PATENT SPECIFICATION (11) 1 588 235

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(21) Application No. 37128/77 (22) Filed 6 Sept. 1977
(31) Convention Application No. 720 606
(32) Filed 7 Sept. 1976 in
(33) United States of America (US)
(44) Complete Specification published 15 April 1981
(51) INT CL³ B25B 15/00; A61C 5/00
(52) Index at acceptance
B3N 7B
A5R DF

(19)

(54) APPARATUS AND METHODS FOR USE IN DENTISTRY

(71) I, SHIRLEY ELLMAN, of 558 Willow Avenue, Cedarhurst, New York 11516, United States of America, a Citizen of the United States of America do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus and methods for use in a retentive pin dentistry technique.

Dentists for many years have used retentive pin techniques for restorative and operative dentistry, such as in tooth restoration, coping for crown or bridge abutment, replacement of fractured incisal angles, and repair of bridge and crown facings. The three types of retentive pins used have been the cemented pin, the friction lock pin, and the threaded pin. The threaded pin can be threaded into a pre-tapped hole, or the pin itself used as a self-tapping screw and self-threaded into a slightly undersized pilot hole. In one known technique, the end of the threaded pin is flattened to form a flared end adapted to seat in a correspondingly shaped slotted recess in a hand wrench, which can then be used as a driver to screw the self-threading pin into the pre-drilled tooth hole.

According to a first aspect of the invention there is provided the combination of a retentive dentistry pin and a pin driver therefor, said retentive dentistry pin comprising a straight cylindrical member with an outer thread running the full length of the pin, said driver comprising a shank portion having at one end a blind threaded bore, said bore thread matching that on the pin and being engageable by the pin.

According to a second aspect of the invention there is provided a retentive pin dentistry kit comprising at least one combination in accordance with the first aspect of the invention, in which kit a plurality of pins are provided having the same configuration and threading.

According to a third aspect of the invention there is provided a method for mounting a pin in tooth dentine in a retentive pin technique, comprising pre-drilling a hole in the tooth dentine, providing a pin threaded along its full length and a driver therefor having a threaded blind bore engageable by the threaded pin, said pin major diameter slightly exceeding the dentine hole diameter, screwing one end of the pin into the driver bore, using the driver screwing the opposite end of the pin into the dentine hole to anchor it therein, and unscrewing the driver from the pin without removing the pin from the dentine hole.

Other features of the invention will be apparent from the following description of embodiments of the various aspects thereof, these features including, *inter alia;* the use of the driver as a bending tool to bend the pin to a desired orientation; a driver construction to facilitate its removal from the pin; and the use of a self-threading pin with an adhesive to eliminate leakage, seal any voids between the pin and tooth hole, and also act as a cavity liner where necessary.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings wherein:

Figure 1 is a plan view of one form of self-threading pin forming part of a combination in accordance with the first aspect of the invention;

Figure 2 is a plan view of one form of chuck-driver forming part of a combination in accordance with the first aspect of the invention for use with the pin of Figure 1; Figure 2a shows a variation;

Figure 3 shows the assembled pin of Figure 1 and chuck-driver of Figure 2; and

Figures 4a, 4b and 4c illustrate mounting of pins in a tooth by a method in accordance with the third aspect of the invention.

The retentive pin technique anchors a pin into dentine such that the terminal end of the pin projects above the dentine. The dentist then uses the terminal end to support various materials such as composites, cements and acrylic resins in order to restore bulk to the

tooth. One known technique employs a self-tapping, threaded pin which is screwed into a pilot hole pre-drilled into the dentine. The pin is retained by the elasticity of the dentine and the slight oversize of the pin threads. To assist in screwing in the pin, which is relatively small, typically 0.023—0.030" in diameter, the end of the pin is flattened for engagement with a slot in a small driver.

The present invention is concerned with a related technique, in which the pin and driver construction are functionally related in a different manner in order to obtain certain advantages. Fig. 1 illustrates the threaded pin 8 of a combination in accordance with the invention, comprising a cylindrical member 10 of suitable material, such as for example stainless steel, which has an outer thread 11 running throughout its full length. The dimensions of the pin can be the same as those of the known pins, typically 0.023" or 0.030" with lengths of 5 mm and 6 mm, respectively. The thread is also standard, with a pitch typically of 0.0079". The pins are readily made by an automatic type of screw machine which threads a length of rod, and then cuts up the threaded rod into the desired pin lengths.

A driver 9 for use with the pin 8 of Fig. 1 is illustrated in Fig. 2. It comprises a shank portion 12 one end of which is enlarged to form a handle 13 for being held by the fingers of the dentist. The handle 13 in this embodiment has a knurled surface 14 to improve gripping. The opposite ends of the shank 12 is provided with a blind central bore 15 which has an internal thread 16. The bore threads 16 match that 11 of the pin, so that the driver bore 15 can be screwed onto the threaded pin 8. The depth of the bore 15, indicated by reference numeral 17, can be chosen to be approximately one-quarter to one-half the length of the threaded pin 8 to ensure that the pin 8 is firmly held by the driver 9. The driver is preferably made of metal.

In use, the dentist first predrills a slightly undersized pilot hole for receiving the pin. Fig. 4a shows a typical tooth 19 to which two retentive pins are to be added. In Fig. 4a, a hole 20 is shown which has been drilled to receive a threaded pin. Next to it is illustrated the drilling of a second hole 21 using a standard dental twist drill 22. For 0.023" and 0.030" sized pins, 0.022" and 0.029", respectively, sized drills can be used. If desired, the drill may be provided with a depth stop in the form of a shoulder 23 to enable a desired hole depth to be obtained, for example 2 mm.

The pin 8 of Fig. 1 is then screwed into the threaded bore 15 of the driver 9 of Fig. 2. The assembled pin 8 and driver 9 are illustrated in Fig. 3. The pin seats securely within the driver providing a firm connection between the two, preventing wobble of the pin relative to the driver. The pin 8 can now actually be regarded as a rigid extension of the shank 12 of the driver 9, to be used as a tap to form a thread in the pilot hole.

As shown in Fig. 4b, the dentist now simply screws the pin 8 into the predrilled dentine holes 20, 21, by inserting the free pin end into the hole and rotating the driver clockwise (assuming the normal right-hand thread on the pin), which action results in the pin threads 11 displacing the elastic dentine adjacent to the pilot hole. This same action tends to tighten the threaded engagement of the pin with the driver. The pin threading can be continued until the pin reaches the bottom of the pilot hole. This can be determined by the increased resistance to turning. It is preferred however to use the driver as a stop. This is readily accomplished by choosing the pilot hole depth to match that of the pin portion projecting from the driver, indicated at 25 in Fig. 3. For instance, for a 4 mm long pin, the driver bore depth 15 can be chosen to be 2 mm, with the projecting pin length 25 also equalling 2 mm, and the dentine hole is drilled to a depth of 2 mm by providing a drill with a depth stop 23 equal to 2 mm. Thus, when the driver end surface 18 reaches the tooth, the pin will be at the extremity of its possible depth of travel as indicated in Fig. 4b.

Some clinicians however favor leaving a small space between the bottom of the dentine hole and the end of the pin. This is readily accomplished by the dentist stopping rotation of the driver when the driver end 18 is spaced from the tooth 19 by a like amount. The space left by the dentist between the driver end and the tooth will substantially equal that left between the threaded pin and hole bottom where the dentine hole depth matches the length of the projecting pin portion from the driver.

After the pin 8 has been threaded to the desired depth, the driver 9 is removed. Even though the driving action has had the effect of tightening the pin in the driver, and even though the threaded pin may not be bottomed in the dentine hole, it is found that reversing the rotation of the driver 9 (counter-clockwise) will loosen it from the pin 8 and allow it to be unthreaded from the pin 8 without unthreading the pin from the dentine hole. It is believed the foregoing results because the threaded pin is held more tightly to the elastic dentine by the displaced dentine, than it is to the preformed threads in the rigid driver.

In accordance with a further feature of one combination in accordance with the invention, in order further to increase the difference in adherence of the threaded pin to the driver and to the dentine, respectively, to promote removal of the driver, the threaded

bore 15 is provided with a permanent lubricant or release coating to reduce sticking and thus facilitate unthreading from the pin. A preferred release material is a silicone material. This is available commercially from several sources and is known as siliconizing a surface to reduce adherence and facilitate release. In Fig. 2, the release coating on the bore interior is designated 26.

A further feature of one method in accordance with invention is use of the driver 9 as a bending tool to orient the pins in a desired manner. It is often desirable for the pins to be angled to distribute their support throughout the added bulk material and lessen the chance of the bulk material being separated from the pin. A pin on occasion must be inserted at such an angle that its terminal end projects outward past the surface of the tooth. Such a pin must be bent inward. Slight bending of pins for proper positioning is required on anterior teeth when incisal or proximal restorations are planned. The driver 9 of the combination in accordance with the invention is well suited for this purpose because it can be backed-off or unthreaded from the anchored pin 8 by a desired amount, and then, since it still firmly engages the anchored pin so long as three or four threads thereof are engaged, is then readily employed to bend the pin in any desired direction or orientation that the dentist desires. This is illustrated in Fig. 4c, which shows how the driver 9 has been backed off about one-quarter and then used to bend the pin 8 horizontally across the top of the tooth. Afterwards, the driver 9 is completely removed leaving the pins 8 retained in the tooth.

With the combination described the advantages include firm seating of the pin in the driver by reason of the threaded engagement, with little risk of the pin falling out of the driver within the patient's mouth before it has engaged the dentine. Further, if desired, the chuck can be provided with a hole through the handle to accommodate string or readily available dental floss can be threaded through it to provide a loop for securing the chuck to the dentist's finger for greater safety should the chuck slip from the dentist's fingers. The threaded engagement of the pin to the chuck prevents pin wobble and facilitates the dentist's insertion into the tooth hole wherever located. Use of the driver as the bending tool eliminates the need for extra bending tools or expensive handpiece drivers.

As described above, the major diameter of the threaded pin is larger than that of the dentine pilot hole that is made. The dentine elasticity which helps retain the pin also prevents the pin thread grooves from being filled, leaving voids between the anchored pin and the dentine. These voids may be enhanced because the form of the pins may not precisely conform to the shape of pilot hole due to drill wobble. Moreover, accumulation of air or fluid in the pilot hole may prevent seating the pin to the pulpal line angle.

In accordance with a further feature of one method in accordance with the invention, prior to screwing the pin into the undersized dentine hole, it is first dipped into or coated with a cyanoacrylate adhesive liquid, and then it is screwed into the pilot hole. A coating by dipping step is readily carried out once the pin has been screwed into the driver. The cyanoacrylate liquid may be chosen from among those listed in United Kingdom Patent Specification No. 1,422,692, the contents of which are herein incorporated by reference. A preferred cyanoacrylate is ethyl cyanoacrylate. The advantages of this technique include the following:

a. the cyanoacrylate adhesive, when it hardens, provides added retention to the retentive pin, and a biologically sound base if leakage, stress, fracture or thread stripping of the dentine hole should occur,

b. the cyanoacrylate fills any voids between the pin and dentine forming a tight seal preventing leakage, and preventing entry of undesired debris into the joint,

c. the cyanoacrylate can act as a cavity liner to cover the pulp with a compatible material in the event of an accidental exposure. The technique in applying the cyanoacrylate liquid is similar to that described in the aforementioned patent specification, except that the pin 8 is screwed into the undersized hole with the driver 9 rather than merely inserted or pushed therein.

The necessary equipment for carrying out a method in accordance with the invention is readily assembled in a suitable kit and sold in that form to dentists. The kit may contain:

a. two sizes of pins to handle most retentive pin techniques, e.g., 0.023″ with a length of 5 mm, and 0.030″ with a length of 6 mm,

b. two sizes of twist drills for providing the pilot holes for the pins indicated above, namely, 0.022″ and 0.029, respectively, each with a depth stop of, for example, 2 mm,

c. two drivers, each to accommodate one of the pin sizes. The bore depth should be sufficient to accommodate the full length of the portion of the pin that projects above the tooth when the pin reaches the bottom of the drilled hole, and

d. if desired, a vial of cyanoacrylate cement.

Of course, the kit can also be limited to only one pin size, such as intermediate the sizes listed above, thus requiring only one size driver and one size drill, and can also omit the drill where the latter is already possessed by the practitioner.

The pin can also be driven in with a hand-

piece drive. For this purpose, a standard latch type shank 30, illustrated in Fig. 2a, can be provided at one end with a threaded hole 31 for receiving the threaded pin. A low speed reversing Contra-angle handpiece drive is used which can receive the latch-type shank end. With the pin screwed into the hole 31, the handpiece with shank 30 is aligned above the pilot hole, and the pin inserted while the engine is running and while applying firm down pressure. The threaded pin will easily start in the pilot hole and be threaded down until it seats. Then the handpiece engine is reversed, unthreading the shank from the seated threaded pin.

WHAT I CLAIM IS:—

1. The combination of a retentive dentistry pin and a pin driver therefor, said retentive dentistry pin comprising a straight cylindrical member with an outer thread running the full length of the pin, said driver comprising a shank portion having at one end a blind threaded bore, said bore thread matching that on the pin and being engageable by the pin.

2. A combination as claimed in Claim 1, wherein the driver has at the opposite end a finger-engageable handle, and the bore depth is approximately one-quarter to one-half the length of the pin.

3. A combination as claimed in Claim 1 or Claim 2, wherein the pin and the driver are both of metal.

4. A combination as claimed in any of Claims 1 to 3, wherein a release coating is provided on the driver bore interior.

5. A retentive pin technique dentistry kit comprising a combination as claimed in any of Claims 1 to 4, in which kit a plurality of pins are provided having the same configuration and threading.

6. A retentive pin technique dentistry kit as claimed in Claim 5, and further comprising a twist drill for pre-drilling a pilot hole in dentine, said drill being slightly undersized compared with the diameter of said pins having the same configuration and threading.

7. A retentive pin technique dentistry kit as claimed in Claim 5 or Claim 6, and further comprising a supply of cyanoacrylate cement.

8. A retentive pin technique dentistry kit as claimed in any of Claims 5 to 7, wherein said kit comprises a further plurality of pins having the same configuration and threading but of a different size to the other plurality of pins, a further pin driver being included for use with pins of said further plurality and forming with one such pin a combination as claimed in any of Claims 1 to 4.

9. A method for mounting a pin in tooth dentine in a retentive pin technique, comprising pre-drilling a hole in the tooth dentine, providing a pin threaded along its full length and a driver therefor having a threaded blind bore engageable by the threaded pin, said pin major diameter slightly exceeding the dentine hole diameter, screwing one end of the pin into the driver bore, using the driver screwing the opposite end of the pin into the dentine hole to anchor it therein, and unscrewing the driver from the pin without removing the pin from the dentine hole.

10. A method for mounting a pin in tooth dentine in a retentive pin technique as claimed in Claim 9, wherein, before the driver is unscrewed completely from the pin, it is used to bend the projecting end of the anchored pin into a desired orientation.

11. A method for mounting a pin in tooth dentine in a retentive pin technique as claimed in Claim 9 or Claim 10, wherein before screwing the pin into the dentine hole, its free end is first coated with a cyanoacrylate adhesive.

12. A combination as claimed in any of Claims 1 to 4, wherein the driver shank portion has a latch-type end for engaging a handpiece drive.

13. A combination of a dentistry retentive pin and a pin driver therefor substantially as herein described with reference to Figures 1, 2 and 3, or Figure 2a of the accompanying drawings.

14. A retentive pin technique dentistry kit substantially as herein described.

15. A method of mounting a pin in tooth dentine substantially as herein described with reference to Figures 4a and 4b, or Figure 4c of the accompanying drawings.

For the Applicant,
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Chartered Patent Agent.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1588235 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

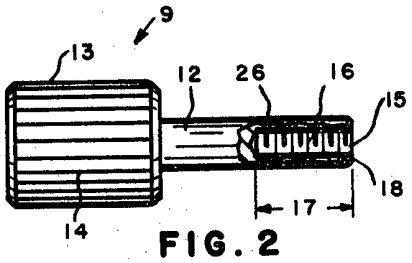

FIG. 2

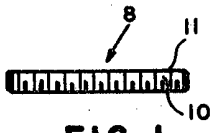

FIG. 1

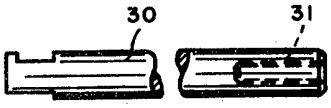

FIG. 2a

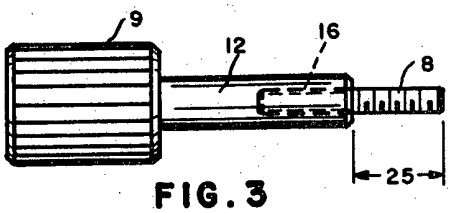

FIG. 3

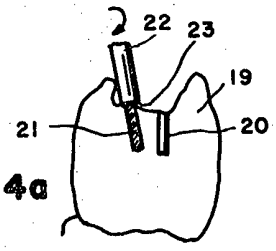

FIG. 4a

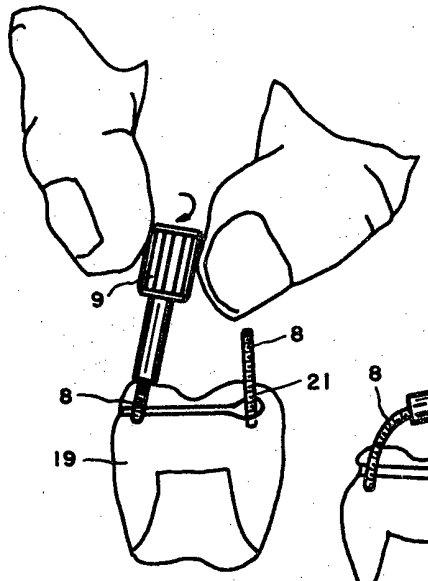

FIG. 4b

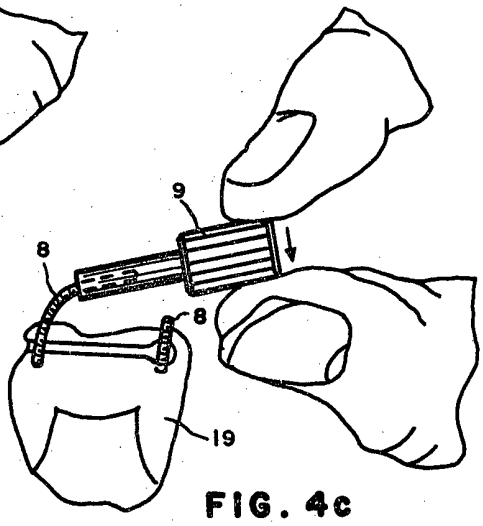

FIG. 4c