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(54) HAND-HELD DEVICE FOR BODY CARE, IN PARTICULAR FOR TOOTH CARE AND MOUTH CARE

(71) We, LES PRODUITS ASSOCIES LPA S.A., a Societe anonyme organised under the laws of Switzerland of 39, rue Peillonex, 1225 Chene-Bourg, Switzerland, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to a hand-held device for body care, in particular for tooth care and mouth care, comprising a casing serving as a handle and housing a hydraulic piston motor, an instrument holder supported by the casing and adapted to be oscillatably driven by the hydraulic motor, a liquid inlet duct in the casing connectable to an external liquid pump for feeding pulsating liquid to the hydraulic motor, at least one adjustable valve for switching the hydraulic motor on or off, and treatment instruments constituted by a toothbrush and spraying nozzle adapted to be interchangeably pushed onto the instrument holder.

In such known hand-held devices (German patent specification 1,802,838, German Offenlegungsschriften 2,109,005 and 2,109,006) the hydraulic piston motor is arranged concentric with or in the longitudinal axis of the casing. During the operation of the hydraulic motor, the piston thereof is reciprocally driven in the axial direction of the casing by the pressure pulses produced by the liquid pump and sets the instrument holder into an oscillating rotary motion about its longitudinal axis by means of a motion converter. The hydraulic motor is inoperative when a push-on spraying nozzle is used which is fed through the liquid duct in the casing.

The motion converter consists e.g. of a driving sleeve which is freely rotatably, but axially non-displaceably mounted in continuation of the motor cylinder and has a helical groove provided in its peripheral wall. The leading end of the piston enters into the driving sleeve and supports a radial pin which engages into the helical groove and thus converts the axial reciprocatory motion of the

piston into an oscillating rotation of the driving sleeve. A plug member attached bush-like to the leading end of the driving sleeve serves for receiving the treatment instruments. The liquid duct in the casing for feeding the spraying nozzle includes e.g. an annular space concentrically surrounding the motor cylinder, an opening in the peripheral wall of the driving sleeve and the internal space thereof which is in communication with the bush-like plug member.

These known devices require a plurality of co-operating movable parts, because of the motion converters. Due to their mechanical friction, they cause abrasion effects and reduce the efficiency of the drive, and furthermore the path of the feed pipe for the spraying nozzle in the casing with the inclusion of the motion converter is rather complicated.

The object of this invention is to provide such a hand-held device having a considerably simplified hydraulic piston motor which avoids the need to provide a motion converter and permits the instrument holder or a shaft forming or supporting this instrument holder to be directly driven in an oscillating manner.

According to the invention there is provided a hand-held device for body care, in particular for tooth and mouth care, comprising a casing serving as a handle and housing a hydraulic piston motor, an instrument holder supported by the casing and adapted to be oscillatably driven by the hydraulic motor, a liquid inlet duct in the casing connectable to an external liquid pump for feeding pulsating liquid to the hydraulic motor, at least one adjustable valve for switching the hydraulic motor on and off, and treatment instruments constituted by a toothbrush and spraying nozzle adapted to be interchangeably pushed onto the instrument holder, the piston of the hydraulic motor being arcuate in the direction of its stroke and being connected to a shaft carrying the instrument holder, which shaft is mounted in the casing and is rotatable about its own longitudinal axis by the piston, which axis is con-

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centric with a circle extending through the curved longitudinal axis of the piston and is perpendicular to the plane of the circle, and a return spring for the piston being connected between the shaft and a stationary part of the device.

The invention has the great advantage that the piston of the hydraulic motor may be substantially rigidly connected directly to the shaft supporting the instrument holder, preferably by means of an arm formed on the outer end of the piston, so that the driving mechanism comprises only a single moving part and no centering or guidance for the piston is required in the motor cylinder.

Preferably the motor cylinder is also arcuately curved in the piston stroke direction, like the piston, which is advantageous for reasons of space saving and avoiding superfluous cylinder space, and the piston being surrounded with play by the motor cylinder and being sealed preferably by means of a sleeve only at the end at which it extends from the cylinder.

The oscillatory system formed by the piston and the shaft with the instrument holder as well as the return spring operates with an oscillation frequency of at least 20 Hz, preferably between 40 to 60 Hz, the liquid pump being appropriately dimensioned. The piston oscillation is further considerably improved in this case by elastic abutments which determine the maximum stroke of the piston. Under certain circumstances, even higher oscillation frequencies up to e.g. 100 Hz may be obtained.

The motor cylinder may be constructed rectilinearly. In this case it must merely be dimensioned large enough in order to receive the curved piston. The return spring for the piston consists preferably of a helical spring which surrounds the shaft concentrically and the spring tension of which can be adjusted even after the assembly.

The hand-held device according to the invention is preferably so arranged that it can be operated either with a push-on toothbrush driven by the hydraulic motor, or with a push-on spraying nozzle which, upon adjustment of an appropriate valve, is fed through the hollow instrument holder with the liquid stream delivered by the external liquid pump. According to a further feature of the invention, the shaft mounting the instrument holder is hollow, the inner duct of which constitutes a section of the inner spraying nozzle feed pipe, and the rear end of this hollow shaft is connected to the liquid inlet duct in the casing by a flexible tube which is freely movable over at least a portion of its length. Thereby the important advantage is obtained that the instrument holder or the hollow shaft need not be mounted in sealing rings of any kind, but it is sufficient to arrange the shaft freely rotatable in a substantially

smooth axial bore of the casing body, wherein this axial bore can be constructed sufficiently long for stable mounting. A long bearing bore is favourable in view of the fact that the driven toothbrush is often subjected to rather strong pressure in use.

Since no sealing rings are required for the hollow shaft, all problems are avoided which are connected with the friction and ageing of the sealing rings as well as with the physical and chemical change of the sealing material by toothpaste penetrating therein. The easy mobility thus obtained of the shaft improves considerably the oscillation behaviour so that the instrument holder can be driven with a high degree of efficiency.

Moreover, owing to the use of the hollow shaft and the tube for the spraying nozzle feed pipe the path of this liquid pipe within the casing is simplified, superfluous internal spaces being largely avoided in which air inclusions could be formed.

The inner connecting tube consists preferably not only of a flexible material, but also a sufficiently elastic material in such a manner that in the operation of a driven instrument it effects a certain additional resetting force, which has been found to be advantageous for the oscillation behaviour of the whole oscillation system.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal section through a hand-held device for tooth and mouth care with a push-on toothbrush attached and fitted with a hydraulic motor according to the invention.

Fig. 1a is a longitudinal section through a spraying nozzle which can be attached to the device according to Fig. 1 in place of the push-on toothbrush.

Fig. 2 is a section on the line II—II of Fig. 1.

Fig. 3 is a section on the line III—III of Fig. 1 through the hydraulic motor.

Figs. 4 to 6 are diagrammatic views illustrating the three operational states of the device, namely operation of the liquid pump during idling (Fig. 4), operation of the hand-held device with a driven toothbrush (Fig. 5), and operation of the device with a spraying nozzle fed with a liquid (Fig. 6), and

Figs. 7a and 7b is an axial section through a second embodiment of the device with push-on toothbrush.

Fig. 8 is an axial section of the forward portion of the device with a spraying nozzle fitted thereon, and

Fig. 9 is a section on the line IX—IX of Fig. 7a.

According to Fig. 1 the device 1 comprises a casing 4 serving as a handle having a push-on toothbrush 2 attached thereto, the casing

4 being closed at its rear end 5 and having a body 6 inserted into the front end thereof. The body 6 has two connecting tubes 7 and 8 for the connection of flexible tubes which form the liquid feed pipe and the liquid return pipe, respectively. These tubes (not illustrated) connect the device to a liquid pump which is also not illustrated and which produces a pulsating liquid jet.

The forward end of the body 6 has attached thereto an annular flange 9 onto which a removable cover cap 10 snap fits. A central bore 12 of the body 6 has a hollow shaft 13 mounted therein which is oscillatable about its longitudinal axis and the forward end 14 of which projects with play through a central opening 11 of the cover cap 10. This forward end 14 of the hollow shaft 13 is provided with a detent profile for pushing thereon the toothbrush 2 or alternatively a spraying nozzle 3 which is illustrated in Fig. 1a. Thus the hollow shaft 13 forms an instrument holder.

The rear end of the body 6 has attached thereto a hydraulic motor 15 which will be described hereafter with reference to Figs. 2 and 3. The motor 15 has a piston 17 directly and non-rotatably connected to the hollow shaft 13 and oscillates this hollow shaft 13 about its longitudinal axis.

Liquid ducts 25 to 29, a three way valve 30 and a shut-off valve 31 serving as a change-over valve are disposed in the body 6. The duct 25 connects the inlet tube 7 of the body to the inlet tube 23 of the hydraulic motor 15, and the duct 26 connects the outlet tube 24 of the hydraulic motor 15 to the duct 27 which extends transversely past the central bore 12 to the inlet of the valve 30. The duct 28 which is disposed parallel to the duct 27 connects one outlet opening of the valve 30 to the outlet tube 8 of the device 1 and thus to the liquid return pipe. The short duct 29 connects the other outlet opening of the valve 30 to the inlet of the shut-off valve 31. A flexible tube 33 is substantially freely movable within the casing 4 and connects the outlet tube 32 of the valve 31 to the rear end 34 of the hollow shaft 13, fixing clips 52 and 53 ensuring a sealed connection between the tube ends of the tubes 32 and 33 respectively. The inner duct 35 of the hollow shaft 13 terminates at the forward shaft end 14 and together with the tube 33 and the short duct 29 forms the liquid feed pipe for a spraying nozzle 3 pushed onto the forward end of the shaft 14. The valve 30 permits the hand-held device to be switched on and off while the liquid pump operates, and for this purpose the valve plunger 36 is adjustable together with the valve head 37 forming the closure member, by means of slider member 38 which projects outwardly through an elongate slot 41 of the casing 4. In the position of the valve 30 illustrated

in Fig. 1 the valve head 37 is located sealingly in a rear O-ring 39 and thereby shuts off the feed pipe to the short duct 29 and thus to the other valve 31, whereas the duct 27 is connected to the duct 28 through the O-ring 40 and therefore to the liquid return pipe to the liquid pump. The device is therefore in the idling operating position, as will be illustrated below with reference to Fig. 4. When the slider member 38 and the valve plunger 36 are pushed forwardly, the valve head 37 then tightly engaging into the O-ring 40, shuts the liquid return pipe, and opens the short duct 29 to the valve 31.

This valve 31 also has a valve plunger 42 with a valve head 43 forming a closure member and co-operating with an O-ring 44. The valve plunger 42 has an actuator pin 45 which projects at the front through an opening 47 of the cover cap 10 and under the action of a helical spring 46 assumes the position illustrated in Fig. 1 in which the valve head 43 tightly engaging in the O-ring 44 shuts the inlet to the tube 33 and thereby to the hollow shaft 13. In this position, when the valve 30 shuts the liquid return pipe, the hydraulic motor 15 is driven and thereby the push-on toothbrush is moved oscillatingly. When the actuator pin 45 is pressed in against the action of the spring 46 and therefore the valve head 43 is displaced out of the O-ring 44, access to the tube 33 and to the inner duct 35 of the hollow shaft is opened, so that then a spraying nozzle 3 can be fed. The two last-mentioned operational states of the device will be described in more detail with reference to the Figs. 5 and 6.

In order to perfectly seal the outlet locations of the hollow shaft 13 from the body 6 and simultaneously to ensure the mobility the shaft 13 and actuator pin 45, two truncated cone-shaped sealing sleeves 48 and 49 of a flexible material, for example rubber, are provided the forward ends of which are tightly clamped to the periphery of the hollow shaft 13 and the actuator pin 45, respectively, and the rear ends of which are tightly clamped between the body 6 and the annular flange 9. Both sealing sleeves 48 and 49 are for example as shown in Fig. 1, constructed in one piece, or may be separate parts.

Since the hollow shaft 13 is connected to the stationary body 6 by means of the flexible tube 33, no further seals need be present between this hollow shaft 13 and the body 6. In particular no O-rings are required in which this hollow shaft must be rotatable, so that the friction losses which are normally associated with such a shaft mounting are avoided. The axial displaceability of the hollow shaft 13 is limited by an integral forward shoulder 50 and by a rear bush 51 located on the hollow shaft 13. Within normal tolerances the axial displacement may amount to approximately 0.3 mm.

Referring to Fig. 3, the hydraulic motor 15 comprises the piston 17 which is movable in a motor cylinder 16 with rather large play. The piston 17 and cylinder 16 are arcuate in the stroke direction, their curved axes lying on a circle which is concentric with the longitudinal axis of the hollow shaft 13. A flange 18 fixed to the open cylinder end supports an O-ring 19 sealing the piston 17. The piston 17 is non-rotatably, but axially displaceably secured to the hollow shaft 13 through the intermediary of an integral arm 20 and sleeve 21, the hollow shaft 13 having longitudinal ribs 22 which engage in axial grooves in the inner periphery of the sleeve 21 surrounding the hollow shaft 13. The axial mobility of the piston 17 permits automatic centering thereof in relation to the motor cylinder 16, so that one-sided pressure against the O-ring 19 or oblique positioning of the piston in the cylinder is avoided, when the hollow shaft 13 moves within its axial play and above all when it is pressed rearwardly by the contact pressure exerted by the user of a toothbrush. Thus the movement path and the position of the piston 17 are defined without special centring or guiding members by the sliding seat thereof on the hollow shaft 13, and large tolerance demands need not be fulfilled.

The inlet and outlet openings of the motor cylinder 16 formed by inlet and outlet tubes 23 and 24, respectively, lie adjacent each other as can be seen in Fig. 3 at the inner cylinder end remote from the piston exit end, or are at least approximately disposed diametrically opposite. They may alternatively be disposed at or in the region of the oppositely disposed cylinder ends. Inlet and outlet openings are connected together in all positions of the piston, in particular in the rest position of the piston 17 illustrated in Fig. 3 by full lines, through the annular space between the piston and the inner periphery of the cylinder. Since in this way the motor cylinder 16 forms part of the liquid pipe extending through the body 6 between the ducts 25 and 26, the piston 17 is always well covered with liquid and thus wetted, even during idling of the liquid pump and during feeding of a spraying nozzle, and likewise any air bubbles are removed thereby from the hydraulic motor 15. This is important in order to obtain a perfect start of the hydraulic motor 15 when the duct 27 is closed by the valve 30.

The tubes 23 and 24 which are oriented parallel to each other and perpendicular to the piston stroke are pressed into appropriate openings in this casing portion for simple fixing of the motor cylinder 16 to the body 6.

The return spring used for the piston 17 is a helical spring 54 which is torsion-loaded and concentrically surrounds the hollow shaft 13 to facilitate centring. It is disposed on a

sleeve 59 mounted rigidly on the hollow shaft 13. This sleeve 59 has axial inner grooves and is non-rotatably secured to the rear region of the hollow shaft 13 provided with the longitudinal ribs 22, the ribs engaging in the grooves. The leading spring end 55 is radially bent away and engages in a radially directed groove 57 of a securing member 58 which is formed by a radial projection at a front flange 59a of a sleeve 59, and is therefore non-rotatably connected to the hollow shaft 13. The flange 59a has an annular groove for receiving the front end of the spring. The rear end 56 of the spring which is also radially bent away is secured against displacement in the circumferential direction by a securing member 60 which is formed on an arm 62 rigidly connected to the body 6 or the motor cylinder 16. This securing member 60 arcuately surrounds the helical spring 54 which is not pre-tensioned in the axial direction, over a portion of the periphery thereof and comprises on its side remote from the front spring end a plurality of equiangularly, radially-directed grooves 61 into which the spring end 56 is selectively insertable.

In this manner the pre-tensioning of the spring, i.e. its torsion tension, can be conveniently adjusted even after assembly, by selecting a suitable radial groove 61 for receiving the spring end 56. This avoids the difficulty of having to select a helical spring of predetermined length and spring characteristic prior to assembly. The stroke of the piston 17 is limited in both directions by stationary abutments 63 and 64 which are constituted preferably by rubber buffers, to avoid noise and hard piston impacts. The abutment 63 (Fig. 2) fixed to the arm 62 co operates with the securing member 58 and defines the rest position of the piston 17, illustrated by full lines in Fig. 3. According to Fig. 3 the abutment 64 fixed to the body 6 determines the maximum working stroke of the piston 17 illustrated by dash-dotted lines and serves as a safety limit. In normal motor operation it should not be contacted by the piston or, when the motor runs without load, at most lightly. The helical spring 54 is pre-tensioned in such a manner that the force retaining the piston 17 in its rest position is sufficient to avoid movement of the piston under the effect of the pulsating liquid when the device is operated without load or with a spraying nozzle 3. When the hydraulic motor 15 is in operation, the working stroke of the piston 17 is effected by a pressure pulse delivered by the liquid pump against the effect of the spring 54 which thereafter during the following pressure pause returns the piston to its rest position. In the present example, the maximum working stroke of the piston 17 amounts to approximately 60°, as illustrated by dash-dotted lines in Fig. 2 for

the spring end 56, and for the piston in Fig. 3.

Figs. 4, 5 and 6 illustrate diagrammatically the three operational states of the hand-held device. The liquid pump P and its water reservoir R are diagrammatically indicated in Fig. 4. The pump outlet is connected to the inlet tube 23 of the hydraulic motor 15 by the liquid feed pipe 70, whereas the outlet tube 8 of the device 1 (Fig. 1) is connected to the liquid return pipe 71 which terminates in the liquid reservoir R or at the inlet of the pump P. In Fig. 4 the valve 30 is in its OFF-position in which it connects the liquid feed pipe 70 to the liquid return pipe 71 by way of the cylinder chamber of the hydraulic motor 15, that is to say the inlet tube 23 and the outlet tube 24 of the hydraulic motor are connected by way of the ducts 27 and 28 of the body 6. Since the pump circuit is thus short-circuited in the sense of the arrows by way of the casing, substantially no pressure can be built up in the hydraulic system, the hydraulic motor 15 remains inoperative and the liquid delivered by the pump flows to the reservoir R or back to the pump inlet. At the same time the hydraulic system, in particular the hydraulic motor lying in the liquid path, is de-aerated.

In Fig. 5 the valve 30 is in its ON-position in which the liquid return pipe 71 is shut off. Under the effect of its spring the valve 30 interrupts the connection to the tube 33. Since the liquid travelling from the pump through the feed pipe 70 to the hydraulic motor 15 cannot flow away the hydraulic motor 15 is driven, its piston 17 swinging to and fro under the action of the pulsating liquid and the return spring 54. Therefore the push-on toothbrush located on the driven hollow shaft 13 oscillates about its longitudinal axis in the direction of the double-arrow in Fig. 5. With the exception of leakage losses, substantially no liquid is lost thereby; the liquid column present in the liquid path between the pump and the hydraulic motor 15 merely swings to and fro. Thus the pump P operates, in this case, substantially as a pressure transmitter.

When the hydraulic motor 15 is in operation, the liquid pump, the outer connecting tube, the hydraulic motor, the pulsating liquid as well as all mechanically moved parts form an oscillatory system which under load operates at least approximately at its resonant frequency in order to obtain a sufficient degree of efficiency of the hydraulic motor and a sufficient piston stroke and thereby a sufficient oscillatory movement of the toothbrush 2. The numerous factors which determine the resonant frequency of this system and which must therefore be appropriately selected for its tuning include the helical spring 54 and, to a lesser degree, the tube 33, provided its material is not only flexible but preferably also sufficiently elastic. In addition to the return force of the

helical spring 54, the elastic return force of the tube 33 subjected to forward and backward torsion acts also in this case to a minor degree on the oscillating hollow shaft 13. When the oscillatory system referred to has been tuned substantially coarsely by a suitable choice of the factors which determine the resonant frequency, but which are of no detailed interest here, fine tuning is still possible after the assembly of the major parts of the device in a simple manner by means of the helical spring 54 as well as also by means of the tube 33, which is very advantageous. As already described, the torsional tension of the helical spring 54 can be changed by the selection of an appropriate groove 61 for the spring end 56, whereas the return force exerted by the tube 33 is variable by simply changing the tube dimensions, in particular the tube length. This constitutes a further advantage.

Furthermore, in order to prevent the oscillation amplitude of the oscillatory system referred to and thus the stroke of the piston 17 from increasing too much in the unloaded state of the hydraulic motor compared with the loaded state, that is to say when the user presses the toothbrush against the teeth, a suitably dimensioned damping of the oscillating parts is important. This necessary damping is then produced in a simple manner by the flexible sleeve 48 which is twisted to and fro during the oscillation of the hollow shaft 13 and the material of which is selected accordingly in respect of thickness and size. In this manner it can be ensured that the oscillation amplitude of the system and thus the stroke of the piston 17 in the unloaded state of the hydraulic motor is at most 30% greater than under load and thus the piston 17 contacts the abutment 64 (Fig. 3) at most, if at all, with a weak impact.

In Fig. 6, the valve 30 is again in its ON-position, whereas the valve 31 is displaced by the pushed-on spraying nozzle 3 into that position in which the liquid feed pipe 70 is connected through the cylinder chamber of the hydraulic motor 15 to the tube 33 and thus to the inner duct 35 of the hollow shaft 13. For this purpose, as illustrated in Fig. 1a, the spraying nozzle 3 comprises an abutment 3b which projects radially outside its plug-on formation 3a and which is constructed in the form of a flange concentrically surrounding this plug-on formation 3a. The abutment 3b cooperates with the actuator pin 45 in such a manner that this actuator pin 45 and thus the valve plunger 42 is displaced into its depressed inner position against the effect of the valve spring 46 when the spraying nozzle 3 is attached. Thus, in this position the hydraulic motor 15 is out of action, the pre-tension of the helical spring 54 preventing a piston movement under the effect of the liquid pulses, and the spraying nozzle 3 is connected to the external liquid pump, so that a pulsating liquid

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jet issues from the spraying nozzle in the direction of the arrow in Fig. 6. The user need not take separate action to effect a valve change-over upon change from 'brush operation' to 'spraying nozzle operation', since as described this changeover occurs automatically when the spraying nozzle 3 is attached. Upon removal of the spraying nozzle the valve 31 automatically assumes its position corresponding to 'brush operation' according to Fig. 5 under the effect of its valve spring 46. The rear end of the push-on toothbrush 2 is so constructed that it does not contact the actuator pin 45 when fitted on the device.

Owing to the direct oscillating drive of the hollow shaft with the toothbrush, not only are friction and abrasion effects avoided which occur in a motion converter, but also the oscillatory system which comprises substantially only one moving part oscillates in an impact and shock-free manner. Moreover the mechanical expenditure is very simple so that the hand-held device is economical to produce, the motor cylinder and the piston with its fixing sleeve being inexpensive components of synthetic resin.

Finally, since the driven shaft is constructed as a hollow shaft and constitutes directly a rectilinear section of the liquid feed pipe the spraying nozzle which extends coaxially in the longitudinal axis of the hand-held device, a simple and direct guidance of the liquid in the device casing is obtained and so-called dead spaces and air inclusions connected therewith are largely avoided.

In the embodiment according to Figs. 7a, 7b, 8 and 9 the hand-held device again comprises an elongate casing 101 and a body 106 in which the valve with the outer actuator element 138, not illustrated here in detail but corresponding to the three-way valve 30 in the first embodiment, and the shut-off valve 131 operating as change-over valve and corresponding to the shut-off valve 31 in the first embodiment are mounted. In the present case, the valve 131 is located approximately diametrically opposite the three-way valve. The hollow shaft 113 is mounted in the central bore 112 of the body 106 and consists of an inner metal tube 175 of stainless steel and a synthetic resin jacket 176, for example an acetate resin. In the region of its bearing it is provided with a metal sleeve 177 pressed thereon. The rear connecting tube 134 of the hollow shaft 113 is again connected to the tube 132 of the change-over valve 131 by means of a flexible freely movable tube 133. The forward end of the hollow shaft 113 supports a sleeve-like member 178 which serves for clamping the forward end of the elastic sealing sleeve 148 and comprises at the front a detent profile 114 for attaching a push-on toothbrush 102 or a spraying nozzle 103 (Fig. 8). The forward end of the casing body 106 has a flange 109 attached thereto which clamps

the rear end of the sealing sleeve 148 against the body 106 and on which a cover cap 110 is retained.

Within the cover cap 110 an axially freely movable cup-shaped slider member 180 is mounted on a guide pin 179 of the flange 109. As illustrated in Fig. 7b, the actuator pin 145 of the change-over valve 131 engages in an inner opening of the slider member 180 which is not engaged by the plug of a push-on toothbrush 102 (Fig. 7b), but is pushed back (Fig. 8) when a spraying nozzle 103 is attached by the axially rearwardly elongated projection 103b of the nozzle plug, with consequent displacement of the actuator pin 145. As in the first embodiment, during attachment of the spraying nozzle 103 the change-over valve 131 is displaced against its valve spring 146 by which it is normally held in the position which corresponds to the feeding of the hydraulic motor 115, such displacement occurring by means of the slider member 180 into the position which corresponds to the feeding of the spraying nozzle. In the embodiment under consideration, the actuator pin 145 is located outside the sealing sleeve 148 and is sealed by an O-ring 149.

The curved cylinder 116 of the hydraulic motor 115 consists of synthetic resin and is secured to the body 106. In this case, it has at the rear end only a single lateral feed tube 123 which is connected through a single duct to the liquid inlet pipe in the body 106, corresponding to the duct 27 according to Fig. 1. Thus the outlet tube 24 and the duct 26 of Fig. 1 are omitted. It is sufficient that the cylinder 116 is connected through a single pipe to the feed pipe from the external liquid pumps. In the embodiment according to Fig. 1 this is the duct 27 leading from the casing connecting tube 7 to the three-way valve 30. It has been found that even in this simplified construction the hydraulic motor operates perfectly and that substantially no air inclusions are formed in the cylinder and its feed pipe. The casing connecting tubes, corresponding to the tubes 7 and 8 of Fig. 1, as well as the ducts in communication therewith and extending in the casing body, to the motor cylinder 116 as well as to the three way valve corresponding to the valve 30 in Fig. 1, and to the change-over valve 131 are not illustrated in detail in Fig. 7b. The casing connecting tube 107 can be seen in Fig. 9.

The arcuate motor piston 117 consists of a curved metal pin of circular cross-section, is again arranged with play in the cylinder 116 and sealed at the outer cylinder end by a sealing sleeve 119 which is retained by a flange 118 fixed to the cylinder, as in the embodiment according to Fig. 3. The outer end of the metal platen 117 is embedded in a synthetic resin component, for example glass-reinforced polyester, which forms a radial arm 120 with an attachment 181 directed parallel

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to the hollow shaft 113 (Fig. 7a) and a fixing sleeve 121 which is non-rotatably mounted on the hollow shaft 113, but is axially easily displaceable thereon because of the self-centering of the piston. Again as in the first embodiment, longitudinal ribs 122 provided on the synthetic resin jacket 176 of the hollow shaft 113 engage in corresponding longitudinal grooves in the inner periphery of the sleeve 121. As illustrated in Fig. 7a, the fixing sleeve 121 supporting the piston has a relatively great axial length, which ensures a good sliding seat for the piston. At its casting location the metal piston 117 has a transverse opening 183 (Fig. 7a) which during casting is penetrated by synthetic resin and ensures a particularly stable connection. The attachment 181 of the synthetic resin component is surrounded by a rubber buffer 182 which in the inner position of the piston illustrated in Fig. 9 abuts against the casing abutment 118 and thereby defines the rest position of the piston. The maximum stroke of the piston which amounts to 45° in the present embodiment is limited by an elastic stationary abutment in the form of a rubber buffer 164 pushed over a casing pin 184, the piston arm 120 impinging upon this buffer which, in order to prevent a tilting of the piston upon striking the abutment, lies in the plane of the circle defined by the curved piston or at least approximately in the continuation of the curved longitudinal piston axis. The maximum piston displacement where it abuts the rubber buffer 164 is illustrated by dash-dotted lines in Fig. 9.

The casing pin 184 is formed on an inner casing part 185 which, on the one hand partly embraces a tubular attachment of the body 106 receiving the valve body of the valve 131, and, on the other hand, comprises the cup-shaped fixing member 160 (Fig. 7a) for the stationary end 156 of the helical spring 154 which forms the return spring for the piston 117 and surrounds with play the hollow shaft 113 and the fixing sleeve 121. For the purpose of fixing, the radially bent spring end 156 engages in a radial groove 161 of the fixing member 160.

The other spring end 155 which is likewise radially bent is secured to a fixing member 158 which is connected to the hollow shaft 113, and which comprises a radial groove 157 which is engaged by the spring end 155. This fixing member 158 which surrounds the spring 154 like a cup sits on a sleeve 159 which is pressed on to the rear end of the hollow shaft 113, the longitudinal ribs 122 of the latter engaging into corresponding axial grooves in the inner periphery of the sleeve 159. The fixing member 158 comprises an axially rearwardly extending annular flange, the inner periphery of which has internal teeth 186 meshing with peripheral teeth 187 of the sleeve 159, the member 158 having a rear smooth peripheral region 188. A flange 189 which en-

sures the fixing of the tube 133 on the connecting tube 134 of the hollow shaft 113 engages into the rear smooth region of the inner periphery of the fixing member 158.

The described construction of the fixing of the spring end 155 permits in a simple manner pre-tensioning of the helical spring 154 which in operation is torsionally loaded, to be adjusted after the assembly, in that the fixing member 158, under certain circumstances with the flange 189 removed, is displaced forwardly on the hollow shaft 113 while compressing the spring 154 until its internal teeth 186 are disengaged from the teeth 187 of the sleeve 159, whereupon the fixing member 158 together with the spring end 155 engaging into the groove 157 can be rotated in the one direction or the other by one or more teeth of the teeth referred to with corresponding change of the torsion pre-tension. Thereafter the fixing member 158 must merely be displaced into its normal position illustrated in Fig. 7a in which it is non-rotatably fixed on the hollow shaft 113 by the intermeshing of the teeth.

The hand-held device described above is so constructed that the piston 117 of the hydraulic motor 115, in operation, abuts with a more or less great force the abutments limiting its stroke elastically so that noise is damped and shock-free oscillation is improved. When the external liquid pump is appropriately dimensioned, the arrangement may be made so that the motor piston with the hollow shaft and the driven instrument oscillates at a frequency of at least 20 Hz, preferably between 40 and 60 Hz, wherein when the electro-motor driving the hydraulic pump rotates preferably for example at a speed of 3000 revs/min, the toothbrush is driven during idling of the hand-held device at a speed of 50 Hz, this being particularly favourable for the massage of the gums.

The function of the hand-held device in this embodiment is the same as in the first embodiment as described with reference to Figs. 4 to 6.

WHAT WE CLAIM IS:—

1. A hand-held device for body care, in particular for tooth and mouth care, comprising a casing serving as a handle and housing a hydraulic piston motor, an instrument holder supported by the casing and adapted to be oscillatably driven by the hydraulic motor, a liquid inlet duct in the casing connectable to an external liquid pump for feed pulsating liquid to the hydraulic motor, at least one adjustable valve for switching the hydraulic motor on and off, and treatment instruments constituted by a toothbrush and spraying nozzle adapted to be interchangeably pushed onto the instrument holder, the piston of the hydraulic motor being arcuate in the direction of its stroke and being connected to a shaft carrying the instrument holder, which shaft is mounted



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to the hollow shaft 113 (Fig. 7a) and a fixing sleeve 121 which is non-rotatably mounted on the hollow shaft 113, but is axially easily displaceable thereon because of the self-centering of the piston. Again as in the first embodiment, longitudinal ribs 122 provided on the synthetic resin jacket 176 of the hollow shaft 113 engage in corresponding longitudinal grooves in the inner periphery of the sleeve 121. As illustrated in Fig. 7a, the fixing sleeve 121 supporting the piston has a relatively great axial length, which ensures a good sliding seat for the piston. At its casting location the metal piston 117 has a transverse opening 183 (Fig. 7a) which during casting is penetrated by synthetic resin and ensures a particularly stable connection. The attachment 181 of the synthetic resin component is surrounded by a rubber buffer 182 which in the inner position of the piston illustrated in Fig. 9 abuts against the casing abutment 118 and thereby defines the rest position of the piston. The maximum stroke of the piston which amounts to 45° in the present embodiment is limited by an elastic stationary abutment in the form of a rubber buffer 164 pushed over a casing pin 184, the piston arm 120 impinging upon this buffer which, in order to prevent a tilting of the piston upon striking the abutment, lies in the plane of the circle defined by the curved piston or at least approximately in the continuation of the curved longitudinal piston axis. The maximum piston displacement where it abuts the rubber buffer 164 is illustrated by dash-dotted lines in Fig. 9.

The casing pin 184 is formed on an inner casing part 185 which, on the one hand partly embraces a tubular attachment of the body 106 receiving the valve body of the valve 131, and, on the other hand, comprises the cup-shaped fixing member 160 (Fig. 7a) for the stationary end 156 of the helical spring 154 which forms the return spring for the piston 117 and surrounds with play the hollow shaft 113 and the fixing sleeve 121. For the purpose of fixing, the radially bent spring end 156 engages in a radial groove 161 of the fixing member 160.

The other spring end 155 which is likewise radially bent is secured to a fixing member 158 which is connected to the hollow shaft 113, and which comprises a radial groove 157 which is engaged by the spring end 155. This fixing member 158 which surrounds the spring 154 like a cup sits on a sleeve 159 which is pressed on to the rear end of the hollow shaft 113, the longitudinal ribs 122 of the latter engaging into corresponding axial grooves in the inner periphery of the sleeve 159. The fixing member 158 comprises an axially rearwardly extending annular flange, the inner periphery of which has internal teeth 186 meshing with peripheral teeth 187 of the sleeve 159, the member 158 having a rear smooth peripheral region 188. A flange 189 which en-

sures the fixing of the tube 133 on the connecting tube 134 of the hollow shaft 113 engages into the rear smooth region of the inner periphery of the fixing member 158.

The described construction of the fixing of the spring end 155 permits in a simple manner pre-tensioning of the helical spring 154 which in operation is torsionally loaded, to be adjusted after the assembly, in that the fixing member 158, under certain circumstances with the flange 189 removed, is displaced forwardly on the hollow shaft 113 while compressing the spring 154 until its internal teeth 186 are disengaged from the teeth 187 of the sleeve 159, whereupon the fixing member 158 together with the spring end 155 engaging into the groove 157 can be rotated in the one direction or the other by one or more teeth of the teeth referred to with corresponding change of the torsion pre-tension. Thereafter the fixing member 158 must merely be displaced into its normal position illustrated in Fig. 7a in which it is non-rotatably fixed on the hollow shaft 113 by the intermeshing of the teeth.

The hand-held device described above is so constructed that the piston 117 of the hydraulic motor 115, in operation, abuts with a more or less great force the abutments limiting its stroke elastically so that noise is damped and shock-free oscillation is improved. When the external liquid pump is appropriately dimensioned, the arrangement may be made so that the motor piston with the hollow shaft and the driven instrument oscillates at a frequency of at least 20 Hz, preferably between 40 and 60 Hz, wherein when the electro-motor driving the hydraulic pump rotates preferably for example at a speed of 3000 revs/min, the toothbrush is driven during idling of the hand-held device at a speed of 50 Hz, this being particularly favourable for the massage of the gums.

The function of the hand-held device in this embodiment is the same as in the first embodiment as described with reference to Figs. 4 to 6.

WHAT WE CLAIM IS:—

1. A hand-held device for body care, in particular for tooth and mouth care, comprising a casing serving as a handle and housing a hydraulic piston motor, an instrument holder supported by the casing and adapted to be oscillatably driven by the hydraulic motor, a liquid inlet duct in the casing connectable to an external liquid pump for feed pulsating liquid to the hydraulic motor, at least one adjustable valve for switching the hydraulic motor on and off, and treatment instruments constituted by a toothbrush and spraying nozzle adapted to be interchangeably pushed onto the instrument holder, the piston of the hydraulic motor being arcuate in the direction of its stroke and being connected to a shaft carrying the instrument holder, which shaft is mounted



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in the casing and is rotatable about its own longitudinal axis by the piston, which axis is concentric with a circle extending through the curved longitudinal axis of the piston and is perpendicular to the plane of the circle, and a return spring for the piston being connected between the shaft and a stationary part of the device.

2. A device according to claim 1, in which the piston and the masses moved thereby, and the return spring are so dimensioned that they constitute an oscillatory system the oscillation frequency of which amounts to at least 20 Hz.

3. A device according to claim 1, in which the motor cylinder is also arcuate in the direction of the piston stroke, the motor cylinder surrounding the piston with play, and the piston being sealed by only one seal disposed at the piston outlet end of the cylinder, the inlet opening of the motor cylinder being arranged in the vicinity of the end of the cylinder opposite the outlet.

4. A device according to any one of the claims 1 to 3, in which the return spring is a helical spring which surrounds the shaft, one end of the spring being non-rotatably attached to the shaft and the other end of which is retained stationary, the spring ends being bent radially to engage in radial grooves of fixing members, one of which is fixed to the casing and the other non-rotatably to the shaft.

5. A device according to claim 4, in which for the purpose of adjusting spring tension the said one fixing member comprises a plurality of radially-directed, angularly spaced grooves into which the said other bent spring end can be selectively inserted.

6. A device according to claim 4, in which one of the fixing members of cup-shaped construction has internal teeth and sits on a sleeve with peripheral teeth which is securely connected to the shaft, the fixing member being non-rotatably fixed on the sleeve by the inter-meshing of the two sets of teeth and being axially displaceable thereon for the purpose of adjusting spring tension, and being rotatable when the teeth have been disengaged.

7. A device according to any one of claims 1 to 6, in which a radially directed arm is attached to the outer end of the piston and carries a sleeve surrounding the shaft, longitudinal ribs provided on the shaft engaging in longitudinal grooves in the inner periphery of the sleeve.

8. A device according to claim 7, in which the piston is a curved metal pin on to which

a synthetic resin component is cast, which component forms the arm and the sleeve.

9. A device according to any one of the claims 1 to 8, in that the maximum stroke of the piston is determined by elastic abutments.

10. A device according to claim 9, in which that at least one abutment lies in the plane of the circle extending through the longitudinal curved axis of the piston.

11. A device according to any one of claims 1 to 10, comprising a liquid feed pipe terminating in the instrument holder which is of hollow construction for feeding a push-on spraying nozzle with the pulsating liquid jet delivered by the external liquid pump, and a change-over valve for selectively switching on the hydraulic motor or the spraying nozzle, the shaft being hollow so as to provide an inner duct which constitutes a section of the said feed pipe for the spraying nozzle, and this inner duct being connected by a flexible tube to the liquid inlet duct in the casing, and the flexible tube being freely movable in the casing over at least a portion of its length and having elastic properties.

12. A device according to claim 11, in which the change-over valve comprises an axially displaceable valve plunger with an actuator pin which projects out of the front of the casing and which is spring loaded to a position which corresponds to the pulsating liquid feeding the hydraulic motor with the actuator pin located in its foremost position, the push-on spraying nozzle having an abutment which cooperates with the actuator pin and by which, when the spraying nozzle is pushed-on, the actuator pin is pressed into its rear position corresponding to the pulsating liquid feeding the spraying nozzle, the toothbrush, when pushed on to the instrument holder, remaining clear of the actuator pin.

13. A device according to claim 12, in which a slider member in the form of a cup-shaped member surrounding the instrument holder with a play and, cooperating with the actuator pin, is axially displaceable within a cover cap placed on the forward casing end, and the abutment of the pushed-on spraying nozzle which extends through a central opening of the cover cap serving to press the slider member into its rear position in which the actuator pin is depressed.

14. A device according to claim 11 or 12, in which the hollow shaft consists of a metal tube provided with a jacket of synthetic resin, this synthetic resin jacket supporting



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a metal sleeve in the region of its bearing within the central bore in the casing.

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15. A hand-held device for body care in particular for tooth and mouth care, substantially as hereinbefore described with reference to Figs. 1 to 6, or Figs. 4 to 9 of the accompanying drawings.

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