(No Model.) 2 Sheets—Sheet 1.

# F. H. BERRY.

## DENTAL ENGINE.

No. 562,793. Patented June 30, 1896.

Fig. 1.

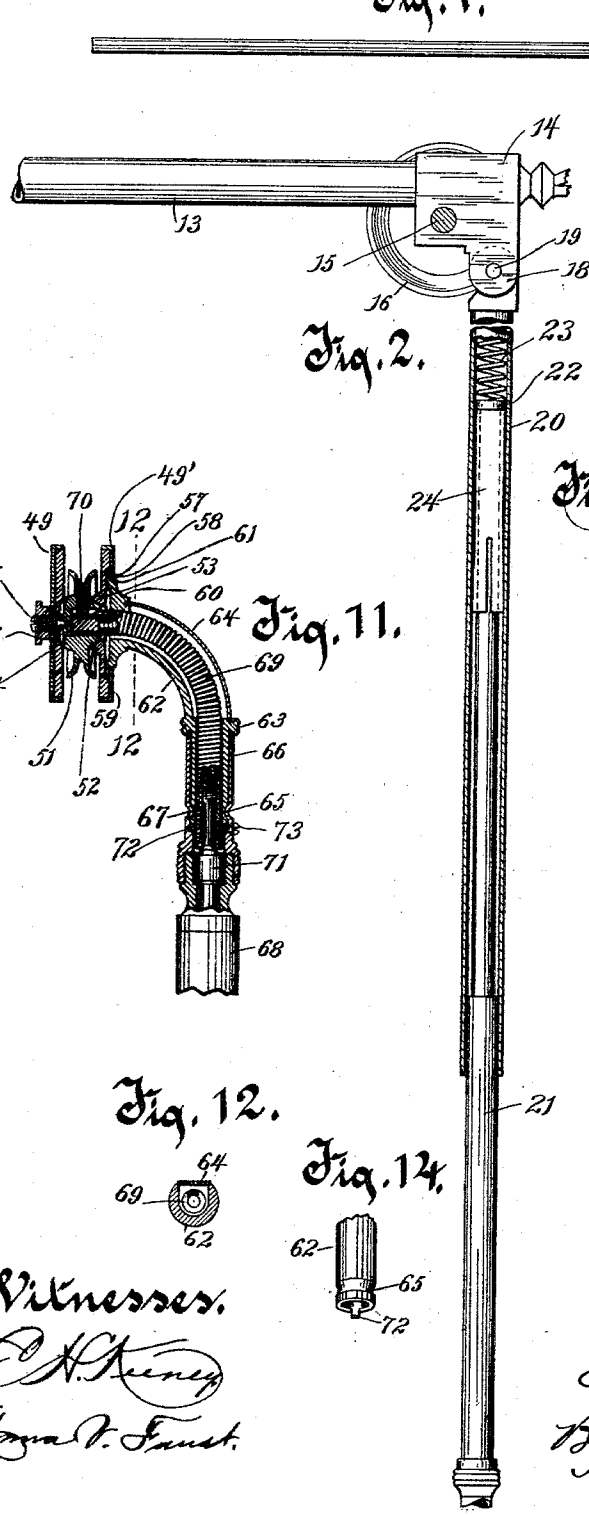



Fig. 2.

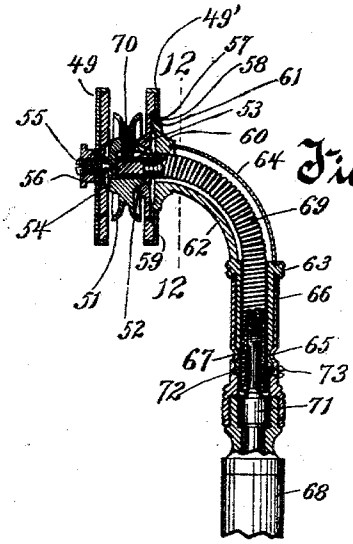
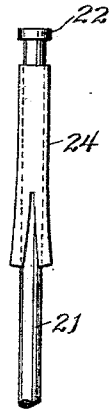



Fig. 11.

Fig. 3.



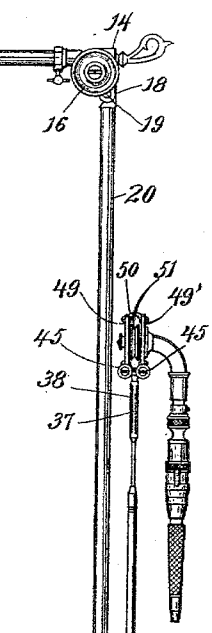
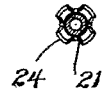




Fig. 4.



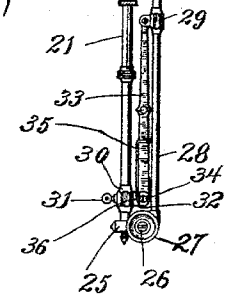




Fig. 12.




Fig. 14.




Witnesses.

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(No Model.) 2 Sheets—Sheet 2.

# F. H. BERRY.

## DENTAL ENGINE.

No. 562,793. Patented June 30, 1896.

Fig. 6.

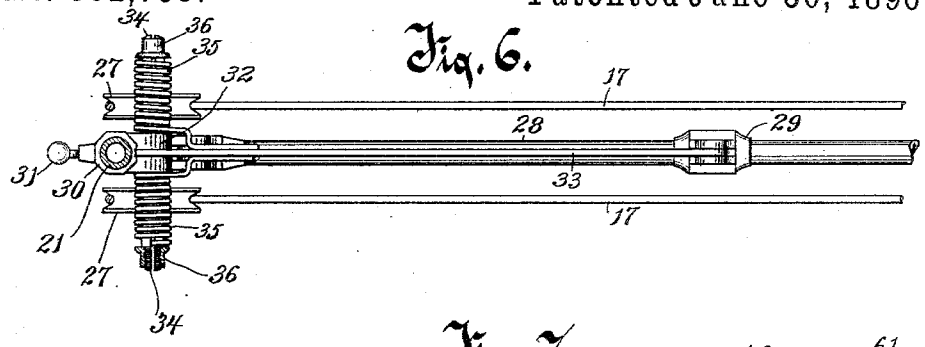



Fig. 7.

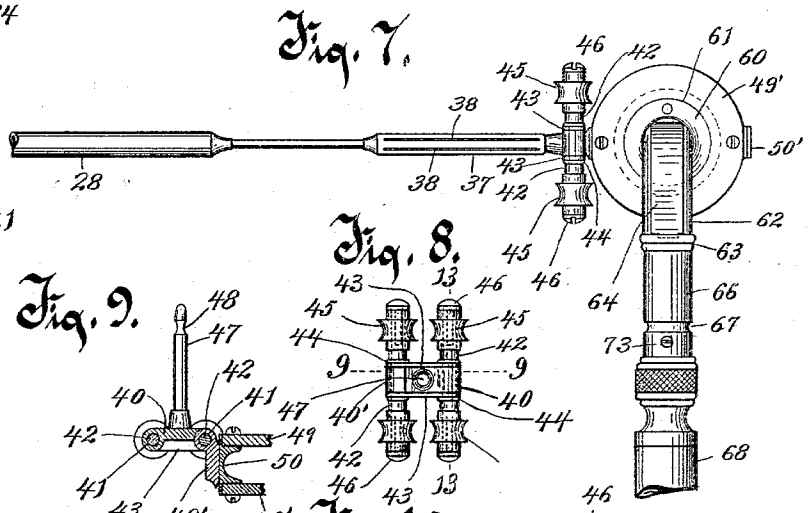



Fig. 8.




Fig. 9.




Fig. 5.

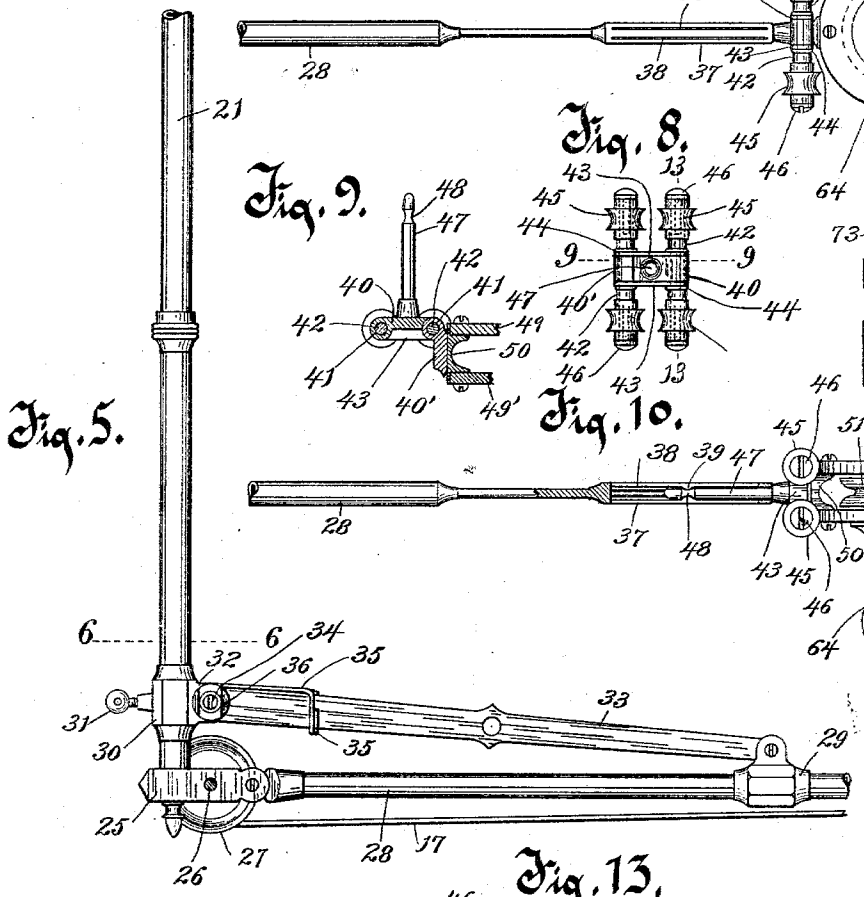



Fig. 10.

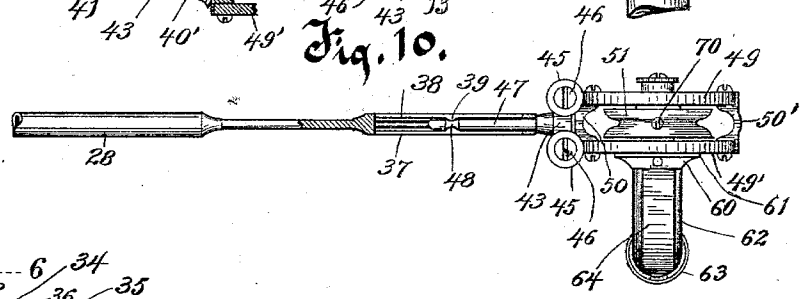
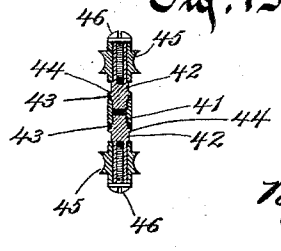



Fig. 13.




Witnesses:

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# UNITED STATES PATENT OFFICE.

FREDERICK H. BERRY, OF MILWAUKEE, WISCONSIN.

## DENTAL ENGINE.

SPECIFICATION forming part of Letters Patent No. 562,793, dated June 30, 1896.

Application filed June 17, 1895. Serial No. 552,986. (No model.)

*To all whom it may concern:*

Be it known that I, FREDERICK H. BERRY, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Dental Engines, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

My invention has relation to improvements in dental engines.

An object is to provide an improved construction whereby a free and even movement of the handpiece in all directions is obtained without the necessity of employing a long flexible power-conveyer, which flexible conveyer as ordinarily used is open to the objection of uneven movement and backlash.

A further object is to provide an improved construction whereby "straight-ahead" drilling may be readily accomplished, and a further object is to provide for automatically lengthening and shortening the driving-belt with the adjustment of the handpiece.

With the above and other objects in view the invention consists of the devices and parts, or their equivalents, as hereinafter set forth.

In the accompanying drawings, Figure 1 is a side elevation of the invention. Fig. 2 is a fragmentary view similar to Fig. 1 on an enlarged scale, parts being in section. Fig. 3 is a detail view of the inner split sleeve and the inner section of engine-arm, which it embraces. Fig. 4 is a lower end view of Fig. 3. Fig. 5 is a view of the lower portion of the inner section of the engine-arm, showing the forearm pivoted to the lower extremity thereof. Fig. 6 is a section of Fig. 5 on the line 6 6. Fig. 7 is a side view of the outer portion of the forearm, showing the wrist-joint closed and the terminal section turned at right angles to the forearm. Fig. 8 is a view of that side of the wrist-joint from which the stem 47 projects. Fig. 9 is a cross-section on the line 9 9 of Fig. 8, with one leaf of the hinge opened out. Fig. 10 is a plan view of Fig. 7, part in section. Fig. 11 is a sectional view of the driven pulley, the disks or frames supporting the same and in which it has its bearings, the flexible shaft-casing and its connection with one of said disks and the handpiece-casing, disclosing the connection between said flexible shaft, the driven pulley, and the rotary spindle of the handpiece. Fig. 12 is a cross-section on the line 12 12 of Fig. 11. Fig. 13 is a cross-section on the line 13 13 of Fig. 8, and Fig. 14 is a detail of the lower end of the neck portion 62.

Referring to the drawings, the numeral 13 indicates a rod which is designed to be connected up to a swinging bracket. (Not shown.) At the outer end of this rod is fixed a block 14, in which is journaled a shaft 15, said shaft carrying at opposite ends pulleys 16 16, and around which pulleys an endless cord 17 (shown in Figs. 5 and 6) passes. The block is provided with depending ears or lugs 18, between which fits the upper end of an engine-arm, a pivotal connection being formed by means of a transverse pivot-pin 19. The engine-arm is composed of two parts, the outer tubular part being indicated by the numeral 20. Within this part slides the inner telescoping part 21, which is provided with a reduced portion extending longitudinally thereof for a considerable distance, said reduced portion terminating at the upper end in an enlargement 22. Within the outer tubular part, and confined between the upper end thereof and the enlarged end of part 21, is a coiled spring 23. The reduced portion of the part 21 is surrounded for a portion of its length by a sleeve 24, the lower end of which sleeve is split, as clearly shown in Figs. 2 and 3.

At the lower end of the part 21 of the engine-arm is rigidly secured a block 25, which is intersected by a pin 26, said pin having mounted upon opposite ends pulleys 27 27. At the end of the block 25 is pivoted a forearm 28, upon which a sleeve 29 is mounted so as to slide freely. Upon part 21 of the engine-arm is also mounted a sleeve 30, which is held up to adjusted position by means of a set-screw 31. This sleeve is provided with a projecting lug 32, into which extends one end of a counterbalancing arm 33, the opposite end of said arm being pivotally connected to an upwardly-extending lug from the sleeve 29. A non-rotatable shaft 34 passes freely through the projecting lug 32 and also through that end of the arm 33 which enters the lug, said arm turning on the shaft as a pivot. The shaft 34 is encircled, on opposite sides of the lug 32,

by coiled springs 35 35, the outer ends of which pass into the split ends of shaft 34. These split ends are threaded exteriorly to receive nuts 36 36, which nuts firmly bring the split ends together, and therefore securely hold the ends of the springs in place in the slots. The inner ends of the springs, upon opposite sides of the lug 32, are extended at right angles from the shaft 34, and then bent inwardly and extended longitudinally along the edge of the arm 33 for a desired distance. Each of the springs is bent at right angles across one side of the arm and around the edge of said arm, and extended a short distance on the opposite side of the arm, as will be clearly seen by reference to Figs. 5 and 6 of the drawings. The office of the springs 35 35 is to maintain an upward pressure upon the arm 33, and thereby form a counterbalance for the weight of the handpiece. By reason of the fact that the sleeve 30 is, through the set-screw 31, vertically adjustable on section 21, said sleeve may be set to suit the weight of different sizes of tool-chucks. A vertical adjustment of the sleeve 30 will of course vary the arc of the circle described, and consequently thereby regulate the balance. As it is not necessary to change the tool-chucks frequently, this adjustment is therefore only required at long intervals.

The outer end of the forearm 28 is formed into a tube 37, which is provided with a series of longitudinal slits 38, and interiorly, at a medial point, with an annular shoulder 39. Adapted to be connected to the tube 37 is a peculiar form of hinge, which constitutes the wrist-joint between the forearm and the handpiece, the parts of which will now be described.

The numerals 40 40′ indicate two leaves, each of which terminates at one end in an interiorly-threaded eye 41.

The numerals 42 indicate short pins, four in number, the inner ends of which are adapted to pass through openings in connecting-links 43, and are threaded at their extremities to engage the female threads of the eyes of the leaves. The pins are also provided medially with shoulders 44, bearing against the links and holding them to place. The free end of each leaf is rounded slightly to fit the rounded contour of the eye of the other leaf.

The numerals 45 indicate small guide-pulleys, the hubs of which fit and turn upon the pins 42. Against the outer ends of these hubs the heads of screws 46 bear, the ends of said screws engaging threaded openings in the ends of the pins. Rigidly connected to leaf 40 is a stem 47. This stem is adapted to enter the bore of tube 37. The end of this stem is rounded slightly, and just back of the rounded end is provided with an annular groove 48. When the stem is inserted into the tube, this rounded end, by reason of the provision of the longitudinal slits, spreads the annular shoulder 39, and as the stem is further forced inward, the annular groove 48 is engaged by the annular shoulder 39. From this construction it will be seen that the stem is free to rotate within the tube, but can only be withdrawn therefrom by the application of considerable power.

The numerals 49 49′ indicate two disks rigidly connected together and held at a desired distance apart, by means of plates 50 50′, screwed thereto, the whole forming a bearing-frame for the driven pulley hereinafter referred to. Plate 50 is riveted, or otherwise suitably secured, to the leaf 40′. Between the two disks is arranged a pulley 51. This pulley has projecting from one face a conical hub 52, which is received in an inwardly-projecting tubular lug 53 from the disk 49′. The opposite face of the pulley is provided with a conical recess 54, adapted to receive the conical end of a screw 55, which passes through the disk 49. By this means an adjustable cone-bearing is formed. The outer threaded end of the screw is adapted to receive a nut 56, which holds the screw to adjusted position. The outer face of disk 49′ is provided with an annular recess 57, having an outer depending annular flange 58, formed by the sheathing or covering 59 of the disk. Within this annular recess fits freely a head 60, said head having a reduced peripheral portion fitting back of the annular flange 58. This reduced peripheral portion forms a shoulder 61 to receive the edge of the flange.

The numeral 62 indicates a flexible shaft-casing, one end, or the neck thereof, being curved to about one-fourth of a circle, and connected to the head 60. This flexible shaft-casing is provided medially with an enlargement 63, and the top of its neck portion is left with a longitudinal opening, which is filled by means of a plate 64, connected at opposite ends, respectively, to the head 60 and to the enlargement 63. The flexible shaft-casing continues from its neck portion in a straight line, and near its lower end is provided with an annular groove 65.

The numeral 66 indicates a sheathing or casing, which at its upper end fits freely and revolubly in a groove upon the under side of the enlargement 63. This sheathing or casing is provided with an inwardly-extending rounded bead 67, which fits within the annular groove 65, and thereby provides for the lower part of the neck rotating within said sheathing or casing, but held against longitudinal separation. The lower end of the sheathing 66 is enlarged and provided with internal threads adapted to engage the threaded end of the handpiece-casing 68. The outer portion of this enlargement is preferably milled to provide for firmly and conveniently holding it against rotation when the handpiece-casing is being screwed thereto.

Within the neck 62 is a flexible shaft, preferably consisting of a coiled spring 69, the upper end of which passes through the disk 49′ and enters the conical hub 52 of the pulley 51. A set-screw 70 passes through the pulleys and

engages the end of the spring. Within the handpiece-casing is disposed the rotary spindle 71 of the handpiece, the upper reduced end of said spindle extending into the flexible shaft-casing and having threads adapted to engage the lower end of said flexible shaft.

From the preceding description it will be seen that I have described a dental engine in which a series of arms or sections are employed, the outer or last section being, and for convenience here designated, as the "terminal section."

The endless cord 17, it will be understood, leads from a suitable source of power and extends over one of the pulleys 16, thence down and beneath one of the pulleys 27, thence up to and between two of the small guide-pulleys 45, thence around driven pulley 51, thence back between the other two guide-pulleys 45, then down to and around the other pulley 27, then upwardly and around the other pulley 16, and finally back to the source of power. This cord is at all times automatically held taut by the spring 23, owing to the constant pressure of said spring upon the telescoping part 21. All looseness of the belt is therefore effectually guarded against. The split sleeve 24 performs an important function in that while not interfering with the free rotation of the telescoping part 21, yet, in case of breakage of the cord, the two telescoping parts will not separate, owing to the pressure of the split end of the sleeve against the outer tubular part 20 of the engine-arm. The same function is also performed by the longitudinal slitted tube 37, in connection with the stem 47.

In the form of dental engine in which a long flexible shaft is employed the backlash which such shaft engenders and the jerky motion it causes are objectionable. In my invention the improved construction substituted for such flexible shaft brings the driven pulley and the operating-cord close to the tool. This arrangement obviates the jerky motion referred to, and instead thereof a steady action is obtained.

It is further to be noted that by my improved construction I obtain all the movements of which the flexible shaft ordinarily employed is capable. In the first place, it will be noted that the telescoping part 21 has rotary motion in the tubular part 20. Again, the fore-arm 28 has a swinging motion at right angles to the axis of rotation of the telescoping part 21. The stem 47 has rotation at right angles to the swing of the fore-arm 28. The neck has a complete circular rotation in the annular recess of disk 49', and the two disks, in turn, are capable of swinging in a direction at right angles to the independent rotation of the neck, as best illustrated in Fig. 9, which illustrates the hinge-leaf 40' opened out, the tension of the belt 17 on one set of guide-pulleys 45 holding links 43 43 back, so as to embrace opposite edges of the leaf 40. If it is desired to swing the handpiece laterally in the opposite direction, (referring to the same, Fig. 9 of the drawings,) power is applied to the handpiece in the proper direction to swing the leaf 40' back to its position between the links 43 43. The further turning of the handpiece will then cause the turning of the links 43 43 upon the pin 42 of the leaf 40. It will thus be seen that on one lateral swing a leaf opens out from the links, while on the opposite lateral swing the links open out from one leaf, and the other leaf is held between the links by the tension of the operating-cord.

When the hinge is opened in one direction, the belt 17 is guided by the upper and lower pulleys on the corresponding side to the swing, and when opened in the other direction said belt is guided by the upper and lower pulleys on that side. It is evident that when the hinge is opened out in either of the directions just referred to the belt 17 must necessarily be lengthened somewhat, and the necessary result of opening out the hinge is to effect this lengthening, inasmuch as by opening out the hinge the tension of the belt is increased, and the telescoping part 21 thereby forced up into the tubular part 20 of the engine-arm against the pressure of the spring 23. Now, the moment the hinge is opened out to the extent desired, and the swinging motion is stopped, the tendency of the spring 23 to resume its normal expanded condition will again force the telescoping part outwardly, and thereby again tighten the belt, and with the tightening of the belt the hinge is closed at the position to which the handpiece has been swung, thus relieving the tension of the cord.

The neck portion 62 bent at one-quarter of a circle is an important feature of the invention. This curved neck has the effect of throwing the line of the handpiece at right angles to the axis of the driven pulley, thereby adapting my improved construction of dental engine to drilling straight ahead.

The foregoing description will clearly show that with my improved engine a movement of the handpiece in all directions is possible, and yet at the same time the long flexible power-conveyer heretofore used is dispensed with, thus obviating backlash and the uneven movement existing in the class of dental engines referred to.

As the operator's fingers grasp the handpiece tightly, near the lower end thereof, it is evident that the straight portion of the flexible shaft-casing 52, when the handpiece is turned to the different positions permitted by the universal-joint connection, should be permitted to turn, in order to prevent the necessity of the operator unduly and uncomfortably twisting his hand to conform to the adjustment. The rotatable connection between the lower end of the flexible shaft-casing 62 and the outer sheathing 66, hereinbefore described, is therefore provided. If the lower portion of the flexible shaft-casing, however, were permitted to make a complete turn, the headed portion 60 at the upper end

of said flexible shaft-casing would also completely turn the disks 49 49′ and the pulley 51 carried by said disks. As the pulleys 27 27 are not capable of rotation in a plane at right angles to their axes, it is obvious that the belt would be twisted around the forearm. In order to avoid this, I provide the outer end of the straight portion of the flexible shaft-casing with a projecting lug 72. A screw 73 is passed through the sheathing 66, and this screw is adapted to contact with the lug 72, and thereby act to prevent the complete turning of the neck portion 62, and consequently prevent the twisting of the belt.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a dental engine, the combination, of a terminal section, a section in advance thereof, a bearing to which the terminal section is rotatably connected, and a wrist-joint connection between the bearing and the section which is in advance of the terminal section, said wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the bearing, and the other leaf connected to the section which is in advance of the terminal section, substantially as described.

2. In a dental engine, the combination, of a terminal section, a section in advance thereof, a bearing to which the terminal section is connected, a driven pulley journaled in the bearing, a wrist-joint connection between the bearing and the section which is in advance of the terminal section, said wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the bearing, and the other leaf connected to the section which is in advance of the terminal section, guide-pulleys carried by the wrist-joint, and a driving-belt leading from a source of power and passing between one set of the guide-pulleys, around the driven pulley, and back between the other set of guide-pulleys, substantially as described.

3. In a dental engine, the combination, of a terminal section, a section in advance thereof, and a wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the terminal section, and the other leaf connected to the section which is in advance of said terminal section, substantially as described.

4. In a dental engine, the combination, of a terminal section, a section in advance thereof and provided with a tubular end, and a wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the terminal section, and the other leaf having a stem projecting therefrom and passing into, and rotatable within, the tubular end of the section which is in advance of the terminal section, substantially as described.

5. In a dental engine, the combination, of a terminal section, a section in advance thereof, a wrist-joint connection having oppositely-opening leaves connected respectively to the respective sections, and each leaf having an eye at one end, pins engaging the eyes, and links connecting the pins and arranged adjacent to opposite edges of the leaves, substantially as described.

6. In a dental engine, the combination, of a terminal section, a section in advance thereof, a bearing to which the terminal section is connected, a driven pulley journaled in the bearing, a wrist-joint connection between the bearing and the section which is in advance of the terminal section, said wrist-joint consisting of leaves connected respectively to the bearing and the section which is in advance of the terminal section, each leaf having an eye at one end, pins engaging the eyes and arranged adjacent to the leaves, guide-pulleys carried by the pins, and a driving-belt running from a source of power, and passing between one set of guide-pulleys, thence around the driven pulley, back between the other set of guide-pulleys, and back to the source of power, substantially as described.

7. In a dental engine, the combination, with a terminal section having a curved neck at one end, a section in advance of the terminal section, and a rotatable connection between the neck and the section which is in advance of the terminal section, substantially as described.

8. In a dental engine, the combination, of a terminal section having a curved neck at one end, a bearing to which the curved neck is rotatably connected, a section in advance of the terminal section, and a wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the bearing, and the other leaf having a rotatable connection with the section which is in advance of the terminal section, the rotatable connection between the curved neck and the bearing adapting said curved neck to swing in a circle at right angles to the swing of the wrist-joint, substantially as described.

9. In a dental engine, the combination, of a terminal section having a curved neck at one end, a bearing to which the curved neck is rotatably connected, a driven pulley mounted in said bearing, a shaft within the terminal section, said shaft having one end connected to the driven pulley, a rotary spindle also within the terminal section, to which spindle the other end of the shaft is connected, a section in advance of the terminal section, a connection between the bearing and this section which is in advance of the terminal section, and a driving-belt, substantially as described.

10. In a dental engine, the combination of disks or plates, one of said plates provided upon its inner side with an inwardly-extending tubular projection, and upon its outer side with an annular recess having an overlapping outer flange, a driven pulley arranged between the plates or disks, and provided with a conical hub fitting the conical tubular extension of one of the disks or plates, a conical screw-bearing for the opposite side of the

pulley, a terminal section having a curved neck at one end, said neck provided at its end with an annular head fitting the annular recess of one of the plates or disks, and lying back of the annular flange thereof, a flexible shaft within the terminal section, one end thereof passing through an opening in the head of the neck and secured within the conical hub of the pulley, a rotary spindle also within the terminal section and connected to the opposite end of the flexible shaft, a section in advance of the terminal section, and a driving-belt, substantially as described.

11. In a dental engine, the combination, of an engine-arm, a forearm pivoted thereto, a terminal section, a bearing to which the terminal section is rotatably connected, and a wrist-joint connection having oppositely-opening leaves, one of said leaves connected to the bearing, and the other leaf having a rotatable connection with the section which is in advance of the terminal section, said leaves opening in a direction at right angles to the swing of the forearm, and the axis of rotation of the terminal section being at right angles to the swing of the leaves, substantially as described.

12. In a dental engine, the combination, of an engine-arm, a forearm pivoted thereto, and a counterbalancing-spring having connection between the engine-arm and the forearm, substantially as described.

13. In a dental engine, the combination, of an engine-arm, a forearm pivoted thereto, a counterbalancing-arm having one end connected to the engine-arm and its opposite end connected to the forearm and a counterbalancing-spring having its free end engaging the counterbalancing-arm, substantially as described.

14. In a dental engine, the combination, of an engine-arm, a forearm pivoted thereto, an adjustable collar on the engine-arm, a sliding sleeve on the forearm, a counterbalancing-arm having one end pivotally connected to the collar and its opposite end pivotally connected to the sleeve, and a spring having its free end engaging the counterbalancing-arm, substantially as described.

15. In a dental engine, the combination, of an engine-arm, a forearm pivoted thereto, a shaft carried by the engine-arm, a counterbalancing-arm having one end pivotally connected to said shaft, and its opposite end pivotally connected to the forearm, springs wound about the shaft upon opposite sides of the pivoted end of the arm, said springs having their ends extended at right angles from the shaft to engage the counterbalancing-arm, substantially as described.

16. In a dental engine, the combination, of a terminal section, consisting of a shaft-casing and a handpiece-casing, the former provided at its lower end with a projecting lug, a sheathing rotatably surrounding the shaft-casing, to which sheathing the handpiece-casing is rigidly connected, a screw passing through the sheathing, with which screw the depending lug is adapted to contact, a bearing to which the terminal section is rotatably connected, a section in advance of the terminal section, and a rotatable connection between the bearing and the section which is in advance of the terminal section, the plane of rotation thereof being at right angles to the plane of rotation of the terminal section, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FREDERICK H. BERRY.

Witnesses:
ARTHUR L. MORSELL,
ANNA V. FAUST.