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C. B. SMITHSON, JR
MOTOR-DRIVEN TOOTHBRUSH

2,648,787

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FIG. 1.

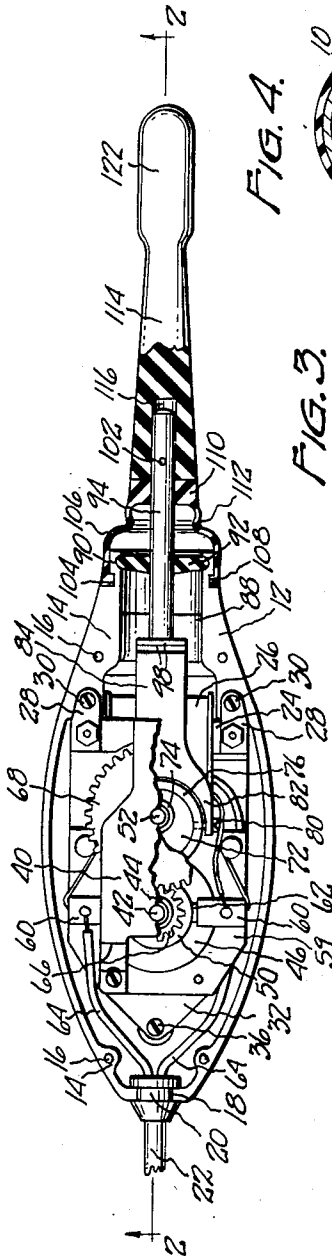


FIG. 4.

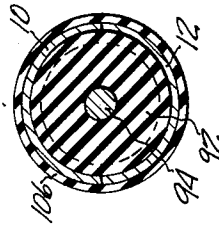
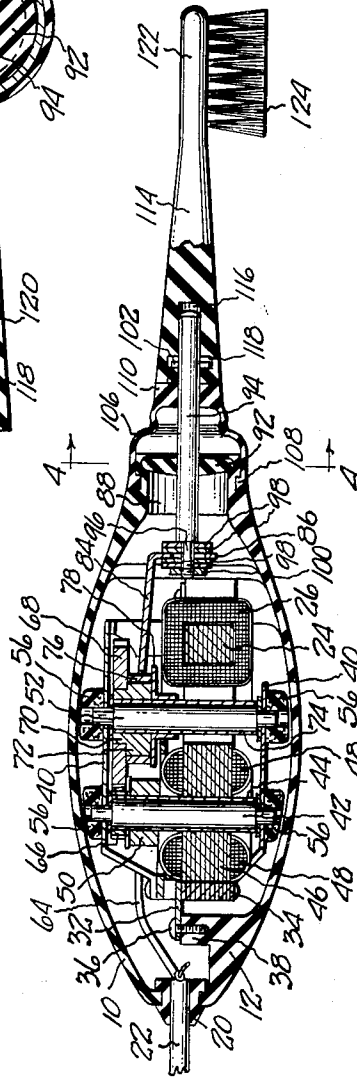


FIG. 3.



FIG. 2.



INVENTOR.
CHARLES B. SMITHSON, JR.
BY
Ottoch + Knoblock
ATTORNEYS.

UNITED STATES PATENT OFFICE

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MOTOR-DRIVEN TOOTHBRUSH

Charles B. Smithson, Jr., Clay Township,
St. Joseph, Ind.

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10 Claims. (Cl. 310-47)

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This invention relates to improvements in motor driven tooth brushes.

The occurrence of unhealthful conditions of the gum tissues has caused dentists to conduct extensive investigations into the subject of the causes and treatment of the condition. Such conditions may entail either swelling of the gums or gingival tissues or recession thereof from the teeth, in each case resulting from cessation of proper functioning of the gum tissues. Several treatments have been devised to combat these conditions. One procedure which has been extensively tested and which has produced favorable results entails a massaging of the gum tissues. The massaging, if properly performed by oscillations or movements of small amplitude in which the sides of the bristles, rather than the tips of the bristles of the brush, move in contact with the gum tissues, has been found to stimulate the gum tissues and to overcome the unhealthful condition in many instances. The conditions under which the treatment is carried out are important, and one of the important features is the control of the path of the flexing of the brush bristles. An orbital path of flexing movement wherein the dimensions of the path are very small, for example, of an amplitude not substantially greater than one-eighth of an inch, has been found to be of greatest value. The practice of using such an orbital path of bristle flexure is used in the Charter technique, which technique is a recognized standard for treatment in this field.

The problem of producing the orbital movement uniformly, as treatment is carried on at both the inner and outer surfaces of the gums and at both the upper and lower jaws, has been difficult. It will be apparent that, as different sections of the mouth are acted upon, the tooth brush must be held in different attitudes and at different angles, and the result has been difficulty in maintaining uniformity of the stroke or path of the brush bristles as they contact the gum tissues. To secure uniformity and to reduce the amount of time required for the gum treatment, it is desirable that means be provided to operate uniformly to accomplish these results. No such means have been provided heretofore which have been fully successful.

One of the conditions encountered with power operated devices has been that the treatment requires the exertion of a substantial amount of friction incident to the engagement of multiple brush bristles with the gum tissue. Even though the brush bristles are pressed lightly against the

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gum tissues, the pressure develops a load which the ordinary small vibrator or motor is not adapted to withstand or carry. For this reason some efforts have been made to utilize devices wherein a motor of sufficient power serves as the driving means, being mounted upon a support and connected with a hand-held brush holder through a flexible type of power take-off. Mechanisms of this character are objectionable, however, because of the expense, the size, the lack of portability, and other conditions.

It is, therefore, the primary object of the present invention to overcome the aforesaid disadvantages and difficulties by providing a compact unit which has sufficient power for its intended use, and which controls accurately the desired orbital path of the brush bristles and which may be used also for brushing the teeth.

A further object of the invention is to provide a device of this character having a casing confining a motor and serving as a handle for a tooth brush which is driven by the motor, wherein the eccentrically operating parts of the device are located substantially centrally with reference to the mass of the motor and the casing so that there will not be objectional vibration.

A further object of the invention is to provide a device having a totally enclosed casing which is effectively sealed against saliva and moisture and which provides for the detachable connection of a tooth brush therewith.

A further object is to provide a device of this character of compact construction, wherein novel bearings are provided in the nature of elongated tubes rotatably encircling a fixed shaft and providing a large area of bearing surface.

A further object is to provide a novel, detachable, sealed connection between a driving motor and the shank of a brush.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is a top plan view with a part of the casing of the device removed and with parts of the device broken away.

Fig. 2 is a longitudinal sectional view taken on line 2-2 of Fig. 1.

Fig. 3 is an enlarged longitudinal sectional view of a modified form of the shank portion of a tooth brush.

Fig. 4 is an enlarged transverse sectional view taken on line 4-4 of Fig. 2.

Referring to the drawing which illustrates the preferred embodiment of the invention, the numerals 10 and 12 designate two registering parts

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of a housing or casing, which parts are adapted to be secured together to form a generally elongated hollow casing. The casing parts preferably meet at a longitudinal substantially central parting plane and are suitably ribbed, as at 14, and apertured at 16 to accommodate securing screws or the like (not shown) for connecting the housing parts together. The housing or casing will preferably be of a character to fit conveniently and naturally within the palm of the hand, and will preferably be molded from plastic material, hollow rubber, or any other suitable material, preferably of dielectric or non-conductive nature. At one end the housing parts will be provided with a restricted opening 18 adapted to receive a grommet or fitting 20 encircling an insulated electrical lead wire or conduit 22 to provide a seal at the end of the casing through which the wire 22 enters the device.

The housing 10, 12 mounts an electric motor 20 which may be of any type found suitable. A series wound A. C.-D. C. brush type motor is preferred. This motor has a laminated frame or field lamination unit including an end portion 24 encircled by the magnetic coil 26. The motor frame has a plurality of projections by means of which it is secured to the housing. Thus, as best seen in Fig. 1, the frame may include ears 28 projecting from the portion 24 and secured to the rib 14 of the housing part 12 by means of securing screws 30. A rib or plate extension 32 may project from the opposite end portion 34 of the motor frame and be secured by the screw or other securing member 36 to a post-like portion 38 formed integrally with the housing 12. At least three points of connection of the motor to the frame and the housing are preferred so as to securely anchor the motor.

Plates 40 are anchored to the motor frame or field lamination unit at spaced points to constitute the end bells or end plates thereof. The plates preferably extend substantially parallel to each other and are spaced outwardly from opposite surfaces of the laminated motor frame. These plates 40 are apertured or socketed to mount the reduced opposite end portions of a pin or shaft 42. The pin 42 is rotatably encircled by an elongated metal sleeve 44 to which is fixedly secured the laminated motor armature 46 positioned to lie within an armature socket of the motor frame and in the plane of the motor frame. The armature 46 is provided with suitable electric windings 48. The armature 46 is formed in any suitable manner conventional in the art, and has associated therewith the commutator portion 50.

The arrangement of the parts is preferably such that the shaft 42 and the armature will be located in longitudinally spaced relation to the longitudinal center of the casing 10, 12 so as to leave a space substantially at the center of the housing within the motor frame and between the armature 46 and the field coil 26. A shaft or pin 52 is positioned within the last named space, having its opposite ends mounted in sockets in the end plates 40. The shaft 52 will preferably be positioned exactly parallel to the shaft 42. Felt wicks 56 to retain lubricant are mounted on portions of the pins or shafts 42 and 52 which project outwardly from the end plates of the motor. In this connection, each of the two shafts or pins 42 and 52 will preferably be formed of sintered bronze or any other material characterized by some measure of

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porosity, an example of which is well known in the mechanical arts as "Oilite" bearing.

Insulation blocks 59 are carried by the motor frame adjacent to the armature 46 and each thereof mounts a carrier 60 for a brush 62 which engages the motor commutator 50. The leads 64 from the electric line 22 extend to these brushes, the brushes preferably having a series connection with each other and with the field winding 26. This construction is well known in the art and provides a compact powerful motor which will run freely without danger of overheating.

The sleeve 44 mounts a pinion 66 at one end thereof adjacent to and outward of the commutator 50. The pinion 66 meshes with a gear or pinion 68 which is mounted upon the projecting reduced dimension concentric hub portion 70 of an eccentric member or cam 72. The cam 72 is fixed upon an elongated sleeve 74 which rotatably encircles the pin or shaft 52. The cam 72 preferably is of circular peripheral shape or outline, the center thereof being eccentric of the center of the sleeve 74 upon which it is mounted. A ring member 76 encircles the cam 72, being held in place by an annular flange or fitting 78 having a hub portion preferably fixed upon the sleeve 74. In other words, the ring 76 is positioned against axial displacement by the flange 78 on one end thereof and by the gear 68 at the opposite end thereof.

The ring 76 mounts a pair of diametrically opposed pins 80 which lie in a direction transverse of the longitudinal dimension of the housing 10, 12 and which serve to pivotally connect the fork arms 82 of a rigid yoke member 84 which projects longitudinally forwardly to a point clear of and spaced longitudinally from the motor frame and field winding 26. This yoke 84 terminates in a laterally bent terminal portion 86.

The end of the housing 10, 12 opposite that mounting the grommet 20 is provided with an opening or bore 88 of a diameter or size large compared to the size of the opening 18 at the opposite end of the casing and large enough to receive with clearance the terminal end portion of the yoke 84, as best seen in Fig. 1. The bore 88 is interrupted adjacent its outer end by a circumferential internal groove 90 which receives the marginal portion of a disk 92 which is preferably formed of rubber, synthetic rubber or other flexible material. The member 92 has a central aperture therein accommodating and having a tight sealing fit around an elongated rigid shank or rod 94 at a point intermediate the length of that rod. The rod 94 has a reduced diameter portion 96 at its inner end which extends through washers or spacers 98, some of which are preferably formed of dielectric material and engage opposite surfaces of the terminal part 86 of the yoke. The end of rod 94 may be screw-threaded into a nut 100 to hold said shank in fixed motion-transmitting relation to the yoke 84. At a point spaced outwardly from the sealing member 92 the rod 94 mounts a cross-pin 102.

The outer surface of the casing is provided with a circumferential groove 104 at the end of the casing from which the shaft 94 projects, said groove being spaced from the end of the casing. A sealing member is mounted upon the casing, the same having a skirt portion 106 encircling the end of the casing and having an internal bead 108 fitting in the circumferential groove 104 to anchor the same in place. The bead 108 will

preferably have a constrictive fit upon the casing to anchor firmly thereto. The skirt 106 is of progressively decreasing size and terminates in an end portion 110 having an aperture providing a constrictive sealing fit around the shaft 94 adjacent to and spaced inwardly from the cross-pin 102. The skirt 106 is of such a length that it is longitudinally compressed between its anchorage at points 104—108 with the casing 10—12, and its end abutment with the tooth brush mounted on shaft 94, so that it has a circumferential groove or fold 112 therein at a portion intermediate the end 110 thereof and the end of the casing encircled by the skirt. The fold 112 is important to insure that the action of the skirt 106 will not act to impose any substantial restraint upon the shaft 94 incident to vibration or oscillation of that shaft.

A tooth brush is provided with a shank portion 114 having an axial bore 116 providing a snug sliding fit upon the shaft 94. The brush shank 114 will be provided with a bayonet slot including a socket portion 118 adapted to receive and anchor the cross-pin 102. The construction illustrated in Fig. 3 is preferred, in which it will be observed that a tube or sleeve 120 serves to line the axial bore of the brush shank 114 and to have formed therein the bayonet slot 118. The brush head 122 will mount the usual brush bristles 124.

In the operation of the device it will be apparent that as the armature of the motor is caused to rotate when the motor is energized, it will serve to drive the pinion 66 meshing with the gear 68 fixed upon the hub of the cam 72. The cam 72 will rotate within the ring 76 producing an orbital bodily movement of that ring. The yoke 84, which is pivoted at one end to the ring 76 by the pins 88, transmits the movement of the cam ring 76 to the shank 94 and the tooth brush carried thereby. In this connection it will be apparent that the longitudinal component of the orbital movement of the shaft 94 and the brush will be constant at all times and will be equal to the eccentricity of the cam. The lateral component of movement of the parts will vary. It will be apparent that the member 92 serves as the fulcrum of the oscillatory movement of the shaft 94 and associated parts. Consequently, the extent to which the lateral component of the brush movement occurs will depend upon the ratio of the spacing of the brush head from the fulcrum member 92, on the one hand, as compared to the spacing of the yoke pivot 80 from the fulcrum member 92, on the other hand. Thus it is possible by control of the ratio of these dimensions to control the orbital path of movement and, where the ratio is not a one-to-one ratio, then the orbital movement at the brush bristles will be oval or elliptical. It has been found that an orbital movement in which the minor component is .09 inch in extent and the major component is .135 inch is very effective for the practice of the Charter technique. It will be evident that the parts and the proportions or ratios can readily be established to provide an orbital movement of such dimensions.

One of the important features of the invention is the journaling of the parts of the motor and the cam. The sleeves 44 and 74, which rotate about the stationary pins 42 and 52, provide very efficient bearings. By reason of the elongated nature of these bearing sleeves, slight clearances of the sleeves upon the pins are not important and the sleeves are effective to hold rotating gears, cams and other parts about the selected

axes with minimum tendency toward distortion and with maximum bearing surface, all of which results in reduction of wear, reduction of binding, and insures long life and trouble-free operation.

Another feature of the device is that the very nature of the device in translating rotary motion into oscillatory motion tends to result in the creation of vibration. The construction, however, is such that the cam 72 at which the translatory motion occurs is located at the longitudinal center of the casing. Assuming that the casing is gripped normally by the finger tips at or adjacent to the skirt 106 and to the fulcrum of oscillation, with the body of the casing lying in the palm of the hand, then the position of cam 72 serves to reduce vibration, because the mass of the motor and the application at 72 of forces equal and opposite to those acting at the fulcrum, tend to absorb the vibration. In other words, the user of the device is not required to grip the device firmly nor to resist the vibration of the device by manual exertion. At the same time, at the brush head and the brush bristles, the orbital movement or vibration is provided of sufficiently powerful character so that the desired stimulation of the gum tissues can be provided effectively.

The construction of the joint to provide for removable mounting of the tooth brush is of considerable importance. Thus it will be possible that all members of a family may use the same instrument, without sacrifice of sanitation, by simply providing each member of the family with a tooth brush unit so that when any one person desires to use the unit, he applies his personal tooth brush to the shaft through the detachable coupling. The pin and bayonet slot connection is particularly well suited for this purpose in providing a quick and firm connection. It will be apparent, however, that in this construction the skirt 106, being formed of resilient and flexible material and being of a greater length than the normal spacing between the butt end of the brush handle or shank and the motor housing, is flexed or folded at 112. This tends normally to apply continuously an outward pressure from the skirt 106 upon the end member 110 to cause it to abut the end surface of the brush shank. The resilience of the parts and the application of pressure by the skirt against the brush holds the brush at its bayonet slot connection with the shank and also accommodates the longitudinal component of the oscillatory movement of the shank.

Still another function of this skirt 106 is to provide a seal so that saliva or moisture cannot enter the interior of the motor. This seal is in turn supplemented by the second or inner seal provided by the rubber fulcrum member 92 itself. The important functions of maintenance of a positive saliva seal and the application of pressure to maintain a bayonet slot joint connection of parts, all is accomplished in this construction without imposing any substantial loading upon the motor by those means. In other words, the natural resilience and flexibility of the rubber skirt does not tend substantially to damp the lateral components of oscillation of the shaft so that the load upon the motor is maintained at a minimum.

The foregoing features of the construction substantially as described thus provide a device which satisfies the requirements of usage, a device which is readily portable and may be carried about when traveling, a device which is light in weight, compact, strong and readily usable, a device which is integral in charac-

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ter, and one which is especially well suited for its intended purpose. Thus by the use of the device, each and every part of the gum tissues, both at the inner and outer surfaces of the jaws, may be treated with equal efficacy and with substantially the same motion. The stimulation of the gums to treat pyorrhea may occur effectively without substantial effort and without the requirement of any substantial amount of time beyond that required normally for tooth brushing purposes.

While the preferred embodiment of the invention has been illustrated and described, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. In combination, an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally bodily shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a flexible seal spanning said aperture and sealingly encircling and constrictively gripping said shaft to movably fulcrum the same intermediate the ends of the shaft, and means for detachably mounting a tooth brush on the projecting portion of said shaft.

2. In combination, an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally bodily shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a yieldable shaft fulcrum mounted in and sealing said aperture, a separable connector for detachably anchoring a tool shank on the projecting end of said shaft, and resilient means carried by said housing and encircling the projecting portion of said shank to press longitudinally outwardly against a tool shank at a point spaced from the adjacent end of the housing.

3. In combination, an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally bodily shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a yieldable shaft fulcrum mounted in and sealing said aperture, a detachable connector of the pin and slot type for detachably connecting a tool shank on the projecting part of said shaft, and a resilient seal carried by and projecting longitudinally from said housing for closing said aperture and exerting longitudinal outward pressure on the inner end of said shank to maintain normal interlocking engagement of said pin and slot.

4. In combination, an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally bodily shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a yieldable shaft fulcrum mounted in and sealing said aperture, a detachable connector of the pin and slot type for detachably connecting a tool shank on the projecting portion

of said shaft spaced from said housing, and an elongated resilient skirted member having a constrictive fit around said housing at a fixed point and a constrictive fit on the projecting portion of said shaft, said skirted member being adapted to bear against the end of said shank and being of a length greater than the normal spacing between the fixed point of skirt anchorage on said housing and the adjacent end of said shank whereby said member is normally compressed longitudinally.

5. In combination, an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a yielding shaft fulcrum mounted in and sealing said aperture, and a separable connector for detachably anchoring a tool shank on the projecting part of said shaft, said housing aperture having a circumferential groove, said fulcrum constituting a resilient annular member marginally confined in said groove and constrictively engaging said shank.

6. In combination, an electric motor having housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally bodily shiftable shaft projecting from said housing, said housing having an aperture receiving said shaft with clearance, a separable connector on the projecting part of said shaft for detachably securing a tool shank on said shaft in spaced relation to said housing, and a pair of resilient seals preventing leakage through said aperture around said shaft, one of said seals forming a fulcrum for said oscillatory shaft, the other seal projecting longitudinally from said housing and adapted to exert pressure on the inner end of said shank to maintain said separable connector in operative position relative to said shank.

7. A tool comprising an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally shiftable shaft projecting from said housing and adapted to detachably mount a tool member, said housing having an aperture receiving said shaft with clearance, a yieldable member carried by said housing and fulcruming said shaft, said translating means including a motor driven cam rotatable on an axis transverse of said shaft and located substantially at the center of mass of said motor.

8. A tool comprising an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory shaft projecting from said housing and adapted to detachably mount a tool member, said housing having an aperture receiving said shaft with clearance, a resilient member fulcruming said shaft in said aperture, said translating means including a motor driven cam rotatable on an axis transverse of said shaft and located substantially at the center of mass of said motor, a ring slidably encircling said cam, and a yoke embracing and pivoted to said ring, said yoke constituting a rigid extension of the inner end of said shaft.

9. A tool comprising an electric motor having

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a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally shiftable shaft projecting from said housing and adapted to detachably mount a tool member, said housing having an aperture receiving said shaft with clearance, and a yielding fulcrum for said shaft mounted in said aperture, said motor including a frame having spaced end plates, a shaft carried by said end plates and extending transversely in said housing, and a sleeve having a snug rotative fit on said shaft and mounting the motor armature.

10. A tool comprising an electric motor having a housing adapted to be held in the hand, motion translating means actuated by said motor and confined in said housing, said translating means including an oscillatory and longitudinally shiftable shaft projecting from said housing and adapted to detachably mount a tool member, said housing having an aperture receiving said shaft with clearance, and a yielding fulcrum for said shaft mounted in said aperture, said motor including a frame having spaced end plates, a shaft carried by said end plates and extending trans-

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versely in said housing, and a sleeve having a snug rotative fit on said shaft and mounting the motor armature, said shaft being formed of metal characterized by a measure of porosity, and absorbent members carried by the ends of said shaft outwardly of said sleeve.

CHARLES B. SMITHSON, JR.

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