

[54] **HAND HELD, FINGER CONTROLLED SWITCH DEVICE**

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[52] U.S. Cl. .... **200/52 R, 200/157, 200/DIG. 2**

[51] Int. Cl. .... **H01h 3/02, H01h 13/08**

[58] Field of Search ..... **200/52 R, 157; 200/DIG. 2**

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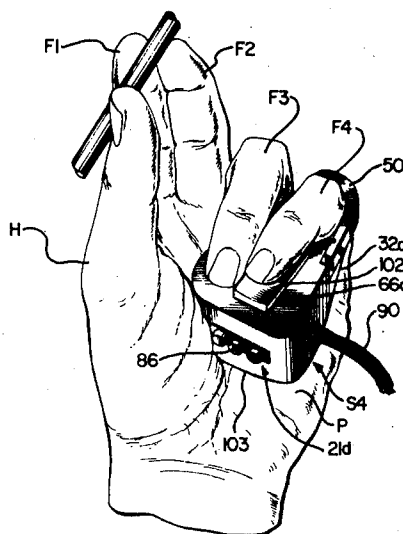
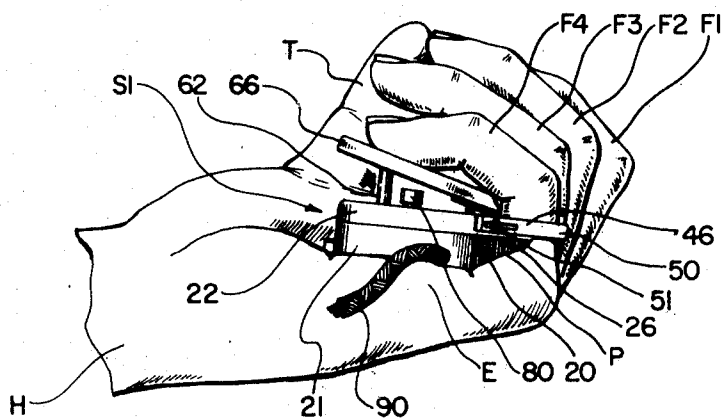
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[57] **ABSTRACT**

A control device for apparatus is adapted for support on the fourth finger of a hand, has a housing of contoured shape to fit in the palm of the hand. A loop extends outwardly of one end of the housing for receiving and encircling the base of the fourth finger. Switches on other control units in the housing have operating members extending upwardly of the housing for operation by third and fourth fingers. Operating levers may be pivotally mounted over the operating members. Other clips on one of the levers and a lateral extension of the loop can provide additional stabilization from rotational movement of the control device on the fourth finger. Other operating members can extend laterally outward of the housing. The control device may contain units for actuating electrical, pneumatic or hydraulic apparatus and combinations of the aforementioned types of apparatus.

**20 Claims, 26 Drawing Figures**



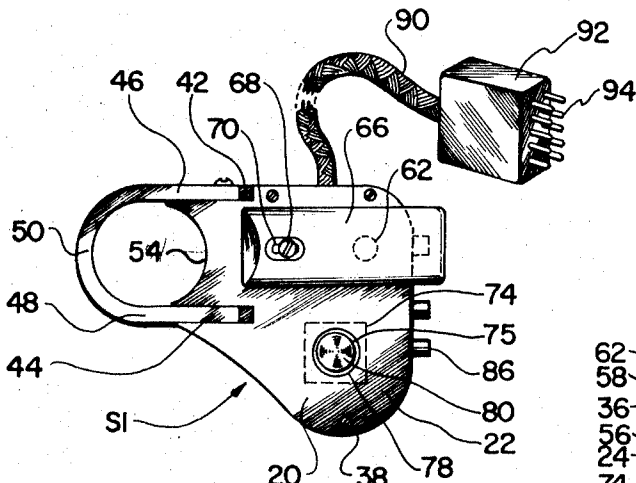


FIG. 1.

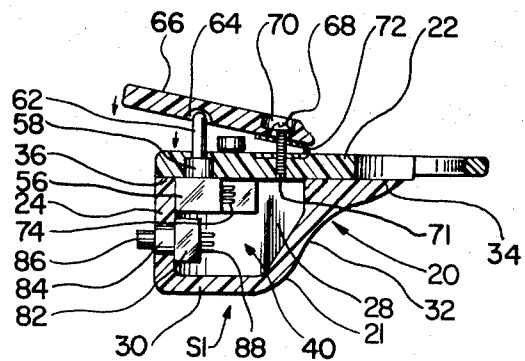


FIG. 5.

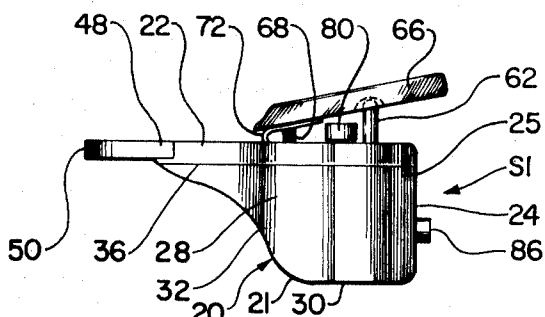


FIG. 2.

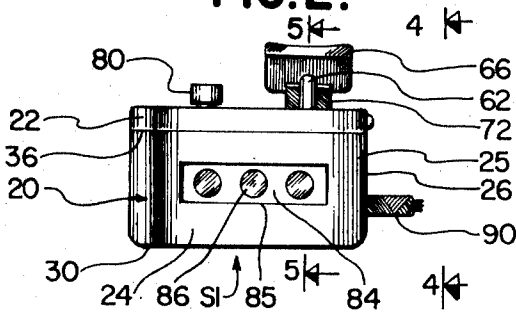


FIG. 3.

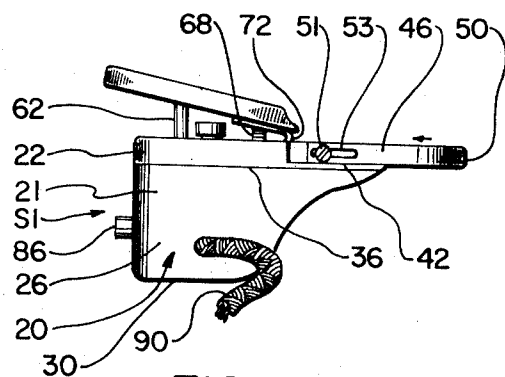


FIG. 4.

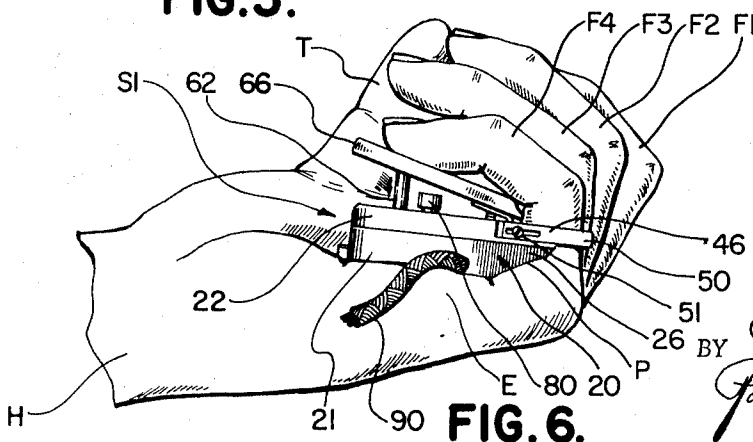


FIG. 6.

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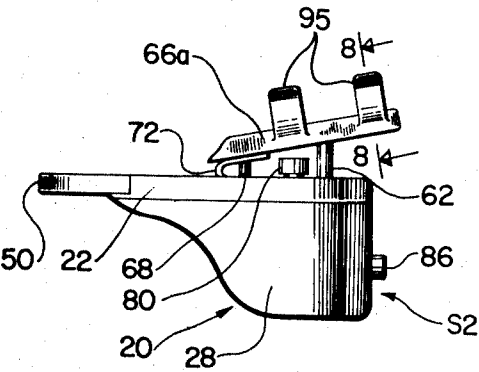


FIG. 7.

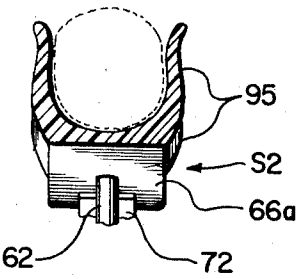


FIG. 8.

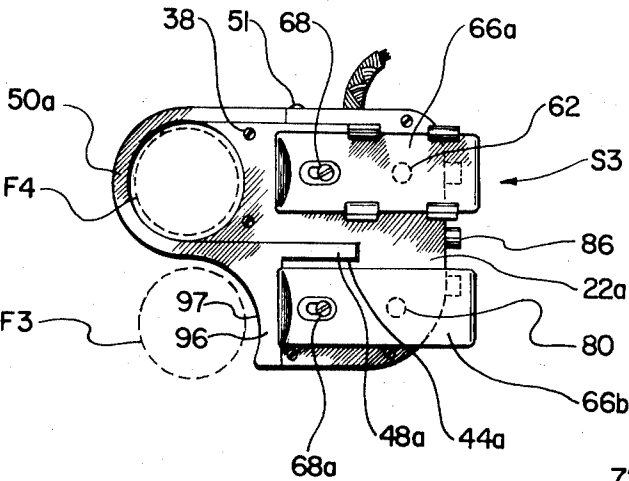


FIG. 9.

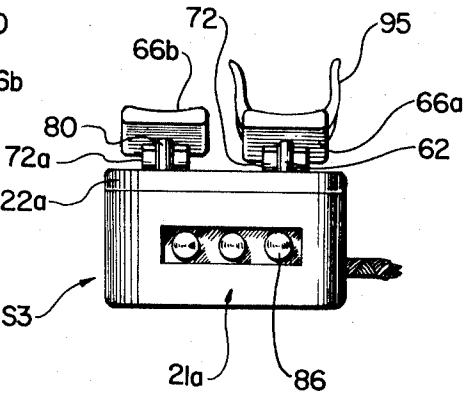


FIG. 10.

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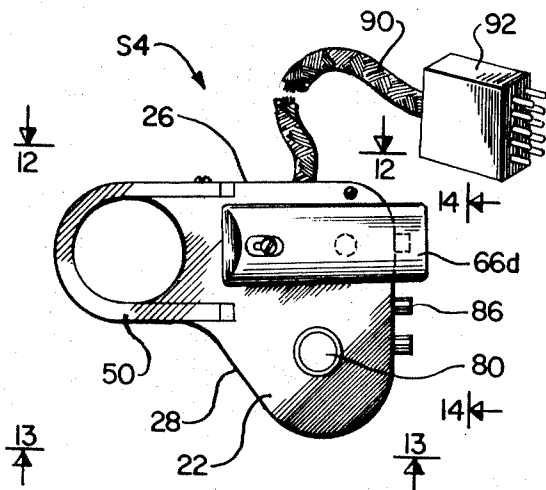


FIG. 11.

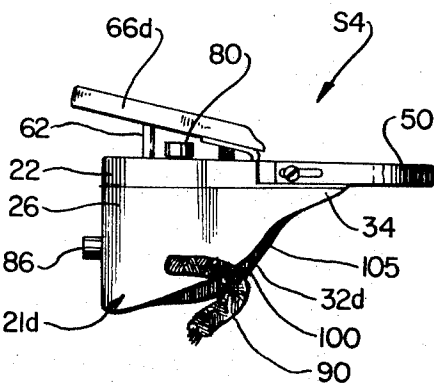


FIG. 12.

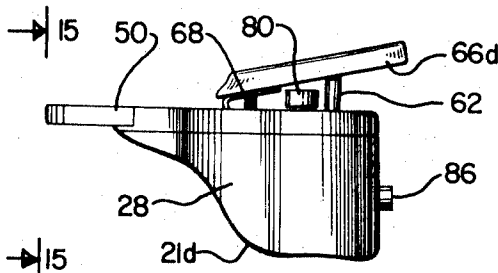


FIG. 13.

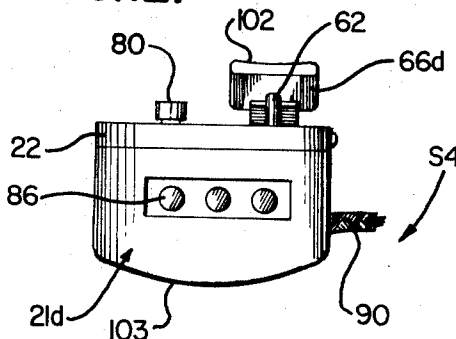


FIG. 14.

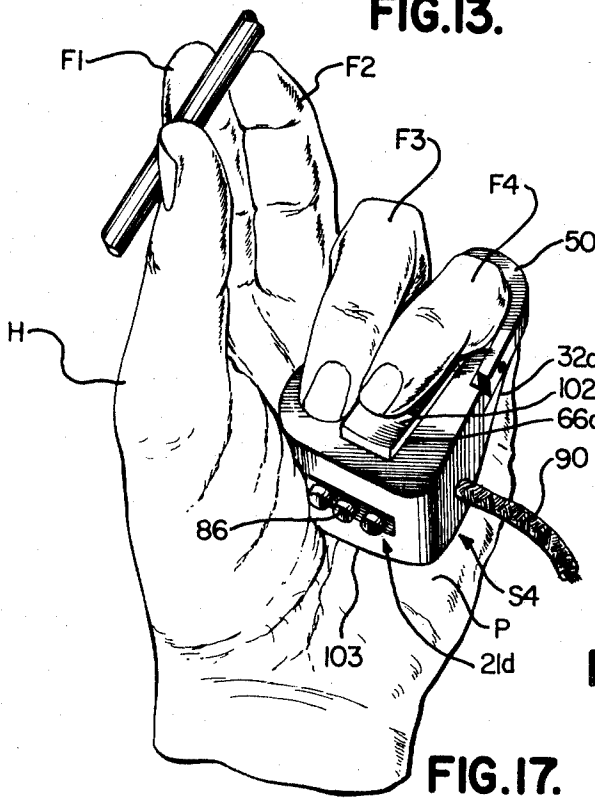
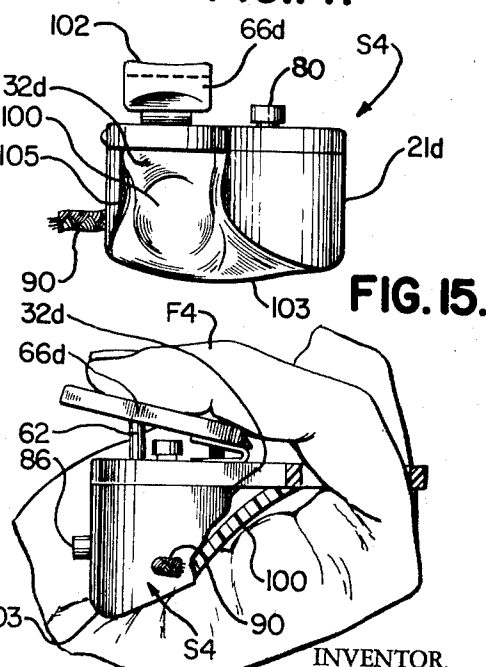


FIG. 15.



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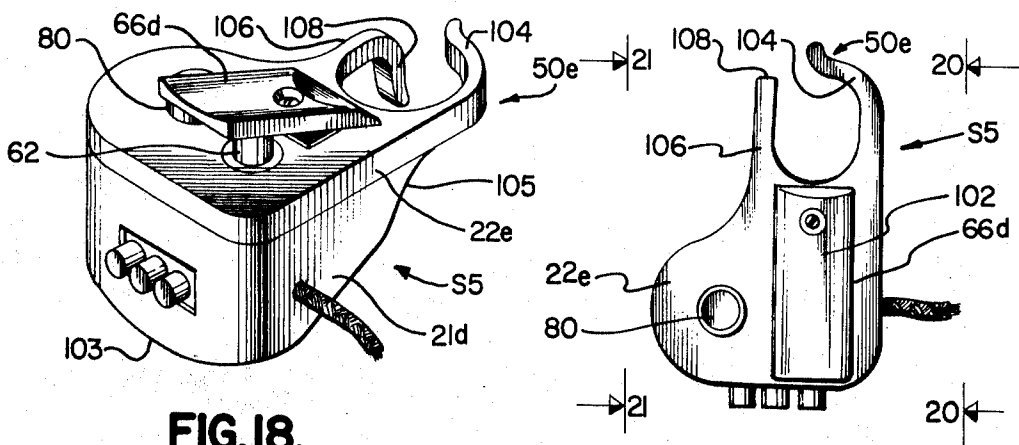


FIG. 18.

FIG. 19.

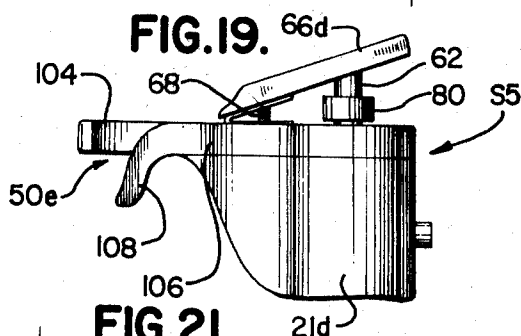
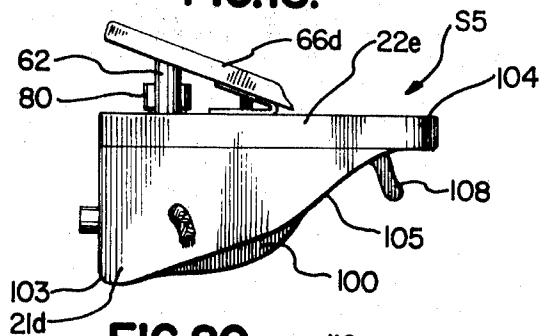


FIG. 20.

FIG. 21.

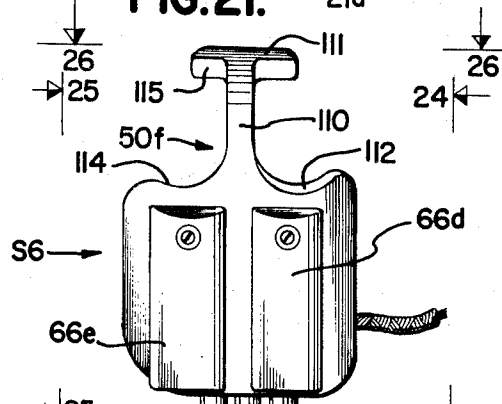
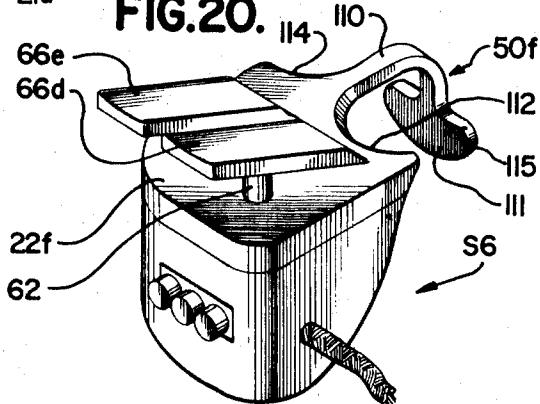


FIG. 22.

FIG. 23.

FIG. 24.

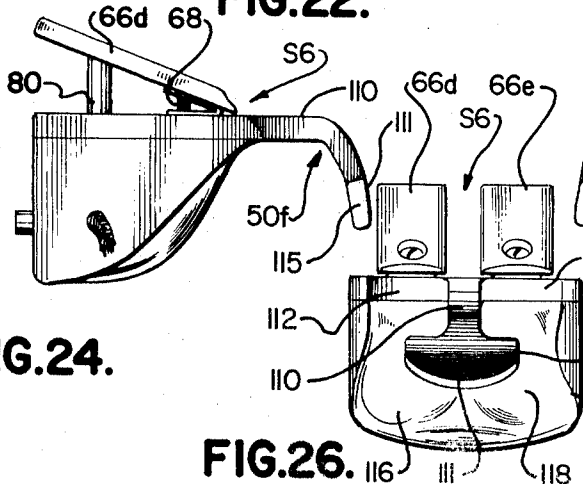


FIG. 25.

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## HAND HELD, FINGER CONTROLLED SWITCH DEVICE

This invention concerns a finger mounting control device particularly adapted for controlling dental equipment, but generally applicable in other fields for controlling electrical, pneumatic or hydraulic apparatus, or the combination thereof, wherever an operator must retain freedom of arm, hand and finger movement while retaining the control device in manual operating position at all times.

Finger and hand mounting control devices proposed heretofore have not proven practical in applications such as the dental fields because they were mounted on or were held by fingers which must remain free for performing other operations while the control device remains in operating position in the hand. Typical of these prior control devices or switch mountings are described in United States Pat. Nos. 879,254 and 3,226,501.

The problem of providing a dentist or dental operator with apparatus control means which can be instantly and continuously operated while leaving the normally used fingers and hands free for performing complex operations, has been a particularly difficult one in the dental field. Generally, the expedient resorted to has been provision of a foot control switch or assembly to activate the dental drilling handpiece. This type of switch has many objections. It requires that the dental operator stand or sit in an unbalanced fashion with one foot relieved of body weight and constantly in a ready position for quick release of pressure on the foot control switch. This is a very tiring position and prevents continuous efficient operation by the dental operator. The foot control constitutes a safety hazard since it is always underfoot and is attached to electric and pneumatic lines extending outwardly from the foot control. The foot control is an unsightly, dangerous, inefficient device on an otherwise clear floor area.

The objections to the foot switch control have been recognized heretofore. One proposed remedy described in U.S. Pat. No. 3,388,472 has been provision of a mouthpiece connected via a pneumatic tube to a pneumatic control device. While this eliminates the objectionable foot switch, it replaces it with an objectionable mouthpiece.

The present invention takes a new approach to the problem by providing a new hand held and operated control device which performs all the control functions of a foot control switch, thus eliminating the need for a foot switch. The hand held control device fits comfortably in one hand, attached to the fourth finger or palm of the hand which heretofore has had only very limited or no function in normal dental procedures. The thumb and other fingers of the hand are free to hold a dental mouth mirror to retract a patients cheek and to perform other necessary functions. The control device always remains in operating position by application of and for operation by the third and fourth fingers of the hand holding the device. Only light finger pressure is required to operate switch buttons extending upwardly of the device which has a contoured housing to fit snugly in the palm of the hand. Levers can be provided on the device for applying pressure to the switch buttons by third and fourth fingers. The device enables

continued use of a dental drill at variable or selected speeds with or without water coolant at the will of the dental operator. Release of pressure on a switch button immediately stops revolution of the dental drill upon completion of a particular operation or in case of sudden movement of the patient, but leaves the dentist's fingers and instruments oriented with respect to the patient's mouth position to resume operations as desired.

The control device may be arranged to convey signal impulses to controlled apparatus via a flexible, insulated cable. However, the device can be operated without external wires by enclosing a miniature supersonic or electromagnetic transmitter. The miniature size of the device enables rapid, more accurate on-off control of external circuitry and apparatus. Use of the control device results in lessened operator fatigue, and prevents body disabilities heretofore caused by continued use of foot control devices. General health improvement results because backaches, foot problems, neck strains, restricted breathing, shoulder misalignment, and other difficulties directly traceable to use of foot control devices are avoided.

Any desired number of independent or interconnected switches can be incorporated in the control device. Other and further features, objects and advantages of the invention will become apparent from the following detailed description taken together with the accompanying drawings, wherein:

FIG. 1 is a top and front perspective view of a hand held first control device embodying the invention, with a circuit plug shown in perspective.

FIG. 2 is a side elevational view of the control device.

FIG. 3 is an end elevational view of the control device.

FIG. 4 is a side elevational view opposite from that of FIG. 2, taken on line 4—4 of FIG. 3.

FIG. 5 is a longitudinal vertical sectional view taken on line 5—5 of FIG. 3.

FIG. 6 is a perspective view of the control device shown in a hand held position.

FIG. 7 is a side view similar to FIG. 2, showing a second control device.

FIG. 8 is an enlarged fragmentary sectional view of an operating lever taken on line 8—8 of FIG. 7.

FIG. 9 is a top plan view of a third control device embodying the invention.

FIG. 10 is an end view of the control device of FIG. 9.

FIG. 11 is a top view of a fourth control device, with a plug shown in perspective.

FIG. 12 and FIG. 13 are opposite side views taken on lines 12—12 and 13—13 respectively of FIG. 11.

FIG. 14 is an end view taken on line 14—14 of FIG. 11.

FIG. 15 is an end view taken on line 15—15 of FIG. 13.

FIG. 16 is a side view of the fourth control device shown in a hand held position.

FIG. 17 is a perspective view of the fourth control device shown in a hand held position.

FIG. 18 is a perspective view of a fifth control device.

FIG. 19 is a top plan view of the fifth control device.

FIG. 20 and FIG. 21 are opposite side views taken on lines 20—20 and 21—21 respectively of FIG. 19.

FIG. 22 is a perspective view of a sixth control device.

FIG. 23 is a top plan view of the sixth control device.

FIGS. 24, 25 and 26 are opposite side and end views taken on lines 24—24, 25—25 and 26—26 of FIG. 23.

Referring first to FIGS. 1—6, there is shown a first control device S1 comprising a closed housing 20, including a hollow base 21 and cover plate 22. The base has a contoured shape to fit snugly in the palm of an operator's hand H. Vertical end wall 24 of the base is substantially flat with rounded corners 25 merging smoothly into flat side wall 26 and curved angularly disposed opposite side wall 28. The flat bottom 30 of the base has an upwardly extending angular portion 32 tapering to wedge shaped end 34. The top rim 36 of the open top of the base is flat. Cover plate 22 overlays rim 36 and is removably secured by screws 38. The chamber 40 inside the housing is effectively closed and sealed off from the external contaminants. The cover plate can be removed to provide access to internal parts in chamber 40.

The cover plate is provided with a lateral outer recess 42 and an inner groove 44 in both of which are slidably engaged respectively opposite sides 46, 48 of a U-shaped finger engaging loop 50. The cover plate is formed with an arcuate edge 54 facing the inner side of loop 50 to define therewith a ring to receive the little or fourth finger F4 of hand H. Loop 50 is a flexible or rigid member and is adjustably held by screw 51 in the side of plate 22. Screw 51 extends through slot 53 in side 46 of the loop.

Mounted under the cover plate is a switch 56 having a sleeve 58 secured in an aperture in the cover plate. An operating spring biased pushbutton 62 extends upwardly into slot 64 formed in the underside of operating lever 66. Lever 66 is aligned with loop 50 longitudinally of the housing so the lever can be depressed by finger F4 as shown in FIG. 6. The lever is pivotally held by a bolt 68 engaged in a slot 70 formed in the lever near one end thereof. The bolt is secured into the threaded hole 71 in the cover plate. The pushbutton 62 holds the free other end of the lever in an elevated position. A U-shaped leaf spring 72 can be provided at bolt to operate as a hinge, and to additionally assist in holding the lever in elevated position for preventing inadvertent downward movement of the lever against the pushbutton.

Another switch 74 is disposed laterally of switch 56 and is provided with a sleeve 75 secured in aperture 78 in the cover plate. A spring biased operating pushbutton 80 in sleeve 75 extends upwardly of the cover plate for operating switch 74 by the third finger F3 of the operator's hand.

A further switch 82 is mounted inside of end wall 24. Switch 82 has a block 84 set in a rectangular aperture 85 in wall 24. A plurality of operating pushbuttons 86 are provided for operating independent sections of switch 82. These pushbuttons extend outwardly of end wall 24 and can be operated by the other hand of the operator for circuitry variations.

The several switches have leads 88 in chamber 40. These leads can be interconnected in various ways depending on the external circuitry to be controlled by the switches. Alternatively each lead can form one wire of a flexible cable 90 shown in FIG. 1 terminating at a plug 92 having individual prongs 94 for the respective wires from the switches. This plug can be engaged in a suitable socket or receptacle of an external circuit controlled by the switches.

FIG. 6 shows the control device S1 held by the left hand H of an operator. The fourth or little finger F4 extends through loop 50 while the housing 20 nestles snugly in the palm P near the right or outer edge E of the hand. This leaves the thumb T and the first three fingers F1, F2 and F3 free for manipulating and operating other instruments. When necessary the third finger F3 can be depressed to contact switch button 80 for operating switch 74.

It will be apparent by the arrangement described, that the operator has complete freedom of movement of hand H. Cable 90 is flexible and can be extended up alongside the operator's arm or disposed in any other way to permit freedom of hand and arm movement. Furthermore, the thumb and forefinger F1 and second finger F2 which are the most essential ones used in performing operations, are completely free. The third finger F3 is also free and need only occasionally be used in operating pushbutton 80. The little finger F4 normally rests on lever 66. However, it will be understood that it is possible to raise this finger from the lever to assist the other fingers in some operation, while the control device will be retained on the hand by the engagement of the loop 50 at the base of the fourth finger.

The housing 20 is preferably made of plastic or light weight metal which can be sterilized. The tightly closed cover plate 22 will exclude sterilizing fluids from chamber 40 where the electrical or control components are located.

FIGS. 7 and 8 show another control device S2 which is substantially the same as device S1, except that two pairs of clips 95 are provided to serve as lateral finger grips on lever 66a. These clips will prevent inadvertent lateral displacement of fourth finger F4 on the lever and will prevent rotation of housing 20 around the fourth finger.

FIGS. 9 and 10 show a third control device S3 which is similar to devices S1 and S2 and corresponding parts are identically numbered. Here a lateral extension 96 is provided on side 48a of loop 50a. Side 48a slides in groove 44a in cover plate 22a on base 21a. This lateral extension has a curved edge 97 against which the third finger F3 can bear to help stabilize the control device while held in the palm of the hand and to prevent rotation of the device around the fourth finger F4. Loop 50a receives the fourth finger F4 in the same manner as described above. Another lever 66b is pivotally mounted adjacent lever 66a for operating spring biased pushbutton 80. This lever is provided with a mounting bolt 68a and hinge spring 72a functioning for lever 66a in the same way as bolt 68 and spring 72a serve for lever 66.

FIGS. 11 through 17 show a fourth control device S4 which is generally similar to devices S1, S2 and S3 and corresponding parts are identically numbered. In device S4, base 21d is formed with a contoured concave recess 100 in the upwardly extending angular portion 32d of the bottom of the base. This recess receives the fleshy part of the palm and first joint of finger F4 so that the device is held more comfortably in the hand as shown in FIGS. 16 and 17. The wider end of housing 21d is formed with a convex bottom portion 103 and is contoured at edge 105 to fit the normal concavity in the palm of the hand when holding the device. The lever 66d is formed with a concave recess 102 at its

upper side in which fourth finger F4 seats comfortably. This arrangement enables the operator to hold the control device comfortably for an extended period of time without feeling fatigue and without interference with operation of instruments by the free thumb and fingers F1 and F2.

FIGS. 18-21 show a fifth control device S5, which is generally similar to the devices, S1, S2, S3 and S4, and corresponding parts are identically numbered. In this device S5 there is a solid, rigid open loop 50e formed integral with the cover plate 22e. This loop has one end 104 bent laterally in the plane of the cover plate and another end 106 extending outwardly of the cover plate and terminating in a free downwardly extending portion 108. This arrangement enables very rapid engagement of the control device on the fourth finger of the hand and rapid disengagement therefrom by an end-wise and lateral motion. Also the open structure of the loop enables fingers of different sizes to be accommodated easily. The end 106 of the loop and downwardly bent portion 108 are contoured to fit comfortably between the third and fourth fingers F3, F4 so that the device is held more stable and non-rotatable in the hand.

FIGS. 22-26 show a sixth control device S6 similar to the devices described above and corresponding parts are identically numbered. In device S6, a loop structure 50f is defined by an outwardly extended end portion 110 of the cover plate 22f and by a concavely curved end edge 112 of the cover plate. The end portion 110 of the loop terminates in a flat plate 111 with laterally extending wings 115. These wings engage at inner sides of the third and fourth fingers of the hand. The fourth finger engages at one lateral edge of end portion 110 of the cover plate and curved end edge 112. The third finger engages the loop structure at the other lateral edge of end portion 110 and seats in another concavely end edge portion 114 of the cover plate. To concavely curved recesses 116, 118 are formed in the tapered portion of base 21f of the housing for snugly receiving joints of the third and fourth fingers. Two levers 66d and 66e are provided for operating respective pushbuttons 62 and 80. The arrangement of control device S6 is such that both the third and fourth fingers can quickly engage and disengage the control device. While in use, the control device is effectively, non-rotatably and comfortably held in the hand.

It will be apparent that the control devices described are well adapted for use in dental operations. The devices will fit comfortably in the hand engaged with the fourth finger which heretofore has had limited usage in normal dental procedures. However, this finger is still available to operate when necessary simply by lifting it from the operating lever while the device remains engaged at the base of the finger.

The control devices described have utility in other than dental operating fields, wherever a hand held control device is required which will not interfere with arm, hand or finger movements of an operator. It is possible to install a miniature supersonic or electromagnetic wave transmitter in the housing of the device. The transmitter will be operable by one or more of the outwardly extending switch buttons. In this arrangement, the external cable 90 can be omitted.

The control devices for electrical apparatus can be converted by exchanging the disclosed electrical components to parts for controlling or actuating lines of fluid mechanisms such as pneumatic or hydraulic devices. Furthermore, the control devices can be constructed to control apparatus combining any two or more electrical, pneumatic and hydraulic equipment, units or devices.

While a limited number of embodiments of the invention have been described it will be understood that many other modifications are possible without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A control device adapted for support in the palm of the hand of an operator, comprising a housing having a contoured shape to fit snugly in the outer edge of the palm of the hand while extending longitudinally thereof and of a size spanning but the third and fourth fingers thereof; a loop-like structure extending outwardly of one end of the housing for receiving and containing at least one of these fingers of the hand over the outer finger joints and adjacent to the knuckle joint with the hand; and a control unit in the housing having an operating member extending upwardly from the housing and in longitudinal axial alignment with the loop-like structure and at a location for engagement of and operation by the free end of said fourth finger, whereby the thumb, first, second and third fingers of the hand are left completely free for engagement with the palm and other fingers to grip instruments and for performing other operations.

2. A control device as defined in claim 1, wherein said housing is hollow; and a cover plate removably attached to said housing, said loop-like structure extending forwardly from the cover plate, the bottom and palm-engaging surface of the housing tapering to wedge shape with the cover plate and toward the loop-like structure so as to accommodate the inner surface of the fourth finger below the finger joints and adjacent to the hand palm.

3. A control device as defined in claim 1, wherein said loop-like structure is defined by a U-shaped member adjustably secured to the housing and positionable to adjust the loop for receiving fingers of different sizes.

4. A control device as defined in claim 1, further comprising a lever pivotally mounted on the housing and overlying said operating member for operation of same, said lever being disposed in alignment with said loop-like structure longitudinally of said housing for operating engagement by the free end of the fourth finger of the hand.

5. A control device as defined in claim 1, further comprising another control unit operating member extending upwardly of the housing for operation by the third finger of the hand.

6. A control device as defined by claim 4, further comprising finger grip means on said lever arranged to prevent lateral displacement of the fourth finger with respect to said lever, and to prevent rotational movement of said housing around said fourth finger.

7. A control device as defined by claim 1, further comprising a lateral extension at one side of said loop-like disposed for contact and engagement by third

finger of the hand to prevent rotational movement of the housing around the fourth finger.

8. A control device as defined in claim 7, further comprising another control unit operating member disposed laterally of the first named operating member and extending upwardly of the housing for operation by the third finger of the hand.

9. A control device as defined in claim 8, further comprising a pair of levers pivotally mounted on the housing and overlying the first named and other operating members respectively for selective operation of the same by the fourth and third fingers respectively of the hand.

10. A control device as defined in claim 1, comprising further control unit operating members extending laterally outwardly of the housing for engagement by the upper palm area of the hand and squeezable thereby to operate the unit.

11. A control device as defined in claim 4, wherein said housing comprises a hollow base, and a cover plate removably attached to said base, said operating member extending upwardly from said cover plate.

12. A control device as defined in claim 1, wherein said control unit is an electrical switch.

13. A control device as defined in claim 1, wherein the contoured housing is formed with bottom concave and convex portions to fit snugly in and conform to the area of the palm surface of the hand and the adjacent surface of said fourth finger.

14. A control device as defined in claim 1, wherein said housing is hollow; and a cover plate removably attached to said housing, said loop-like structure being integrally formed with the cover plate said housing.

15. A control device as defined in claim 14, wherein said loop structure defines an open loop formed by a pair of projecting end portions of said cover plate, one of the end portions being laterally bent to engage the fourth finger of the hand and the other end portion being bent downwardly away from the cover plate to engage between the third and fourth fingers.

16. A control device as defined in claim 15, wherein

the contoured housing is formed with concave and convex portions to fit snugly in the palm of the hand and to engage said fourth finger.

17. A control device as defined in claim 14, wherein said loop structure defines open loops formed by a projecting end portion of the cover plate and adjacent concavely curved edge portions of the cover plate for respectively receiving and engaging the third and fourth fingers, said projecting end portion of the cover plate having a downwardly bent portion for engaging between the third and fourth fingers, said downwardly bent portion having lateral wings for engaging inner sides of the third and fourth fingers.

18. A control device as defined in claim 14, further comprising a lever pivotally mounted on the housing and overlying said operating member for operation by said fourth finger.

19. A control device as defined in claim 18, further comprising another operating member extending upwardly from said housing; and another lever pivotally mounted on the housing and overlying said other operating member for operation by the third finger of the hand.

20. A control device adapted for support in the palm of the hand of an operator comprising a housing having contoured bottom surface conforming to the outer edge area of the palm of the hand and to the inner face of the finger while extending longitudinally thereat and of a size spanning but the third and fourth fingers thereof, a loop-like structure extending outwardly from the forward end of the housing for receiving at least one of these fingers for the support of the housing within the palm of the hand at the outer edge thereof, and a control unit within the housing and having an operating push member extending outwardly therefrom and engageable by the palm of the hand upon the housing being squeezed by the third and fourth fingers of the hand whereby the thumb, first and second fingers of the hand are left completely free for engagement with the palm of the hand and the other fingers to grip instruments and for performing other operations.

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