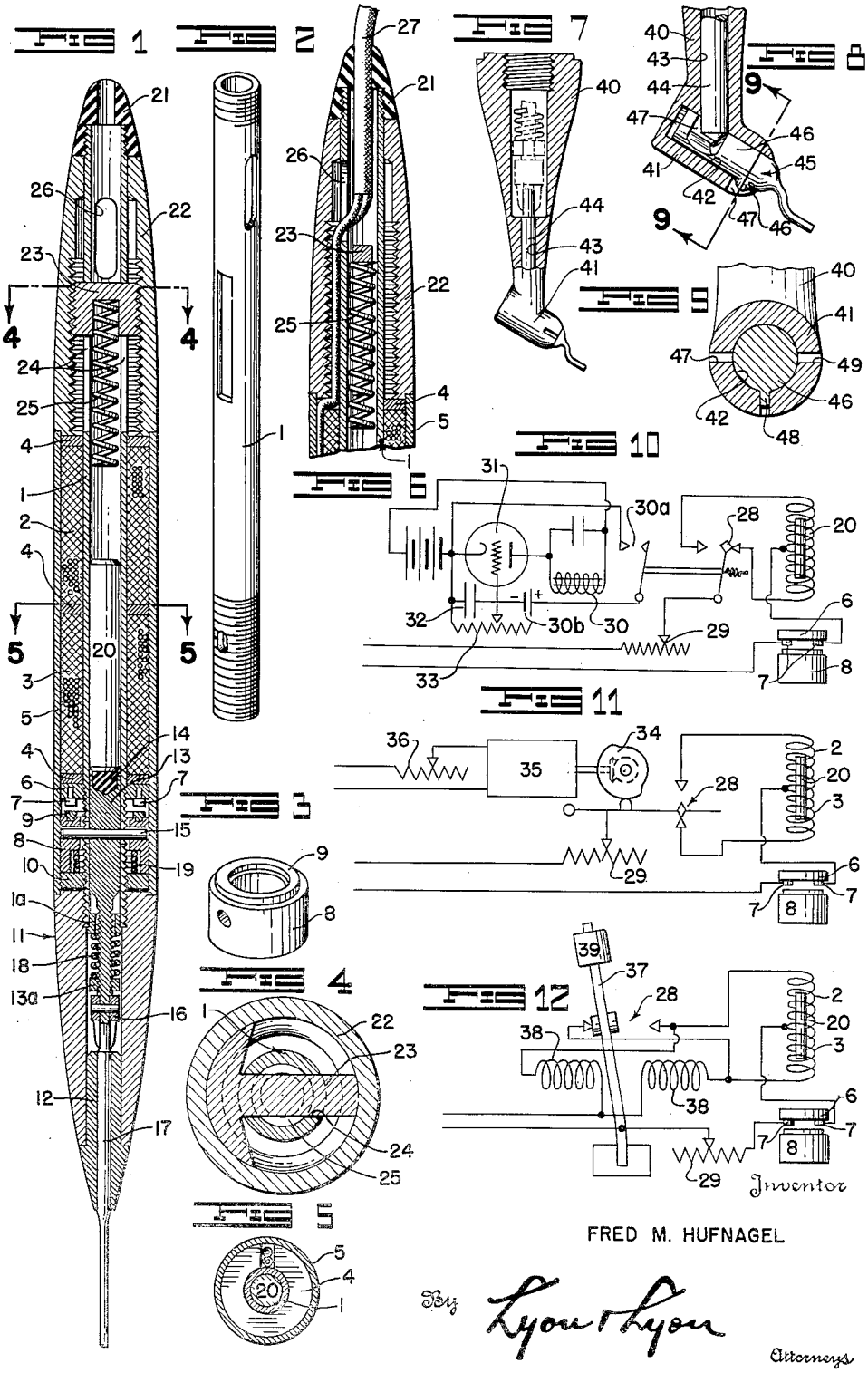
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DENTAL AND SURGICAL PERCUSSION TOOL

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## DENTAL AND SURGICAL PERCUSSION TOOL

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My invention relates to dental and surgical percussion tools, and included in the objects of my invention are:

First, to provide a tool of this character which is of pencil-form so as to be held between the fingers of a dentist or surgeon, and which is arranged to carry various tool tips; for example, compactors or dental foil condensers of appropriate shapes for the purpose of condensing gold or silver fillings into tooth cavities; or various chisels for the purpose of chipping bone or breaking teeth in the course of dental surgery, or in other branches of surgery in which the operation requires the careful and controlled chipping of bone structure.

Second, to provide a percussion tool for dentists and surgeons wherein the frequency or rate of impact and the magnitude of impact may be readily adjusted over a wide range and accurately controlled to meet all conditions of use.

Third, to provide an electrical percussion tool of this class which incorporates a novelly arranged switch operated by pressure applied to the tool tip as well as means for adjusting or predetermining the pressure required against the tool tip to close the switch so that the tool tip may be pressed against the surface to be acted upon with a predetermined force before the switch is closed and the tool is operated thus providing a percussion tool which is inactive or inert except when actually in position for use.

Fourth, to provide a dental or surgical percussion tool which incorporates a novelly arranged head whereby percussion tool tips may be disposed in predetermined angular relation to the axis of the tool, and readily interchanged as needed.

With the foregoing and other objects in view, reference is directed to the accompanying drawings in which:

Figure 1 is an enlarged longitudinal sectional view of my dental and surgical percussion tool.

Figure 2 is a perspective view of the cylinder or core of the tool.

Figure 3 is a perspective view of the movable switch element.

Figure 4 is a further enlarged transverse sectional view through 4—4 of Figure 1.

Figure 5 is a transverse sectional view through 5—5 of Figure 1.

Figure 6 is a fragmentary longitudinal sectional view showing the upper portion of the tool and taken at right angles to Figure 1.

Figure 7 is a partial sectional, partial elevational view of a tool head designed for operation

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at an angle to the axis of the handle of the tool.

Figure 8 is an enlarged sectional view of the operating end of the head structure shown in Figure 7.

Figure 9 is a further enlarged transverse sectional view through 9—9 of Figure 8.

Figures 10, 11 and 12 are wiring diagrams illustrating different means for controlling the operation of the percussion tool.

My dental and surgical percussion tool includes a cylinder or tube 1 of non-magnetic material around which is mounted a pair of solenoid coils 2 and 3. Between and at the ends of the coils are spacer rings 4 of magnetic material. The coils are enclosed by a sleeve 5, also of magnetic material.

The lower end of the cylinder 1, as well as the sleeve 5, extend beyond the solenoid coils. The extended portion of the cylinder 1 is externally threaded and receives a fixed contact plate 6 which overlies the adjacent spacer ring 4. The contact plate carries one or more contacts 7 which are electrically connected to the solenoid coils in a manner to be described hereinafter.

Slidably mounted within the extended lower end of the sleeve 5 and surrounding the cylinder 1 is a switch collar 8 which carries a contact ring 9. The switch collar is limited in downward or outward movement by means of a spacer nut 10, threaded onto the cylinder 1.

The threaded lower end of the cylinder 1 protrudes beyond the sleeve 5 and receives an adaptor head piece 11. The head piece 11 is tapered and may be knurled or otherwise arranged to form a finger grip. The head piece 11 is provided with a central bore which continues axially from the cylinder 1 and which receives at its extended end a bearing tip 12.

Slidably fitted within the cylinder 1 is an anvil 13 having a cushion 14 at its upper end. The anvil 13 is provided with a cross pin 15 which extends diametrically through suitable clearance slots provided in the walls of the cylinder 1. The extremities of the cross pin 15 extend into diametrically disposed holes provided in the switch collar 8. The extended or lower end of the anvil 13 is reduced in diameter and receives a small chuck 16 in the form of a collar or sleeve having an axially split lower end. Any one of a selected series of tool elements 17 is adapted to be inserted through the bearing tip 12 and frictionally engaged by the chuck 16.

The lower extremity of the cylinder 1 is provided with a fixed collar 1a and the reduced

portion of the anvil 13 is threaded to receive an adjustable collar 13a. A spring 18 is interposed between the collars 1a and 13a. Another spring 19 is interposed between the switch collar 8 and the spacer nut 10. Operation of the switch collar and the function of the springs 18 and 19 will be described hereinafter.

The cylinder 1 receives above the anvil 13, a hammer or armature 20 of magnetic material which is caused to reciprocate by alternate energizing of the solenoid coils 2 and 3.

The upper end of the cylinder 1 extends above the solenoid coils and is provided with a cap nut 21. Between the cap nut and upper end of the sleeve 5 is rotatably mounted an elongated collar 22, the lower portion of which is internally threaded. The threads of the collar 22 engage a traveler nut 23 of T shaped cross section the stem of which extends through slots 24 provided in the cylinder 1. Attached to the traveler nut 23 is a cushion spring 25. The traveler nut and its cushion spring form an adjustable and yieldable stop limiting upward movement of the hammer-armature 20.

Above the upper limit of adjustment of the traveler nut 23, the cylinder 1 is provided with a side slot 26. Lead wires, preferably three in number, forming a cable 27 pass downwardly through the cap nut 21 into the cylinder 1, laterally through the slot 26, downwardly through the cut-out portions of the traveler nut 23 to the solenoid coils 2 and 3 and to the contacts 7. As shown in the diagrammatical views, Figures 10, 11 and 12, one lead is common to the two solenoid coils and is in series with the contacts 7. The other leads are connected individually to the solenoid coils and to an alternator switch 28 in the form of a single-pole double-throw switch. Alternating current or direct current is supplied to the common contact of the switch 28 and the common lead of the coils 2 and 3. Interposed in the circuit which energizes the solenoid coils is a voltage regulator 29 for the purpose of adjusting the impulse produced by the solenoid coils on the hammer-armature 20.

The alternator switch 28 may be operated by various means, for example, as shown in Figure 10, the common or moving contact of the alternator switch 28 is actuated in one direction by a magnetic relay coil 30 and in the other direction by a spring. The relay coil 30 is alternately energized and de-energized by a grid controlled electron discharge device 31. The coil is connected serially with the anode and cathode of the device 31 and a space current source which may be either A. C. or D. C. The control grid of the device is connected to the cathode through parallel circuits containing a condenser 32 and a resistance 33 either or both of which may be adjustable. In addition, the control grid and cathode are connected through a normally open auxiliary switch 30a mechanically connected with the alternator switch 28 and a D. C. source 30b, its positive terminal being connected with the cathode and its negative terminal being connected with the control grid whereby closure of the normally open auxiliary switch 30a occasioned by energizing the relay coil 30, renders the control grid sufficiently negative to decrease the flow of space current through the relay coil 30, to the extent that the switch 30a is opened. Thereafter, switch 30a remains open until a substantial amount of stored energy in condenser 32 is dissipated at the variable rate determined by the adjustment of the resistance, after which the relay coil is sufficiently energized to close switch 30a to complete a cycle of operation. A wide range of adjustment of the frequency of operation of the hammer-armature is obtained by this arrangement.

An alternative control for the alternator switch is shown in Figure 11. This includes a cam 34 driven by a variable speed motor 35, the speed of which is determined by a variable resistance 36. The cam 34 engages a lever carrying the common contact of the alternator switch and is so shaped as to close the circuit first to one, then the other of the solenoid coils 2 and 3.

A further modified control is shown in Figure 12 wherein the common contact of the alternator switch is mounted on a vibrating reed 37. Movement of the reed is maintained by opposed oscillating coils 38 which may be connected in parallel with the coils 2 and 3. The period of vibration of the reed 37 is determined by a weight 39.

Operation of my dental and surgical percussion tool is as follows:

Prior to use of the tool, the alternator switch 28 is set into operation at the desired frequency and the voltage regulator 29 for the solenoid coils 2 and 3 is adjusted to impart the desired energy to the hammer-armature 20. Alternatively, the collar 22 may be rotated to adjust the position of the cushion spring 25 thereby to limit the length of travel of the hammer-armature 20. The switch comprising the contacts 7 and contact ring 9 must first be closed before the hammer-armature 20 is reciprocated.

This control switch is closed by applying pressure to the end of the tool element 17. The amount of pressure required is determined by the resultant force exerted by the two springs 18 and 19. The spring 18 is stronger than the spring 19 and its force is exerted in opposition to end pressure on the tool element 17. Upon closing the contacts 7, the solenoid coils 2 and 3 are alternately energized, causing the hammer-armature 20 to reciprocate and rapidly strike the anvil 13. The impact of the hammer is transferred by the anvil to the tool element 17.

The actual movement of the anvil 13 is quite slight; that is, less than the clearance between the extremities of the cross pin 15 and the holes in the walls of the contact ring 9 and thus form a lost motion device. Furthermore, the extremities of the pins bear, if at all, upwardly against the contact ring or movable element of the switch as long as the required pressure is maintained on the tool element 17. Consequently, the spring 19 maintains the contact ring 9 across the contacts 7 even throughout movement of the anvil.

It should be pointed out that it is highly desirable in the operation of the percussion tool that pressure must be maintained by the tool element 17 on the surface which is to receive the impacts, to transmit effectively the percussion blow of the hammer and to render certain that the blows are delivered to precisely the right spot.

Other advantages are gained, for example, the tool element may be one of the several types and shapes of "condensers" used to condense or pack filling such as gold leaf filling or silver alloy into a cavity. It is customary for a dentist to transport increments of the filling from his supply to the cavity by means of the extremity of the tool element itself. This would not be possible if the tool element continuously vibrated. Instead, the tool is automatically brought into operation when the tool element is pressed against

the filling material and automatically ceases operation when pressure is relieved.

It should be further observed that my percussion tool is not limited to such use, but that other tool elements such as chisels or other tooth or bone chipping tools may be employed. For example, by the use of appropriate chisel elements a tooth may be split or the bone chipped to facilitate removal of a tooth such as an impacted wisdom tooth. In such use, the voltage regulator 29 or the collar 22, or both, may be adjusted to increase the impact force delivered to the chisel element. In addition, the collar 13a may be adjusted to increase the force of the spring 18 thereby to increase the initial pressure required on the tool element before the contacts 7 are closed.

It should be noted that Figure 1 is an enlarged view and that the entire tool is no larger than necessary to fit comfortably in the dentist's or surgeon's hand and that only one hand is needed for manipulation of the tool even in difficult bone surgery cases. While reference has been made to surgery involving the jaw or mouth, my percussion tool also has application in other surgical operations such as nasal or sinus operations.

It is not necessary for operation of the tool that the tool element be in axial alignment with the anvil. In this connection, attention is directed to Figures 7, 8 and 9 wherein a modified head structure is shown so arranged that impact may be directed in angular relation to the anvil. This is accomplished by an adaptor 40 which is attached to the cylinder 1 in place of the head piece 11. The adaptor 40 terminates in a head 41 disposed at an appropriate angle. The head 41 is provided with a socket 42 which is intersected by a bore 43 extending axially through the adaptor 40. The bore 43 receives a pin 44, the inner end of which fits into the chuck 16. The extended end of the pin 44 is conical in form and projects into the socket 42.

The socket 42 receives a tool element 45 having a cylindrical shank 46. Formed in the cylindrical shank 46 is a lateral recess 47 which admits the extremity of the pin 44. The lateral recess 47 may be just sufficient to accommodate the pin 44 so that the pin not only retains the tool element in the socket 42 but also prevents rotation. Inasmuch as it is sometimes desirable to set the tool element 45 in different angular positions, the recess 47 may extend circumferentially to permit limited rotation of the tool element. In such case the tool element may be set into one of several positions by means of a key 48 extending from the shank 46 and adapted to fit into one of several slots 49 cut into the extremity of the head 41. The engaging faces of the pin 44 and surfaces 47 are such that inward pressure on the extremity of the tool element 45 exerts an axial pressure on the pin 44 sufficient to close the contacts 7. Under such conditions, impact on the pin 44 is transmitted to the tool element 45.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

I claim:

1. A dental or surgical percussion tool comprising: a body; a hammer-armature mounted for reciprocation on said body; solenoid coil means for reciprocating said hammer-armature; an anvil and tool tip positioned for engagement by said hammer-armature and mounted for limited reciprocation on said body; a control switch for said solenoid coil means operated by movement of said tool tip relative to said body in response to pressure thereof against a surface; and yieldable means adapted to maintain said switch closed during repeated impacts of said hammer-armature and reciprocations of said anvil and tool.



2. A dental or surgical percussion tool comprising: a body; a hammer-armature mounted for reciprocation on said body; solenoid coil means for reciprocating said hammer-armature; an anvil and tool tip positioned for engagement by said hammer-armature and mounted for limited reciprocation on said body; a control switch for said solenoid coil means operated by movement of said tool tip relative to said body in response to pressure thereof against a surface; yieldable means between said switch and body adapted to maintain said switch closed during repeated impacts of said hammer-armature and reciprocations of said anvil and tool; means for regulating the frequency of reciprocation of said hammer-armature; and means for regulating the impact force thereof against said anvil.

3. A dental or surgical percussion tool comprising: a body; a hammer-armature mounted for reciprocation on said body; a pair of axially displaced solenoid coils on said body surrounding said hammer-armature; an anvil and tool tip positioned for engagement by said hammer-armature and mounted for limited reciprocation on said body; a switch for directing a supply of current alternately to said solenoid coils to cause reciprocation of said hammer-armature; means for controlling the frequency of operation of said switch; means for regulating the kinetic energy imparted to said hammer-armature thereby to regulate the impact force delivered to said tool tip; a control switch for said solenoid coils operated by movement of said tool tip relative to said body in response to pressure thereof against a surface; and means to maintain said control switch closed during repeated impacts on said tool tip and reciprocations of said anvil and tool.

4. A dental or surgical percussion tool, as set forth in claim 3 wherein: said frequency controlling means involves an electro-magnetic means for actuating said switch; an electron discharge device; and adjustable means for causing said device to pass current periodically thereby to energize said electro-magnetic means.

5. A dental or surgical percussion tool, as set forth in claim 3 wherein: said frequency controlling means involves a cam means for controlling said switch; and a variable speed motor for driving said cam.

6. A dental or surgical percussion tool, as set forth in claim 3 wherein: said frequency controlling means involves a vibrating member for actuating said switch; electro-magnetic means connected with said switch to vibrate said member, and means for adjusting the frequency of vibration of said member.

7. A dental or surgical percussion tool comprising: a tube; a hammer-armature reciprocable in said tube; a solenoid coil surrounding said tube; an anvil mounted for limited movement in one end of said tube; a rotatable internally threaded member surrounding the other end of said tube; a traveler nut slidable axially in said tube and engageable with said rotatable member, said nut forming an adjustable stop for said hammer-armature; and a yieldable means interposed between said hammer-armature and said traveler nut.

8. A percussion tool for dentists and surgeons, involving: a support; an electromagnetic ham-

mer on said support; an anvil on said support and adapted to be engaged by said hammer; and a tool head including a housing defining an axial bore in alignment with said anvil, and an angularly related bore; a percussion pin in said axial bore operatively associated with said anvil; a tool tip having a shank reciprocable in said angular bore, said shank having a lateral recess for receiving an end of said pin; and mating impact surfaces in said recess and at the end of said pin for transmitting the impact of said anvil to said tool tip.

9. A dental or surgical percussion tool comprising: a body; a hammer-armature mounted for reciprocation on said body; a pair of axially displaced solenoid coils adapted for alternate operation thereby to reciprocate said hammer-armature; an anvil and tool tip mounted for limited reciprocation on said body and positioned for engagement by said hammer-armature; a switch for controlling said solenoid coils operatively connected with said anvil by a lost-motion means; yieldable means urging said anvil in a direction to hold said switch open, said yieldable means being responsive to a predetermined pressure against said tool tip to close said switch; and means for maintaining said switch closed irrespective of movement of said anvil in response to impact of said hammer-armature.

10. A dental or surgical percussion tool comprising: a support; a hammer-armature reciprocable on said support; solenoid coil means for reciprocating said hammer-armature; an anvil and tool tip mounted for movement on said support and positioned for engagement by said hammer-armature; a control switch for said solenoid coil means responsive to movement of said tool tip relative to said support when pressed against a surface to receive an impact; and means for varying the tool tip pressure required to actuate said switch.

11. A dental or surgical percussion tool comprising: a support; a hammer-armature reciprocable on said support; a pair of axially displaced solenoid coils alternately operable thereby to reciprocate said hammer-armature; an anvil and tool tip moveably positioned on said support for engagement by said hammer-armature; a switch for directing a supply of current alternately to said solenoid coils; means for controlling the frequency of operation of said switch; means for regulating the kinetic energy imparted to said hammer-armature thereby to regulate the impact force delivered to said tool tip; a control switch for said solenoid coil means responsive to movement of said tool tip relative to said support when pressed against a surface to receive an impact; and means for varying the tool tip pressure required to actuate said switch.

12. A dental or surgical percussion tool, comprising: a support including a tube; a pair of tandem disposed solenoid coils surrounding said tube; means for alternatingly energizing said solenoid coils; a freely floating hammer-armature reciprocable in said tube upon alternate operation of said coils; a movable tool assembly on said support and having an anvil and extending into one end of said tube for impact engagement by said hammer-armature; a bumper spring mounted in said tube at the end opposite from said anvil; and means for adjusting the position of said spring to yieldably limit the stroke of said hammer-armature.

13. A dental or surgical percussion tool, comprising: a tube; a pair of tandem disposed solenoid coils surrounding said tube; means for alternatingly energizing said solenoid coils; a freely floating hammer-armature reciprocable in said tube upon alternate operation of said coils; a tool assembly having an anvil end positioned for impact engagement by said hammer-armature; a first spring tending to extend said assembly and adapted to be opposed by external pressure exerted against the extended end of said assembly; a switch unit for said solenoid coils normally held open by said first spring, said switch being in position to be engaged by said assembly and closed by movement of said assembly in response to pressure at its extended end; and a second spring subservient to said first spring tending to maintain said switch closed during repeated impacts of said anvil against said assembly and the resulting movement thereof.

14. A dental or surgical percussion tool comprising: a body structure; electromagnetic means in said body structure and including a reciprocable hammer-armature, and a control switch having a movable element; a tool assembly carried by said body structure and including an anvil at its inner end engageable by said hammer-armature, a tool tip at its outer end, a lost-motion device connecting said assembly with the movable element of said switch, and a main spring urging said tool tip to an extended position and normally maintaining said switch in an open position, said main spring being responsive to predetermined pressure exerted against said tip to yield whereby said assembly may move to close said switch.

15. A dental or surgical percussion tool comprising: an anvil unit having an impact receiving end and a tool holder end; a switch element connected with said anvil unit by lost-motion means and movable thereby between an open and a closed position, said lost-motion means permitting a predetermined limited movement of said anvil unit while said switch remains in its closed position; yieldable means urging said anvil unit to a position in which said switch is open, an electromagnetic means in circuit with said switch and including a reciprocable hammer-armature positioned to engage said anvil means.

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