Jan. 4, 1966 J. W. MATTINGLY 3,227,158

METHOD AND APPARATUS FOR ORAL HYGIENE

Filed May 8, 1961

3 Sheets-Sheet 1

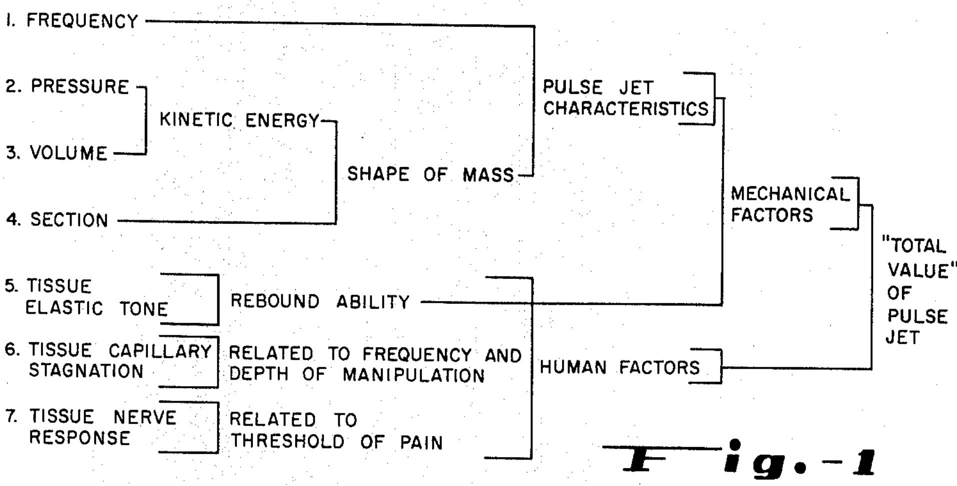

Fig.-1

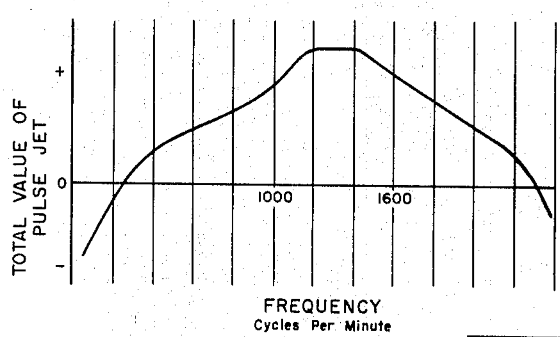

Fig.-2

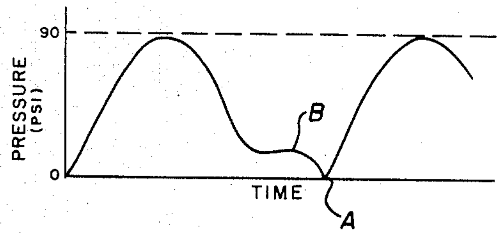

Fig.-8

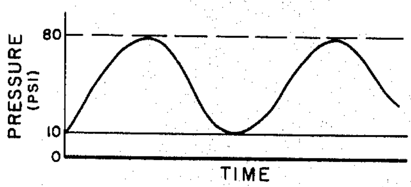

Fig.-9

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METHOD AND APPARATUS FOR ORAL HYGIENE

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3 Sheets-Sheet 2

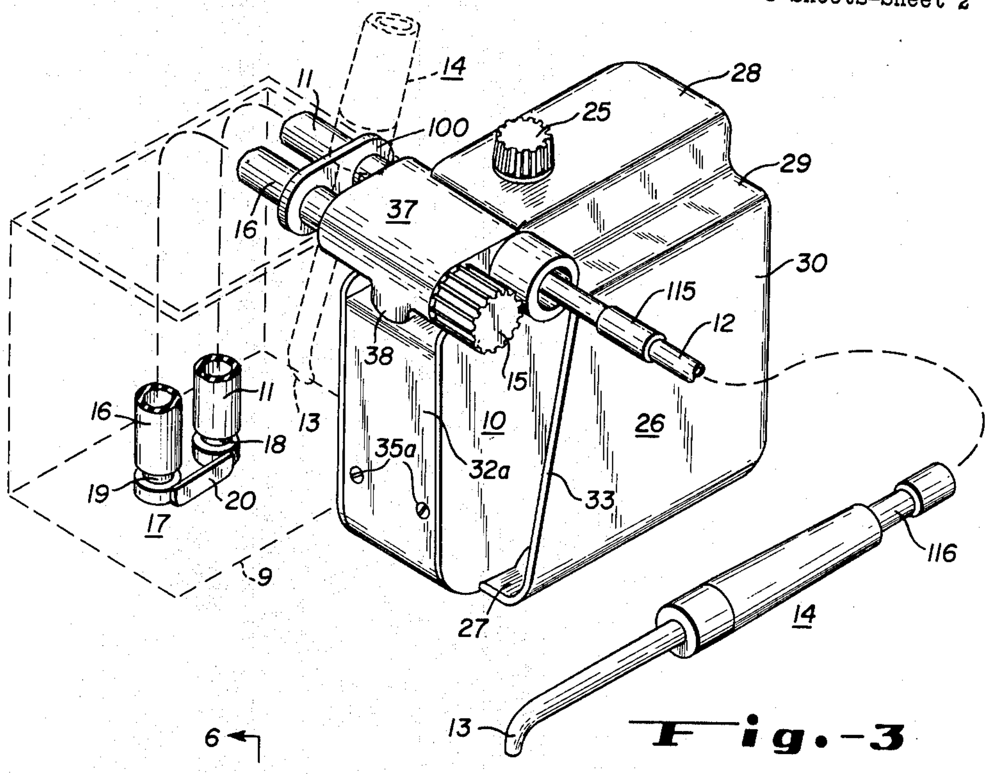
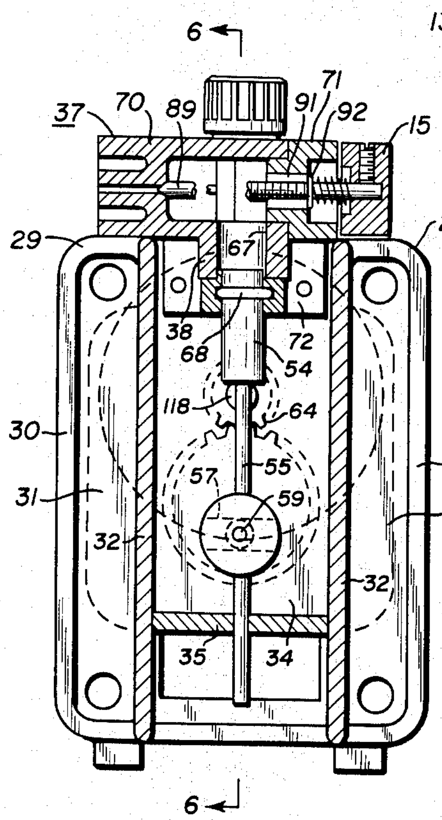


Fig.-3



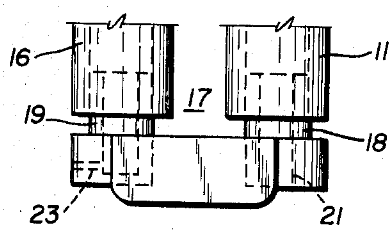


Fig.-4

Fig.-5

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METHOD AND APPARATUS FOR ORAL HYGIENE

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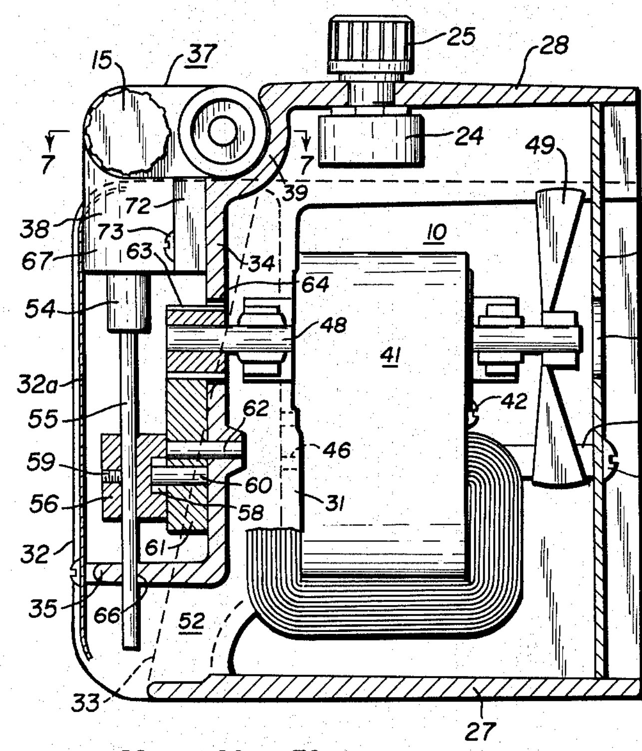

Fig.-6

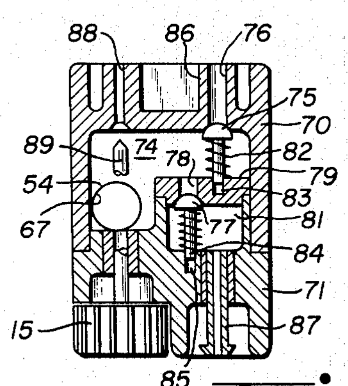

Fig.-7

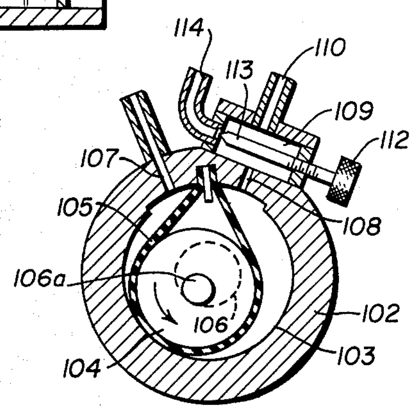

Fig.-11

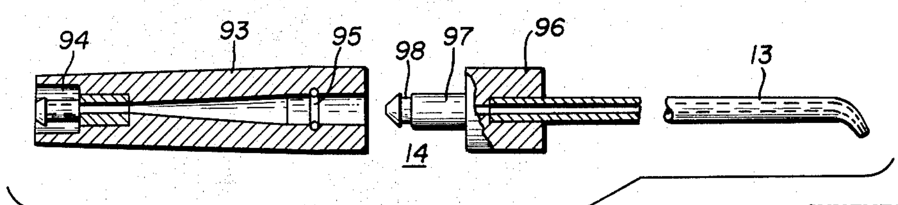

Fig.-10

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METHOD AND APPARATUS FOR ORAL HYGIENE

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Filed May 8, 1961, Ser. No. 108,561
12 Claims. (Cl. 128—66)

This invention relates to the use of high velocity liquid jets in the practice of oral hygiene and particularly to an improved method and apparatus for affording greater effectiveness of liquid jets for stimulating the gum tissues and in the cleaning of teeth and adjacent tissues.

One of the continuing problems in the field of oral hygiene is that of providing simple and effective methods for assuring cleaning of teeth and stimulating the circulation of blood in the adjacent tissues. One of the methods which has met with some degree of success employs a high velocity jet of liquid which may be directed against the teeth and into the spaces between the teeth and the gums. Difficulties have been encountered in securing adequate and sustained liquid pressure and in providing simple and easily manipulated apparatus for nontechnical users. Accordingly, it is an object of this invention to provide an improved method for applying a jet of liquid for cleaning the teeth, subgingival margins, and interproximal spaces.

It is another object of this invention to provide an improved method for cleaning teeth and for stimulating the tissues about the teeth.

It is another object of this invention to provide an improved apparatus for use in oral hygiene to produce a high velocity liquid jet for cleaning purposes.

It is a further object of this invention to provide an improved liquid jet apparatus for use in oral hygiene which effects both cleaning of the teeth surfaces and tissue stimulation.

Briefly, in carrying out the method of this invention in accordance with one procedure thereof, a fine high velocity jet of liquid is produced and is caused to pulsate at a rate within a range of 1000 to 1600 cycles per minute and is directed against the tooth surfaces or other areas to be treated or cleaned. The use of these relatively low frequency pulsations of the jet has been found to be critical and provides more effective cleaning action and manipulation of the gum tissue. This provides a gentle yet positive massaging and stimulating action. This effective stimulation and cleaning, when employing rates of pulsation between 1000 to 1600 cycles per minute, has been found useful not only in daily cleaning but also for stimulating the circulation of blood in the gum tissues and improving the elastic tone of the gum tissue through massage or artificial exercise in connection with the treatment of diseases of the teeth and gums.

One form of apparatus for facilitating the practice of this method is constructed to include a reciprocating pump and a reciprocating plunger arranged in a body of liquid to produce a jet pulsating at the required rate. The pump is provided with controls to effect adjustment of the volume and pressure or intensity of the jet and a convenient liquid supply is provided to facilitate the use of any desired cleansing liquid or solution.

The features of novelty which characterize this invention are pointed out in the claims appended to and forming a part of this specification. The invention itself, however, both as to its organization and method of operation may best be understood upon reference to the accompanying drawings, in which:

FIG. 1 is a chart indicating the relationship of the principal factors affecting the evaluation of a pulsed jet for oral hygiene;

FIG. 2 is a graph illustrating the value characteristics of a pulsed jet with a range of frequencies;

FIG. 3 is a perspective view of a jet type oral hygiene apparatus embodying the invention;

FIG. 4 is an enlarged detail elevation view of the intake and bypass fixture of the apparatus of FIG. 3;

FIG. 5 is a front elevation view partly in section of the motor-pump unit of the apparatus shown in FIG. 3;

FIG. 6 is a side elevation view partly in section of the device taken along the line 6—6 of FIG. 5;

FIG. 7 is a sectional plan view of the pump of the device taken along the line 7—7 of FIG. 6;

FIGS. 8 and 9 are graphs illustrating certain operating characteristics of the apparatus of FIG. 2;

FIG. 10 is a sectional view of the nozzle assembly of the apparatus of FIG. 2; and

FIG. 11 is a sectional plan view of another form of pump suitable for use in practicing the method of this invention.

Extensive studies of the characteristics of water jet devices for oral hygiene were made in connection with this invention. In the course of these studies, the dimensions of the jet as well as its pressure, volume and frequency characteristics were investigated. Further, it was found that the effectiveness of the liquid jet depends upon the characteristics of the individual gum tissue, these characteristics for a wide range of gum tissue conditions were studied and evaluated. Liquid jet devices embodying the invention were employed to determine the effectiveness of the liquid jet under varying conditions of operation and for various adjusted conditions of the device. The characteristics of the gum tissue studied involved the elastic tone of the tissue, the nerve response and "capillary stagnation" which is a condition of swelling brought about by stagnation of blood in the region of capillary transfer from artery to vein.

Initially the optimum size of the jet orifice was investigated and found to lie generally within the range of .025 inch to .045 inch in diameter, these being effectively the outside limits of a practical form of the device as tested. A jet of the order of .025 inch or smaller results in a reaction when directed against the gum tissue which is somewhat similar to the effect of prodding with a pointed instrument even in tissues of high elastic tone. When the orifice size is increased to over .045 inch in diameter, the jet size is excessive in proportion to the masses of gun tissue which must be manipulated in the average oral structure. These larger size jets are also of excessive size when considered from the standpoint of probing, flushing and cleaning the tooth surfaces and zones between teeth, and in addition the larger jets discharge at an uncomfortably large or inconvenient rate of flow of water or other fluid and render the device more difficult to use. The optimum size for the orifice, determinative of the discrete areas of contact of the pulse with gum tissue, was found to lie within a range of the order of .032 to .038 inch.

The desirable discharge pressure ranges were studied and it was found that normal gum tissue could tolerate a steady flow discharge at pressures of the order of 90 pounds per square inch provided short rest periods were allowed. From these studies it appeared that the pressures to be employed should be maintained at or below a maximum design pressure of 90 pounds per square inch and it was further determined that pressures within this range were adequate for cleaning purposes whereas higher pressures might result in some cases in damage to gum tissue and the more sensitive and fragile sub-lingual tissue.

After determination of the desired size and pressure ranges, the human factors were analyzed and the effect of various flow conditions was investigated. It is, of course, desirable to maintain the characteristics of the jet such that the use of the instrument will not result in pain. This being a variable factor, the device may be adjusted to provide conditions suitable for the individual applications. The elastic tone of the gum tissue is important and determines to a substantial degree the desired characteristics of the jet stream. The kinetic energy delivered to discrete areas of the gum tissue must be sufficiently great to cause a desirable depth of depression of the tissue for purposes of manipulation and stimulation, and the pulses must be of a frequency such that time is allowed for the tissue to rebound when the jet is directed against it to cause depression to the desired depth. In the course of the investigation it was found that certain patients experienced pain at frequencies of the order of 1750 cycles per minute when the elastic tone of the gum tissue was low and the tissue was swollen. Investigations using a stroboscope showed that tissue of good average tone failed to rebound completely when treated at frequencies as high as 1750 cycles per minute. On the other hand, tissue of lower elasticity was observed to rebound fully at frequencies of the order of 1250 cycles per minute and no tendency toward painful reaction was observed at these frequencies. Frequencies of the order of 1250 cycles per minute also produced highly satisfactory reaction of tissue having good elastic tone.

For some tissues of low elastic tone relatively low frequencies were found to be usable; however, such frequencies, of the order of say 800 cycles per minute, do not produce an adequate stimulation reaction on tissue of high elastic tone.

All of the factors taken into consideration during the investigations were analyzed and weighed in terms of a total or effective value of the pulse jet. The term "total value" may be defined as a characteristic of the jet within predetermined ranges of size and pressure related to the ability of gum tissue to respond in a beneficial manner to impingement of the jet pulses.

Referring now to the drawings, FIG. 1 is a chart illustrating the relationship of the seven principal factors which are involved in determining the total value of a pulse jet under investigation. The first four factors—frequency, pressure, volume and section—relate to the physical dimensions and characteristics of the jet and have been designated "mechanical factors". The last three factors—elastic tone, capillary stagnation, and nerve response—relate to properties or characteristics of the tissue and have been designated "human factors". The elastic tone determines the rebound ability of the gum tissue and to this extent has been designated a mechanical factor as well as a human factor.

The "Total value" of a pulse jet is illustrated graphically in FIG. 2, which is a curve representing the variations of total value of the jet for a wide range of pulse frequencies. As illustrated on this curve, the total value rises to a peak at approximately 1250 cycles per minute and is relatively high over a range of about 1000 to 1600 cycles per minute, falling off rapidly outside this range. The range of 1200 to 1400 cycles per minute was determined to be quite flat and represents the optimum range of pulse frequencies.

Referring again to the drawings, the apparatus illustrated in FIG. 3 comprises a motor-pump assembly **10** provided with a flexible intake conduit **11** and a flexible discharge conduit **12**. A jet nozzle **13** is secured to the conduit **12** by a coupling **14** and may easily be manipulated to direct a high velocity jet produced at the nozzle **13** against the teeth and the gum tissue. The pump unit **10** is provided with an adjusting knob **15** which controls a bypass from the discharge side of the pump to a flexible conduit **16**. The conduit **16** is made of a resilient flexible material which expands upon application of internal fluid pressure and provides a damping action referred to below. The conduit **12**, on the other hand, is made of relatively inexpansible flexible material to minimize damping action in the discharge line. The ends of the conduits **11** and **16** are attached to a fitting **17**, which may be placed in a cup or other liquid container as indicated at **9**. The fitting **17**, shown in detail in FIG. 4, includes two coupling sleeves **18** and **19** of molded plastic material, over which the ends of the conduits **11** and **16**, respectively, are secured. The sleeves are made integrally with a yoke **20** which extends below the ends of the sleeves and spaces the ends from the surface on which the fitting rests. The sleeve **18** has its lower end open, as indicated at **21**, and when the fitting rests within a liquid container, the yoke **20** holds the open end spaced from the bottom of the container and allows liquid to enter the opening freely. The sleeve **19** is closed at its lower end and is provided with a restricted opening **23** which limits the discharge of liquid through the bypass tube **16**.

The motor pump unit shown in FIGS. 5, 6 and 7 has a casing **26** which in the form illustrated comprises a die casting having a bottom wall **27** and a top wall **28**, the top wall being stepped as indicated at **29** in FIGS. 3 and 5. The stepped portions **29** are connected to the bottom wall by side walls **30**. Between the side walls **30** there are provided inwardly extending wall portions **31** and forwardly extending walls or panels **32**. The sides of the walls **30** are sloped as indicated at **33** and the space between the walls **32** is closed at its rear by an end wall **34** having a forwardly extending flange portion **35** near the lower end thereof and spaced from the bottom wall **27**. The forward side of the space is closed by a removable front plate **32a** held in place by two screws **35a** threaded into the wall portion **35**. A motor control switch **24** is mounted in the casing **26** below the top wall **28** and may be operated by a knob **25** mounted on top of the casing where it is easily accessible and convenient to the operator.

A motor pump or housing unit **37** is mounted on top of the walls **32** and has a cylinder portion **38** extending downwardly between the walls. The pump unit **37** is rounded along its sides and one side portion fits a complementary rounded wall section **39** connecting the forward edges of the walls **28** and **34**. An electric motor **41** is mounted within the main compartment of the casing and is secured by screws or bolts **42** to the inwardly extending wall portions **31**, and the rear end of the casing is closed by a plate **43** secured in place by screws **44** fitting through tubes or posts **45** and threaded into the wall portions **31** as indicated at **46**. The motor has been illustrated somewhat diagrammatically as its details of construction are not essential to an understanding of the invention.

The motor is provided with a shaft **48** extending both forwardly and rearwardly therefrom, the rear portion of the shaft carrying a motor cooling fan **49** for circulating air through the casing from a circular opening **51** in the plate **43** over the motor and through the casing and thence downwardly and out through a passage **52** formed between the bottom wall **27** and flange **35** and the two side walls **32**.

The pump **37** is of the reciprocating type and includes a plunger **54** mounted on a rod **55** and driven by a Scotch yoke mechanism including a yoke **56** mounted on and secured to the rod **55** by a set screw **59** and having a cross slot or guide **57** in which a roller or roller bearing **58** can move or ride. The roller **58** is carried on a stub shaft **60** mounted in a gear **61** having a shaft **62** secured in the wall **34**; the roller **58** then moves back and forth in the slot **57** and reciprocates the rod **55** when the gear **61** is rotated, thus providing forward and reverse strokes occurring during each respective half revolution of the driving roller **58** as it is rotated through a complete revolution by shaft **62**. The gear **61** is driven by a pinion gear **63** mounted on the shaft **48** of the motor, the shaft and pinion extending through the wall **34** in a circular opening **64**. The lower end of the rod **55** passes through a guide opening **66** provided in the wall portion **35**.

The pump assembly **37** may be constructed of molded plastic or other suitable material and the cylinder portion **38** of the pump housing comprises a piston block formed to provide a cylinder **67** within which the piston **54** is mounted for sliding movement and sealed by suitable means such as an O-ring **68** mounted in an annular groove in the cylinder wall. The piston block is cemented or otherwise suitably secured to a main head portion **70** and the pump casing is completed by a closure portion **71** cemented or otherwise suitably secured to the portion **70**. A mounting flange **72** depending from the portion **70** is attached to the wall **34** by screws **73** and holds the pump assembly securely in position on the housing.

As shown in FIG. 7, the pump casing portions **70** and **71** cooperate to form a chamber **74** having an inlet valve **75** for controlling an inlet passage **76** and an outlet valve **77** for controlling an outlet passage **78**. The outlet passage **78** is formed within a partition member **79** cemented to the closure portion **71** and providing an outlet chamber **81** in which the discharge valve **77** operates. The inlet valve **75** is provided with a stem **82** and is mounted for reciprocation in a cylindrical recess **83** in the partition **79**. The discharge valve **77** is provided with a stem **84** mounted for reciprocation in a cylindrical recess **85** in the closure portion **71**. Both valves are spring biased to their closed positions.

When the piston **54** is reciprocated by operation of the motor through the Scotch yoke mechanism, it is moved alternately in and out of the chamber **74** and when moving outwardly, during 180° rotation of drive shaft **62**, draws liquid in through the passage **76** past the valve **75** and on the inward stroke, during the remaining half revolution, the valve **75** is closed and liquid is forced out through the port **78** on opening of the valve **77**. It will be understood that the flexible intake tube **11** is secured in communication with the inlet conduit **76** by being slipped over a nipple **86** and that the discharge tube **12** is secured in connection with the outlet passage **78** and chamber **81** by connecting it over a nipple **87**.

In order to control the rate and intensity or kinetic energy of discharge of liquid from the pump chamber **74** through the port **78**, a bypass port **88** is provided and is arranged to be controlled by a needle valve **89** which may be moved toward and away from the port **88** by turning the adjusting knob **15**. The shaft of the knob **15** which carries the valve **89** is threaded in a bushing **91**, and a spring pressed seal **92** is provided to prevent leakage through the bushing.

During the operation of the pump the liquid is discharged with pulsations at a rate determined by the speed of the pump and the force of the discharge is controlled by the position of the valve **89**, it being greatest when the valve **89** is in its position to close the port **88** and less as the valve is moved away from the port. The motor speed is selected for reasons discussed above so that the rate of pulsations lies within the range of 1000 to 1600 cycles per minute; and in a preferred embodiment, the motor speed is such that the piston **54** is driven at a rate of the order of 1300 cycles per minute. It will be understood that the ratio of the gears **61** and **63** is selected to provide the desired speed depending upon the normal speed of the motor **41**. In some instances it may be desirable to provide a speed control for the motor in order to adjust the frequency of the jet pulsations within the required range. Controls for adjusting motor speeds are well understood in the art of motor control and a speed control has not been illustrated as it is not essential to an understanding of the present invention.

By stroboscopic observation of the jet stream discharged from a pump embodying the invention, it was determined that separate pulses of water were produced and that after each pulse the water can be observed to withdraw a short distance within the orifice. Observations were made with an oscilloscope and strain gauges and it was found that when the bypass is closed and the pulse is discharged at full pressure the curve started at zero pressure and peaked at approximately 90 pounds per square inch, by way of example, in one unit which was tested. The discharge in this unit was at a frequency of approximately 1150 cycles per minute, the stroke of the piston was $\frac{7}{16}$ inch and the orifice was .038 inch in diameter.

The wave form of this jet as discharged is illustrated in the graph FIG. 8. On this diagram the point A is at the beginning of the exhaust stroke of the pump. The sharpness of the curve at this point indicates that there is a shock characteristic. The hump at B is caused by surges in the system due to the valve action. The sharpness of the discharge curve at A as indicated results in a shock characteristic and this facilitates the stimulation of tissue of good elastic tone when maximum stimulation is desired.

When it is desired to reduce the shock effect, the valve **89** is opened to bypass a portion of the liquid and to introduce a damping effect due to expansion of the walls of the conduit **16** and, by way of example, a resulting pressure curve is indicated in FIG. 9. Here it will be noted that the maximum pressure has fallen from 90 pounds to 80 pounds per square inch and that minimum pressure of 10 pounds is present during operation. The wave form is smooth, the shock characteristic having been removed.

It is thus apparent that a change in characteristic of the pulsed jet may be effectively secured by employing the bypass arrangement or other control for adjusting the intensity of the jet.

In order that the nozzle **13** may be changed (for example, so that several members of the family may use the device), the coupling **14** is constructed as shown in FIG. 10. A fitting or sleeve **93** is provided with a recess or socket **94** at its left end to receive the end of the flexible tube **12** and near its right end has an O-ring of synthetic rubber or other suitable plastic positioned as indicated at **95** in an internal annular groove. The nozzle **13** is mounted on a base **96** which includes a plug member **97** which may be inserted into the fitting **93** so that an annular groove **98** at the end of the plug is engaged by the O-ring **95** and retained in position. The O-ring seals the coupling and also affords rotation of the nozzle **13** with respect to the fitting **93**.

During use of the device the supply fitting **17** is placed in the bottom of the receptacle or glass **9** and the pump started by energizing the motor **41**. When it is desired to use the nozzle **13**, the force of the discharged jet is adjusted by movement of the knob **15** and the jet is then directed against the gums and into the spaces between the tooth areas. The pulsating characteristic of the discharged jet of liquid stimulates the circulation of blood in the gum tissue and also dislodges particles of matter caught between the teeth. The nozzle may be turned to select the most desirable angle for directing the jet. In most instances it is preferable to place the nozzle in the mouth before starting the motor in order to prevent undesirable discharge of the jet about the room. When the nozzle is not in use it may be placed in a holder formed by a bar or a cleat **100** mounted in frictional engagement on the tubes **11** and **16** in spaced relationship to the pump body **37**; the cleat having holes slightly smaller than the flexible tubes may be pressed on the tubes. The position of the nozzle when in this holder is indicated by dotted lines in FIG. 3.

Various other types of pumps may be employed to secure the desired pulsating jet effect, and another pump suitable for this purpose has been indicated in FIG. 11 which is a sectional plan view through a pump body of generally cylindrical configuration. The pump body indicated at **102** is provided with a cylindrical pump chamber **103** in which an eccentrically mounted rotor **104** is mounted within a flexible belt or sling **105** and is driven from a shaft **106** on an eccentric stub shaft **106a** so that the sling **105** is moved about the chamber **103**. The direction of movement of the rotor **104** is indicated by the arrow, and as it moves from the position shown liquid is drawn in through an intake port **107** filling the space on the rearward side of the flexible sling **105** and at the same time moving liquid out of the forward side and discharging it through a port **108** into a chamber **109** and thence through to the discharge outlet **110**. This provides a pulsating stream which may be controlled as to its intensity by adjustment of a knob **112** on which a needle valve **113** is mounted to control a bypass port **114**. When employing the pump of FIG. 11 for the device shown in FIG. 3, the intake tube **11** is coupled to the inlet port **107**, the discharge tube **12** to the port **110** and the bypass tube **16** to the port **114**.

In the assembly of the device as illustrated in FIG. 3, the tubing **16** is preferably made of a material sufficiently flexible to afford some expansion when the pressure of the discharge is applied between the discharge port of the pump and the orifice **23** in the fitting **17**. This expanding action effects damping of the discharge and smooths the operation of the pump so that the discharge from the chamber **74** is in effect working against the flexible walls of the tube **16**, and when the valve **89** is open there is less shock in the discharge through the flexible conduit **12**. The walls of the flexible conduit **12** are relatively firm so that there is minimum expansion of these walls and thus the range of intensity of force applied by the pulsating jet may be varied from the direct discharge when the bypass port **88** is closed to a relatively mild intensity when the bypass is wide open as shown in FIG. 7. A short length of more flexible tubing, indicated at **115** in FIG. 3, may be employed to couple the tube **12** to the nipple **87**. And a similar flexible piece **116** may be employed to connect the tube **12** to the nozzle assembly **14**. These short lengths of flexible tubing **115** and **116** are made of readily or highly bendable material and facilitate movement of the nozzle with minimum interference due to the relatively stiff characteristic of the discharge conduit **12**. The lengths are sufficiently short not to introduce significant damping effect and do not change the overall non-damping characteristic of the discharge line. The readily bendable characteristic introduced by the short lengths together with the rotary mounting of the nozzle in its assembly provides for easy universal movement of the nozzle tip.

It will thus be apparent that the motor-pump unit illustrated may be employed effectively in the practice of the method of this invention. The unit may easily be adjusted as to the intensity of the pulsating jet discharged by the pump by adjusting the knob **15**, and the speed of the motor and gearing may be selected to bring the rate of pulsations within the desired range for effective use of the method of this invention.

While the invention has been described in connection with particular pump unit constructions, various other devices and methods of practicing the invention will occur to those skilled in the art. Therefore, it is not desired that the invention be limited to the specific details illustrated and described and it is intended by the appended claims to cover all modifications which fall within the spirit and scope of the invention.

I claim:

1. In the art of oral hygiene, the method of cleaning the teeth and stimulating the gum tissues which comprises forming a high velocity jet of liquid having a small cross section, directing the jet against the surfaces to be treated, and including the step of producing pulsations of the jet at a rate affording depression of the gum tissue during each pulse and its substantially full rebound between pulses and sufficiently rapid to afford effective cleansing of the treated surfaces.

2. In the art of oral hygiene, the method of treating the gum tissues, which comprises

generating a pulsating stream of liquid of small cross-sectional area consisting of spaced pressure pulses which rise and fall between maximum and minimum values of pressure,

directing said pulsating stream of liquid upon and moving it along the gum tissues for manipulating changing discrete areas thereof by

repetitively depressing discrete areas of gum tissue with intermediate rebound,

said repetitive pressure pulses as they successively impinge upon said discrete areas of said gum tissue having kinetic energy sufficient in quantity and applied during that period of time which produces said depression of said gum tissue, said spaced pulses being characterized by spacings one from the other of duration which provides for said rebound of said gum tissue.

3. The method of claim **2** in which said pressure pulses are separated from one another whereby said stream is completely interrupted during the spaces between pulses.

4. The method of claim **2** in which said spaced pressure pulses are produced at a rate of from about 800 pulses per minute to about 1600 pulses per minute.

5. The method of claim **4** in which the pressure pulses and the spaces between the pressure pulses are of about the same duration.

6. In the art of oral hygiene, the method of treating the gum tissues, which comprises

generating a pulsating stream of liquid of cross-sectional area corresponding with a diametrical range between about 0.025 inch to about 0.045 inch consisting of spaced pressure pulses occurring at the rate of from about 800 per minute to about 1600 per minute and which rise and fall between maximum and minimum values of pressure, and

directing said pulsating stream of liquid upon and moving it along the gum tissues for manipulating changing discrete areas thereof by

repetitively depressing discrete areas of gum tissue with intermediate rebound,

said repetitive pressure pulses as they successively impinge upon said discrete areas of said gum tissue having kinetic energy sufficient in quantity and applied during that period of time which produces said depression of said gum tissue, said spaced pulses being characterized by spacings one from the other of duration which provides for said rebound of said gum tissue.

7. The method of claim **6** in which said maximum values of pressure lie within a range having an upper limit of about 90 pounds per square inch.

8. In the art of oral hygiene, the method of concurrently cleaning the teeth and treating the gum tissues, which comprises

generating a pulsating stream of liquid of small cross-sectional area consisting of spaced pressure pulses which rise and fall between maximum and minimum values of pressure,

directing said pulsating stream of liquid against the gum tissues for repetitively depressing discrete areas of gum tissue with intermediate rebound thereof to and from depths which stimulate circulation therethrough of blood, and

moving said pulsating stream of liquid along the teeth and gum tissues for treating changing discrete areas thereof,

said repetitive pressure pulses as they impinge upon said discrete areas of said gum tissue having kinetic energy sufficient in quantity and applied during that perior of time which produces said depression of said gum tissue followed by rebound of said gum tissue before a further pressure pulse produces the next depression of said tissue thereby to stimulate said circulation of blood while cleaning said gum tissue and associated teeth.

9. The method of claim **8** in which said cross-sectional area corresponds to a diametrical range between about 0.025 inch and about 0.045 inch, and wherein said maximum pressure lies within a range having an upper limit of about 90 pounds per square inch.

10. A system of treating gum tissue by applying spaced pressure pulses of liquid to depress discrete areas of gum tissue with the spacing of said pulses one from the other of duration which provides for rebound time for said gum tissue, comprising

generating means for generating said spaced pressure pulses of liquid at a rate of from about 800 per minute to about 1,600 per minute each of said duration to produce said depression of said gum tissue and with spacings between said pulses of duration to provide said rebound time for said gum tissue after said depression thereof,

said generating means having a liquid inlet and a liquid outlet, and

means connected to said liquid outlet for delivering said pulses to said gum tissue without substantial change of the shape, the magnitude or of the spacing of said pulses,

said last-named means including a nozzle having an opening of small cross-sectional area corresponding with a diametrical range between about 0.025 inch to about 0.045 inch for limiting to discrete areas the gum tissue to which said pulses are applied for repetitive depression and rebound of such discrete areas.

11. The system of claim **10** in which said means for generating said pulsating stream of liquid is provided with means located between said liquid inlet and said liquid outlet for varying the kinetic energy of the pulses produced at said liquid outlet to vary the magnitude of the cyclic depression and rebound of the gum tissue.

12. The system of claim **10** in which said means for generating said pulsating stream of liquid comprises a pump having a piston reciprocable in a pump chamber provided with said inlet and with said outlet, and means between said inlet and said outlet for varying the kinetic energy of the pulses of the stream of liquid delivered by said nozzle to the gum tissue to vary the magnitude of cyclic depression and rebound of the gum tissue comprising an adjustable liquid outlet connection from which there may be discharged from said pump chamber a selected fractional part of the liquid prior to entry into said outlet.

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