 3, and motor shaft 12 extending beyond the case, surrounded by a clamp element 16 having a draw bolt 51, as is most clearly seen in Figures 1, 2 and 3.

Reference numeral 13 indicates a spindle housing mounted on the motor case 11, at its base end 15 within the clamp 16, co-axially with the end of the motor shaft 12.

A spindle 20 is threadedly mounted at 21 on the end of the motor shaft 12, forming a continuation thereof, extending through the housing 13.

A disc-shaped anvil 35 having a threaded bore 36 is rigidly mounted on the spindle 20 at threaded section 22. The anvil has four equi-spaced bores 37 there-through, extending parallel to the spindle 20, as is most clearly seen in Figure 9. Four plungers 31, 32, 33 and 34 are slidable mounted in the anvil holes 37.

Each plunger has a flat base end and a semi-spherical head end. The over-all length of each plunger is such that when its flat end is flush with the anvil face 38, its semi-spherical end will protrude beyond the anvil impact face 39 to the extent that its equator will lie in the plane of anvil impact face 39, as seen most clearly in Figure 2.

Reference numeral 40 indicates a cylindrical hammer having a central bore 41 through which the unthreaded portion 24 of the spindle 20 passes. The hammer 40 is free to slide lengthwise of the spindle 20.

Referring to Figure 9, it is seen that hammer 40 has four inclined cam surfaces 42 terminating in 4 flat striking surfaces 43. A longitudinal slot 45 is cut in the edge of the hammer 40. This slot 45 is engaged by a pin or ball 27 mounted on the inner face of the spindle housing 13. When the hammer is so engaged it is free to move lengthwise of the spindle, but is locked against rotation.

Reference numeral 46 indicates a coil spring that is mounted over the spindle section 24, as seen in Figures 2, 4 and 5. The spring is positioned between the collar 25 at the base of the spindle 20 and the hammer 40. Two washers 47 and 49, separated by a ball bearing ring 48 provides a frictionless bearing surface for one end of the spring 46. The outer end of the spring is seated in a socket 44 in the hammer 40. The spring 46 acts to constantly bias the hammer 40 against the anvil impact face 39.

Reference numeral 17 indicates a closure cap that telescopically fits over the spindle housing 13. The cap 17 has an end wall 28 with a central bore 26 through which the threaded end 23 of the spindle extends. The cap 17 is locked to the spindle housing 13 through a peg or ball 18 which engages a spiral groove 14 cut in the outer wall of the spindle housing 13. A beading ring 26 and a pressure washer 30 are mounted on the spindle 20 between the end wall 28 of the cap and the face 38 of the anvil 35.

An impact adjusting handle 19 is threadedly mounted through the cap 17. The end of the handle may be screwed into engagement with the spindle housing 13 to lock the cap in place. By loosening the handle and turning it to rotate the cap 17 on the housing groove 14 the cap end wall 28 can be made to move toward the end face 38 of the anvil as seen in Figures 2 and 4, or away from the end face 38 as seen in Figure 5.

A conventional chuck 50 for holding a drill bit or other tool, is mounted on the end 23 of the spindle 20, as is most clearly seen in Figures 1 and 2.

In the operation of the drill as an impact drill having
the maximum impact of which the device is capable the cap 17 is turned by means of the handle 19 to the position illustrated in Figures 2 and 4. By referring to said Figure 2 will be noted that the pressure washer 30 is pressed tightly against the face 38 of the anvil, thereby causing the plungers 32 and 33 (and plungers 31 and 34, not visible) to take a position wherein their flat ends are flush with the anvil face 38 and their semi-spherical ends protrude beyond the anvil impact face 39 to the point wherein their equators lie in the plane of the impact face 39. When the drill motor is started, the spindle 20 and attached anvil 35 will rotate relative to the hammer 40 which is held stationary by the spindle housing ball 27. This in turn causes the ball ends of the plungers 31, 32, 33 and 34 to travel past the cam faces 42 of the hammer 40. Since the hammer 40 is locked against rotation by the ball 27, engaged in its slot 45, but is free to travel longitudinally of the spindle surface 24, the moving plungers will ride up the inclined cam faces 42a thereby moving the hammer 40 away from the anvil 35 against the biasing action of the spring 46. When the plungers have travelled to the top edge of the inclined cam surfaces 42, as seen in Figure 4, the hammer 40 is under maximum pressure from the spring 46 As the plungers move past the drop off points 43 of the inclined cam surfaces 42, the hammer 40 is snapped back in contact with the anvil impact face 39 by the expansion of the spring 46 to the position illustrated in Figure 2, causing the hammer surfaces 43 to strike the anvil a sharp blow. As the spindle 20 continues to rotate the plungers 31, 32, 33 and 34 repeatedly ride across the cam surfaces 42, and then drop off to permit the hammer to return to its normal position against the anvil impact face 39, thus creating a uniform hammering action.

It will be evident that the travel distance of the hammer 40 and the resultant compression of the spring 46 can be varied between zero and the maximum by backing the cap 17 off the housing 13 so that its end wall 28 will move away from the anvil face 38, thereby permitting the pressure washer 30 to similarly move to create a space into which the plungers may move beyond the face 36 of the anvil. This in turn reduces the degree of protrusion of the ball end of the plunger beyond the anvil impact face 39. As a result the hammer is pushed away a shorter distance, thereby reducing the force of its return impact proportionately. Thus the force of the impact can be quickly, easily, and accurately adjusted by rotating the cap 17 a definite amount, usually less than a quarter turn.

If the cap 17 is backed off to the point illustrated in Figure 5, no vibration or impact will take place and the drill will act as an ordinary continuous drill, since the ball ends of the plungers now lie flush with the anvil surface 39, and the two impact faces 39 and 43 will ride smoothly against each other. It is further evident that the degree of impact can be continuously varied from zero to the maximum, even while the drill is in operation. Since the device can be made to operate as an ordinary continuous drill, it can be so used, when an impact drill is not needed. Thus a second special drill need not be purchased to provide these alternate types of drilling action.

It will now be clear that there has been provided a device which accomplishes the objectives heretofore set forth.

While the invention has been disclosed in its preferred form, it is to be understood that the specific embodiment thereof as described and illustrated herein is not to be considered in a limited sense, as there may be other forms or modifications of the invention which should also be construed to come within the scope of the appended claims.

1. A variable impact drill, comprising in combination, an electric motor, including a drive shaft; a housing having a plurality of spaced plungers slidably mounted therethrough and movable between a first position, in which they extend beyond the impact face of the anvil, and a second position, in which they lie flush with said face; a hammer member non-rotatably mounted on the spindle, within the housing, and slidably longitudinally thereof relatively to the anvil member; the hammer having a series of inter-connected inclined cam tracks arranged in circular configuration and engageable by the anvil plungers when they are in their first positions; spring means engaged with the hammer member to normally bias the hammer cam tracks against the impact face of the anvil, and, impact control means for progressively moving the anvil plungers between their first and second positions.

2. A variable impact drill, comprising in combination, an electric motor, including a drive shaft, mounted in a case having a hand grip; a spindle housing mounted on the case at the drive shaft; a spindled mounted on the end of the case, forming a continuation thereof, and extending through the housing; a closure cap threaded on the free end of the spindle; a cylindrical anvil member, including a flat impact face, mounted on the spindle within the housing and having a plurality of spaced plungers slidably mounted thereon and movable between a first position, in which they extend beyond the impact face of the anvil, and a second position, wherein they lie flush with said face; a hammer member non-rotatably mounted on the spindle, within the housing, and slidable longitudinally thereof relatively to the anvil member; the hammer having a series of inter-connected inclined cam tracks arranged in circular configuration and engageable by the anvil plungers when they are in their first positions; spring means engaged with the hammer member to normally bias the hammer cam tracks against the impact face of the anvil, and, impact control means for progressively moving the anvil plungers between their first and second positions.

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