Nov. 15, 1932. T. E. BRIDGER 1,887,577

METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 1

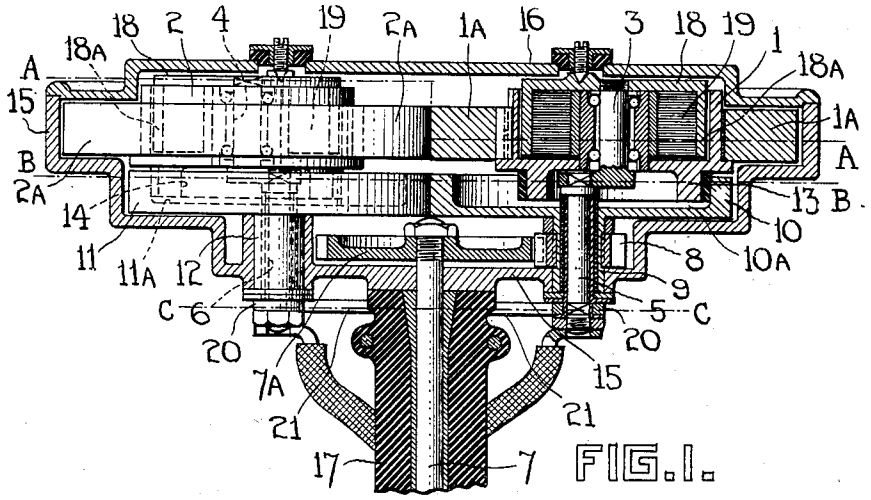


FIG. 1.

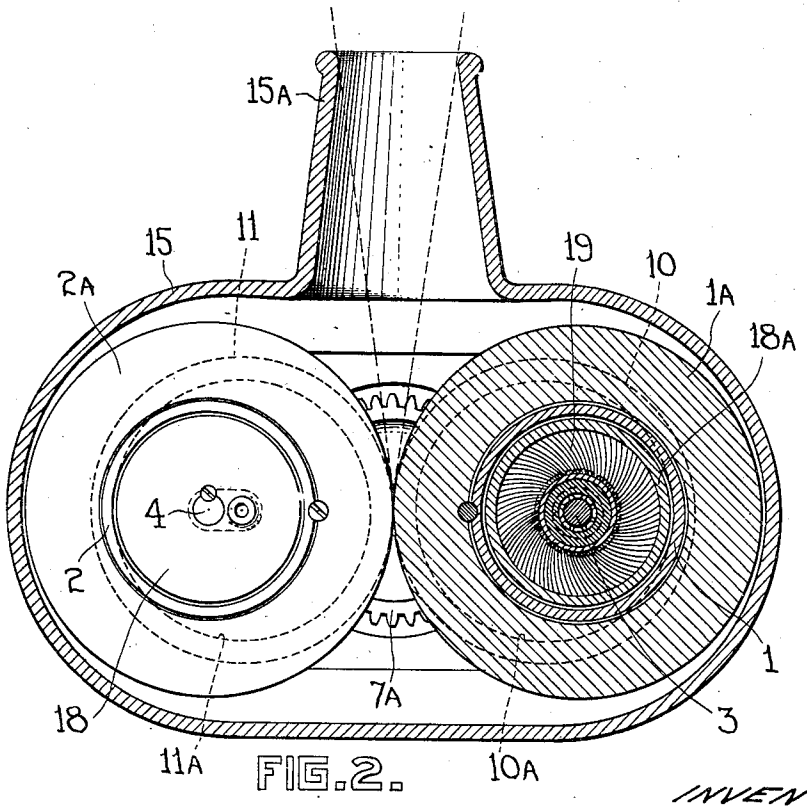


FIG. 2.

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 2

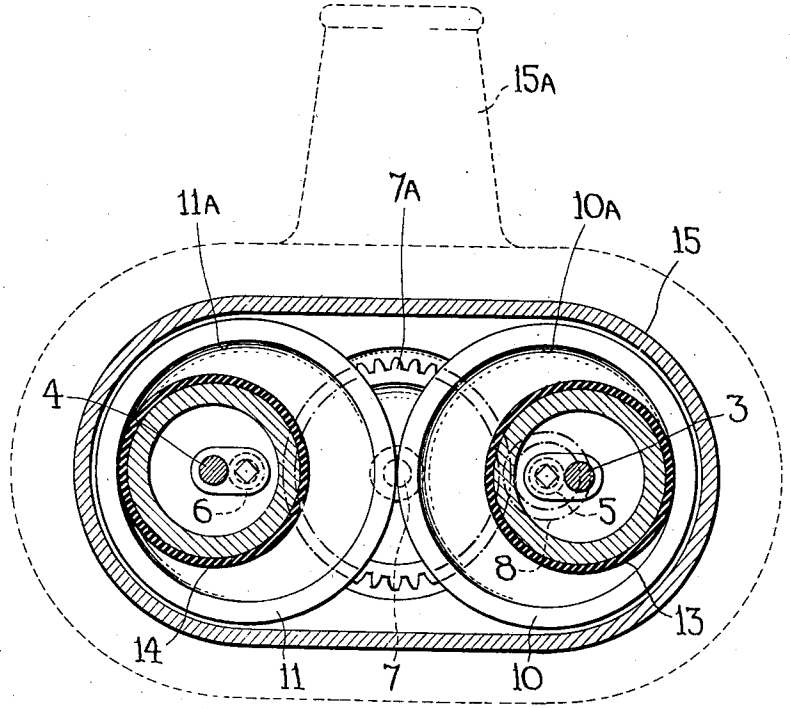


FIG. 3.

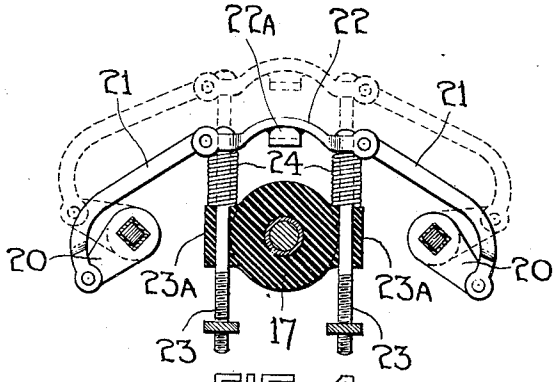


FIG. 4.

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Nov. 15, 1932. T. E. BRIDGER 1,887,577

METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 3

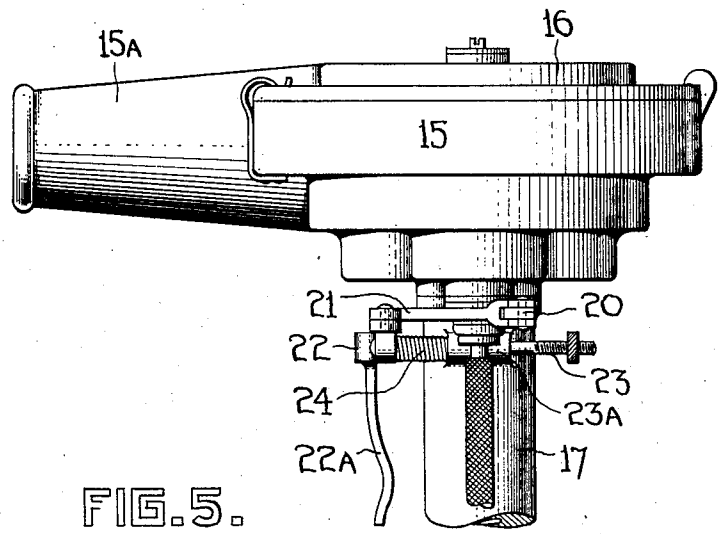


FIG. 5.

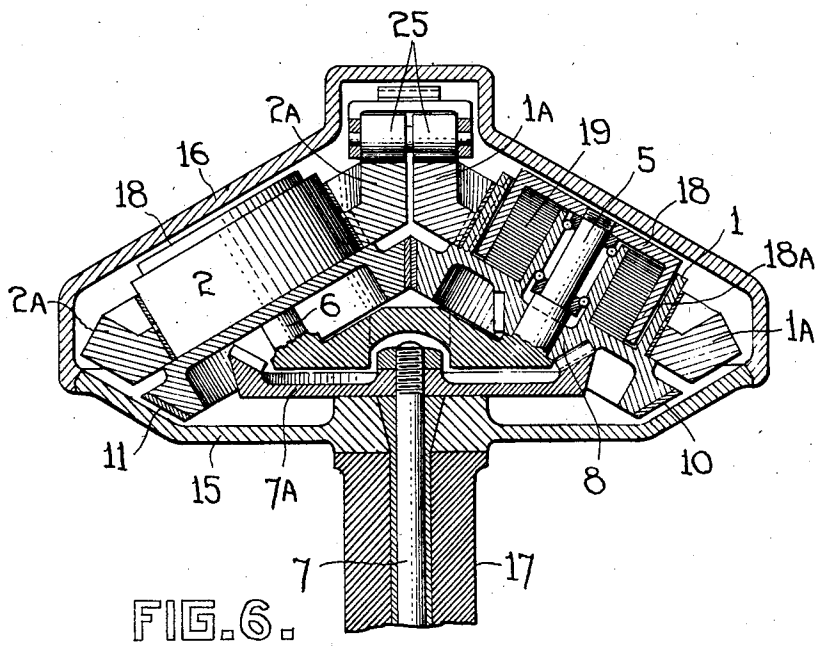


FIG. 6.

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 4

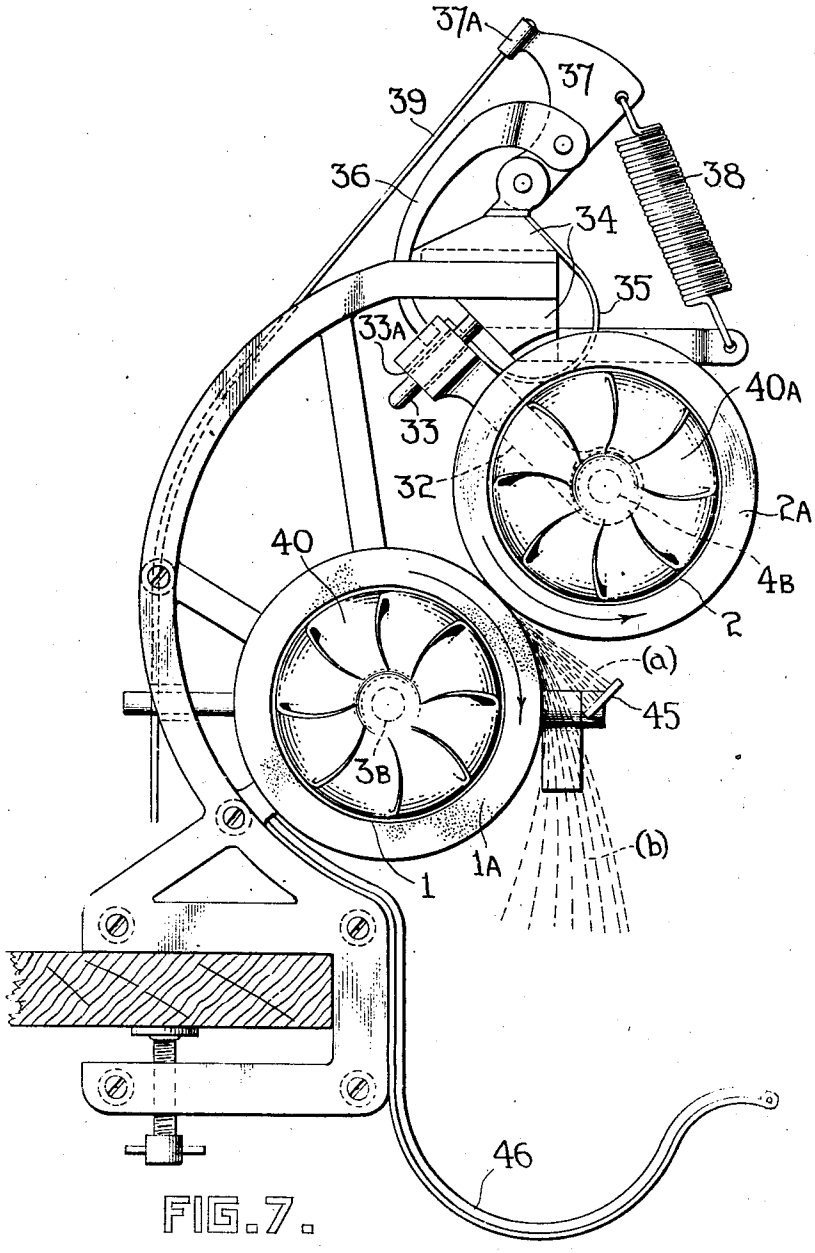


FIG. 7.

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 5

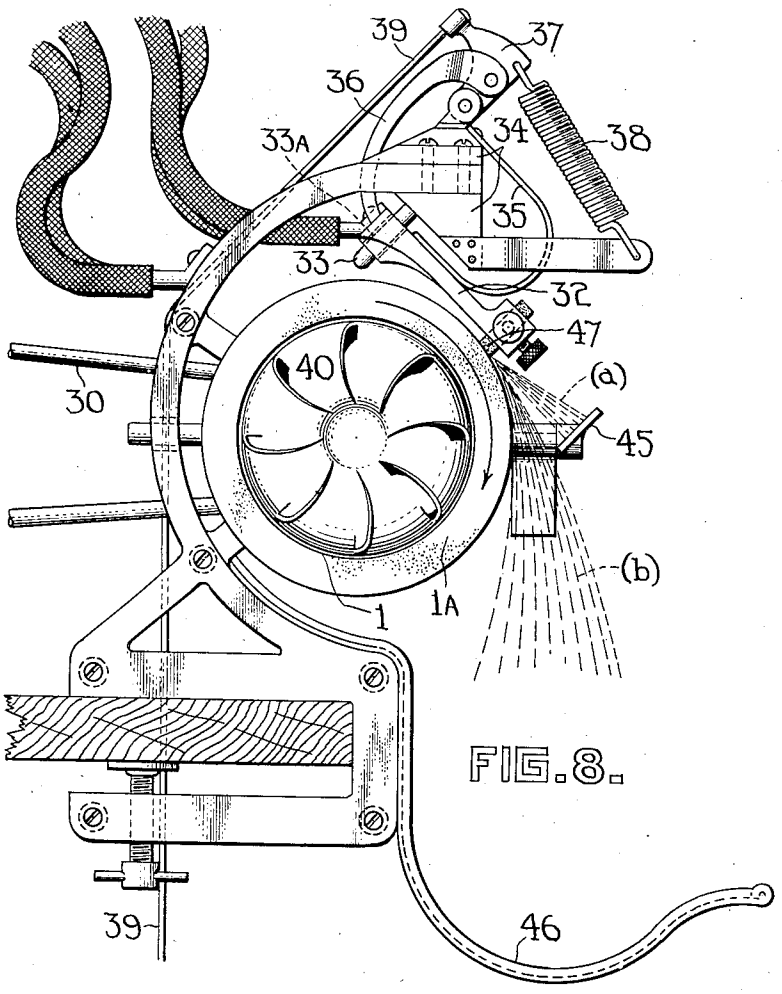


FIG. 8.

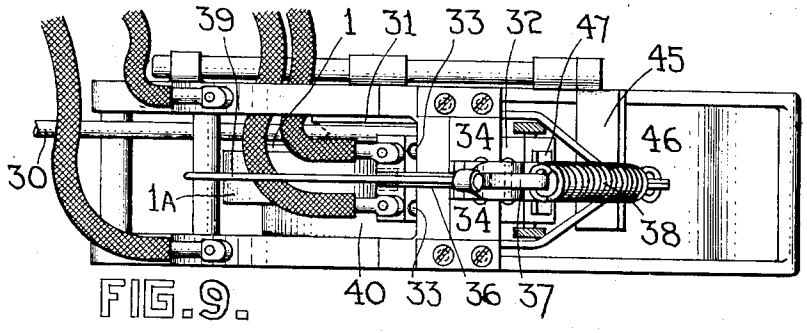


FIG. 9.

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 6

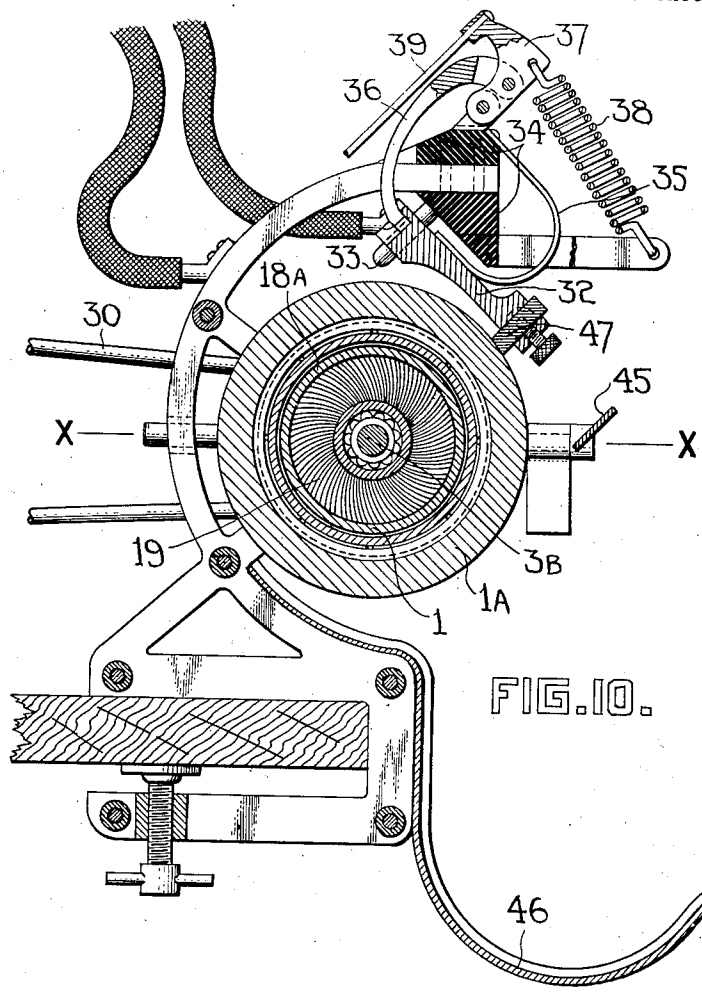


FIG. 10.

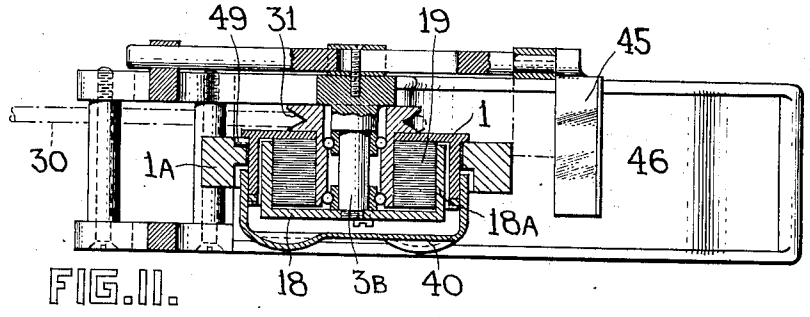


FIG. 11.

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Filed March 8, 1929 7 Sheets-Sheet 7

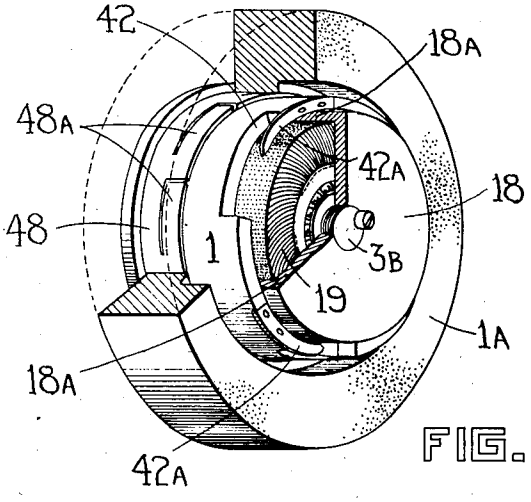


FIG.12.

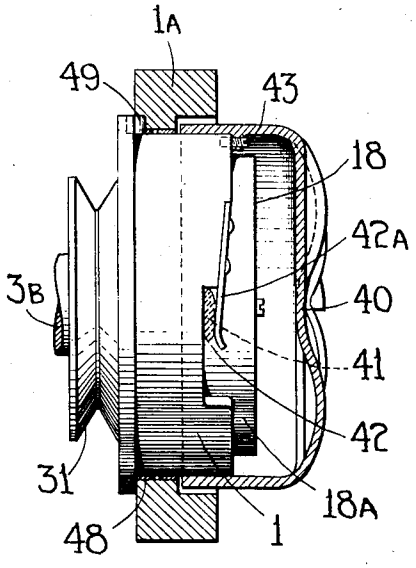


FIG.13.

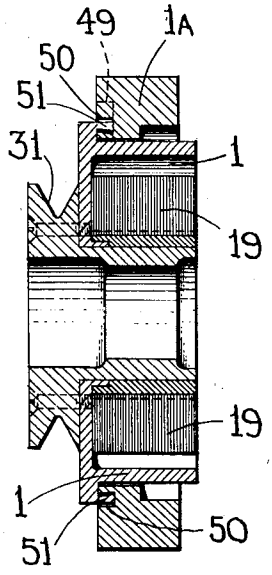


FIG.14.

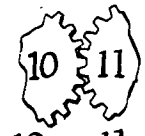


FIG.15.

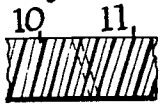


FIG.16

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Patented Nov. 15, 1932 1,887,577

UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR CREATING METALLIC SPRAY

Application filed March 8, 1929, Serial No. 345,489, and in New Zealand March 22, 1928.

This invention relates to a method of and means for creating a metallic spray suitable for depositing on surfaces, and has for its object the provision of an improved method of and means whereby a metallic substance can be broken down electrically and sprayed on to the surface in a chemically clean and brightly scintillating condition adapted particularly for dental commercial and ornamental purposes, such as spraying on fabrics and the like.

A further object of the invention is to provide a cheap and efficient method of and means for creating metallic spray, or combining and mixing the same, and to provide also means for controlling and directing the spray and forming a spray of any desired fineness.

Further, owing to the fact of being able to spray to any desired fineness of the substance or substances, it is possible to combine any two substances together, as the said substances are held together and combined by means of their molecular attraction.

A still further advantage obtained by the use of this invention is that, owing to the fineness to which the spray can be reduced, adhesion of said spray can be obtained on any surface without undue roughening of the latter, while owing to the simplicity and adaptability of the apparatus to suit special conditions of working, and the ease with which the spray can be produced, directed and controlled, it is possible to utilize same for work in any of the finer arts, as for instance, in mechanical dentistry and the like.

According to the invention, the mass of the metal to be sprayed is formed into a suitable regular shape and revolved by suitable means, at a high rate of speed. The revolving mass of metal to be sprayed is placed under electric potential at suitable voltage and at high amperage, and there is placed an intermittent make and break contact with any suitable portion of the surface of the revolving mass of metal to be sprayed. An electric contact or conductor is provided under suitable electric potential. By this means rapidly intermittent short circuiting and arcing of high intensity is created between the revolving mass of metal to be sprayed and the electric contact therewith, with the result that at each period of arcing between the revolving metal mass and the electric contact or conductor, a portion of the metal of which the former is composed, is caused to be fused or broken down and carried into the arc from which latter it is expelled or thrown out in the form of a fine metallic spray, partly under the influence of the magnetic repulsion inherent in the arc, and partly under the influence of the centrifugal force created and exerted upon such metallic particles by reason of their having comprised part of the rapidly revolving metallic mass.

The invention will, however, be more particularly described with reference to the accompanying drawings, wherein:—

Figure 1 is a lateral elevation, partly in section, illustrating the most complete form of apparatus employed, for the purpose of this invention.

Figure 2 is a plan view thereof, also partly in section, upon the line A—A, Figure 1.

Figure 3 is a further sectional plan view of the apparatus illustrated in Figure 1, taken along the line B—B.

Figure 4 is a sectional plan view upon the line C—C, Figure 1, while

Figure 5 is a side elevation of the machine illustrated in Figures 1 to 4.

Figure 6 is a lateral sectional elevation illustrating certain modifications in the mechanical structure and arrangement of the various parts of the machine illustrated in the preceding figures.

Figure 7 illustrates in side elevation a further modification of the machine adapted particularly for use in connection with mechanical dentistry wherein spraying operations may be conducted wholly in the presence of air.

Figure 8 illustrates in side elevation a slight modification of the machine illustrated in Figure 7, in order to further simplify the same and render the device still more adaptable for mechanical dental purposes.

Figure 9 is a plan view of the dental machine as illustrated in Figure 8.

Figure 10 is a sectional side elevation of the dental spraying machine.

Figure 11 is a sectional plan view thereof upon the line X—X, Figure 10.

Figure 12 is a perspective view, partly in section, illustrating means of mounting the revolvable mass of metal to be sprayed, and showing the means whereby the same is placed under electric potential.

Figure 13 is a side elevation, partly in section, of the wheel illustrated in Figure 12, showing applied thereto a fan cover for the purpose of cooling said wheel, while

Figure 14 is a sectional elevation of the wheel and electric collector, and showing alternative means of securing thereto the mass of metal to be sprayed.

Figure 15 is a broken elevation showing a slightly modified form of the masses to be sprayed, indicating a roughened peripheral surface.

Figure 16 is a plan of the same.

In its most elementary form, the apparatus or machine required to effect the purposes of this invention comprises a wheel or hub provided with suitable bearings, supports for the latter, and means whereby it can be rotated at a high rate of speed, and also means for conducting to said hub or wheel electric current at high amperage.

The metal to be sprayed is provided preferably in the form of a ring adapted to be applied and securely held on the periphery of the hub or wheel and to rotate therewith.

An electric contact or conductor comprising a further wheel, which may have a periphery of high fusing point metal or the like, or a roller or brush of suitable design, is arranged so as to be brought into contact with the surface of the revolving ring of metal to be sprayed, either on its periphery or on its side, as is most convenient and desirable, and in such a manner that the contact between the metal to be sprayed and the said contact or conductor is of a vibratory or intermittent nature, thereby causing rapid make and break electric connection to be set up between said metal to be sprayed and said contact or conductor.

Upon each break of electric contact between the metal to be sprayed and the contact or conductor, and owing to the high amperage of the current passing between the same, an arc of high intensity is created and immediately broken, thereby causing part or portion of the metal to be sprayed, to be fused or broken down and carried into the arc in the form of finely divided metallic particles.

Upon the breaking of the arc, the explosion consequent thereon and the properties of magnetic repulsion inherent in said arc, cause a proportion which varies according to the speed of rotation of the hub or wheel, of such metallic particles to be exploded outwardly in the line of least resistance, while the remainder of the metallic particles continue to be influenced by the centrifugal force created by the rapidly revolving wheel carrying the metal from which they have been broken down and are projected in the form of a somewhat coarser spray under the influence of such centrifugal force.

Where a comparatively low amperage is employed in the formation of the electric arc and due to the high speed of revolution of the ring comprising the metal to be sprayed, the spray formed is principally of the finer form and is projected or sprayed in the line of least resistance as determined by the directional effect of the rotation of the wheel on the explosion of the arc, and on the magnetic repulsion exerted by the said arc.

By the use of a higher electrical amperage however, a greater quantity of metallic particles are carried into the arc from the surface of the metal wheel, and a considerable proportion of such particles are thrown out of the arc under the influence of centrifugal force, and are projected or sprayed in the path of least resistance as determined by the centrifugal drag created by the revolving wheel, as a separate and distinct body of spray.

It will therefore be apparent that the above essentials may be provided in a variety of mechanical arrangements, and in the following specification the principal modifications of the apparatus as adapted for general commercial, and mechanical dental purposes, are described in detail, firstly as to the apparatus designed and preferred for general commercial work, and secondly as to the apparatus designed and preferred more especially for use in connection with the fine arts, such as for instance, mechanical dentistry.

In the application of the foregoing principles to a machine adapted and preferred for general commercial spraying, two revolvable hubs or wheels 1 and 2 are provided, each having removable and renewable peripheral bands or rings 1A and 2A, one of which can be comprised of the metal to be sprayed and the other of high fusing point metal.

Where however alternating current is employed as the electrical energy, both hubs or wheels 1 and 2 can carry rings or peripheral bands 1A and 2A of the metal to be sprayed, spraying taking place alternately from each ring or band according to the direction of flow of the electric current, and it is thereby rendered possible to provide the peripheral rings of different metals to produce in the spray an alloy or combination of such metals.

The hubs or wheels 1 and 2 are revolved at a suitable speed, preferably between 4,000 and 5,000 revolutions per minute, and intermittent peripheral contact is established between the peripheral bands 1A and 2A of the hubs or wheels 1 and 2, to provide a rapid electrical make and break contact between the said peripheral rings 1A and 2A, and

electric current as suitable voltage and amperage is passed between the said hubs or wheels 1 and 2, and rings 1A and 2A to form between the latter rapidly intermittent arcing of high intensity.

This arcing between the adjacent and intermittently contacting portions of the metal rings 1A and 2A creates heat of sufficient intensity to cause the substance of which each, or both (as the case may be), of the latter are composed to break down and be carried into said arc in the form of fine and highly heated particles, the latter then being expelled out of the arc in the line of least resistance as determined by the direction of rotation of the hubs or wheels 1 and 2 and by the magnetic repulsion exerted by the said arc upon the metallic particles or molecules, and causing the latter to be projected out of said arc in the line of least resistance.

The hub or wheel 1 is mechanically driven from any suitable or convenient source of power, and the other hub or wheel 2 can be suitably geared to or driven by the said driven hub or wheel 1, both being freely rotatable on spindles 3 and 4 which latter are adjustable towards or away from one another in order that as the peripheries of the rings of material or substance 1A and 2A secured around said hubs or wheels are sprayed away, the said spindles 3 and 4 can be adjusted towards one another to compensate for the reduction of diameter of the rings.

For this purpose the spindles 3 and 4 of the hubs or wheels 1 and 2 are set out from a pair of further or main spindles 5 and 6, in the form of cranked portions at the upper end of the latter. Partial turning movement imparted to such main spindles 5 and 6 by operator causes their cranked portions 3 and 4, on which the hubs or wheels 1 and 2 rotate, to be moved through the arc of a circle to a maximum extent of 180 degrees. The spindles 5 and 6 can if desired be turnable independently of one another in the event of spray being produced from only one of the peripheral rings on the hubs or wheels.

The method of rotating the hubs or wheels 1 and 2 is preferably by mechanical means, a convenient flexible shaft 7 being provided on its end with a spur gear 7A adapted to drive a pinion 8 secured on a sleeve 9 rotatable on the main spindle 5 of the hub or wheel 1. The upper end of this sleeve 9 has fitted thereto or formed integrally therewith a friction wheel 10 adapted to drive a further friction wheel 11 fitted to the sleeve 12 on the main spindle 6 of the hub or wheel 2.

These contacting wheels 10 and 11 are suitably shaped or formed to provide on their upper surfaces circular recessed portions 10A and 11A, in which downwardly stepped circular portions 13 and 14 formed concentrically with and on the undersides of the respective hubs or wheels 1 and 2 are entered and adapted to engage peripherally at one side, thereby establishing frictional planetary gearing between the said circular recesses 10A and 11A in the friction wheels 10 and 11, and the hubs or wheels 1 and 2 mounted on the adjustable or cranked portions 3 and 4 of the spindles 5 and 6 passing through the sleeves 9 and 12 which transmit the mechanical drive.

If desired, gear teeth could be cut around the circular recesses 10A and 11A in the upper surfaces of the wheels 10 and 11 adapted to mesh with and drive teeth formed on the downwardly projecting portions 13 and 14 of the hubs or wheels 1 and 2 to provide an internally geared planetary drive.

In order to provide that the peripheries of the rings 1A and 2A do not run in constant contact with each other, and so cause a constant electrical short circuit between the said rings, the contacting portions of one or both of the latter can be serrated or roughened in any suitable manner as indicated at 2X in Figures 15 and 16 to ensure that each contact between their peripheries will be only momentary and rapidly intermittent, so as to produce the rapid alternate arcing and shorting of the electric current between them necessary for the purpose of producing the spray.

The sleeves 9 and 12, spindles 5 and 6, and the like are mounted in suitably designed bearings within a casing 15 adapted to completely enclose the hubs or wheels 1 and 2, and rings 1A and 2A thereon, said casing being provided with a mouthpiece 15A projecting forwardly in front of the point of peripheral contact of said rings 1A and 2A in a line drawn at right angles to an imaginary line drawn through the centres of the hubs or wheels 1 and 2.

The casing 15 is provided with a conveniently and quickly opened lid or cover 16 to enable access to be readily obtained to the rings 1A and 2A for the purpose of removing or renewing the said rings, and a conveniently shaped handle 17 is provided on the underside of said casing 15 to enable the device to be held by the operator. The flexible shaft 7 of the drive is preferably entered in the casing 15 through the centre of said handle 17.

Conduction of the electrical energy for the creation of the arc between the discs is preferably provided through the spindles of the respective hubs or wheels 1 and 2, non-rotatable discs 18 being secured to the upper ends of the cranked portions 3 and 4 of said spindles 5 and 6 and provided with downwardly projecting flanges 18A around their edges to provide an electric contacting surface arranged concentrically with and around the said cranked portions 3 and 4 of the spindles 5 and 6.

Circular brushes 19 formed of fine wire

are mounted on or secured around the centre bearing bosses of the hubs or wheels 1 and 2, and are adapted to rotate therewith on the cranked spindles 3 and 4 and establish wiping contact with the inner faces or surfaces of the said flanges 18A of the non-rotating discs 18 to collect electric current from the latter and deliver same to their respective hubs or wheels 1 and 2, and thence to the peripheral rings or bands 1A and 2A.

The projecting wires of the brushes 19 are formed with a slight inclination in a direction opposite to that of the direction of rotation of hubs or wheels 1 and 2, so that the centrifugal force created by the rapid rotation of the said brushes causes the wires to tend to straighten out and so cause them to come into contact, or contact more efficiently with the inner surface of the flanges 18A inside which they operate.

Suitable electric insulating means are incorporated in the machine to prevent short circuiting of the electric current, and to ensure its efficient feeding to and from the respective hubs or wheels 1 and 2 and peripheral rings 1A and 2A.

The lower ends of the main spindles 5 and 6 of each hub or wheel are projected downwardly through the drive sleeves 9 and 12 and outside the bottom of the casing 15, where they are fitted or have secured to them levers 20 connected by means of links 21, to a bridge piece 22 mounted on the handle 17 and movable under the influence of a suitable trigger 22A.

The bridge piece 22 has secured thereto a pair of guide rods 23 passed through bearings 23A in either side of the handle 17 so as to be slidable therein, and springs 24 are passed on said guide rods 23 between their bearings 23A and the bridge piece 22 to normally retain the latter and the trigger 22A away from the handle 17.

In this position the levers 20 and spindles 5 and 6 are turned so that the cranked portion 3 and 4 of the latter are at their extreme outward limit of throw. Pressure on the trigger 22A, therefore, to bring the bridge piece 22 towards the handle 17 and causes the spindles 5 and 6 to be turned to move the cranks 3 and 4 towards each other and so bring the peripheral rings 1A and 2A of the hubs or wheels 1 and 2 into contact. This control mechanism is illustrated in Figures 4 and 5 of the drawings.

With the apparatus as hereinbefore described in relating to Figures 1 to 5 of the drawings, and in order to produce a metallic spray under the most efficient conditions, this spraying from the rotating wheels is conducted in an atmosphere of hydrogen or other suitable chemical re-agent or gas, in order to prevent the forming of nitrates or the oxidizing or carbonizing of the spray or of the spraying surfaces of the peripheral ring composed of the metal being sprayed, such gas or the like being introduced into the casing 15, which is rendered gas-tight, through suitable nipples or connections in the same, portion of such gas being ejected through the nozzle 15A with the spray issuing therefrom. Where spraying is conducted under such conditions it will be necessary for a suitable cap to be applied to the nozzle 15A to close the latter when spraying is suspended, and to prevent undue escape and wastage of the gas or the like.

Certain modifications of the above described apparatus are illustrated in Figure 6 of the drawings, wherein the hubs or wheels 1 and 2 and rings 1A and 2A thereon are shown mounted direct on the main spindles 5 and 6, no cranked portions being provided on the latter, and no provision being made for the moving of the hubs or wheels 1 and 2 towards each other, owing to the fact that the rings 1A and 2A are not brought into peripheral contact at any time, but are each contacted with on their sides near their peripheries by a common or separate contact or conductor roller or small wheel 25, suitably mounted so as to roll in frictional and vibratory contact with the rings 1A and 2A.

Each hub or wheel 1 and 2 and their associated rings 1A and 2A then act as separate spraying wheels, and the electric arc is produced between the sides of the revolving rings 1A and 2A and the periphery of the vibrating roller or wheel 25. The mounting of the roller or wheel 25 to enable it to vibrate and make intermittent contact with the rings 1A and 2A is preferably by means of a device of a similar nature to that illustrated in Figure 7 of the drawings.

If desired the roller 25 could be replaced by a non-rotating brush or wipe contact of suitable high fusing point metal, mounted in the manner illustrated in Figures 8 and 10 of the drawings, so as to be brought into vibratory contact with the rings 1A and 2A and provide a common pole for the arcing from each of said rings, or said brush or contact could be utilized merely to intermittently short the electric current from one ring to the other and so cause arcing to occur upon each breaking of such short circuit.

In Figure 7 of the drawings there is illustrated a modification of the apparatus particularly adapted for use where it is desired to produce a machine of simplified construction required principally for the production of spray from low fusing point metals in the presence of air, where there is no necessity for the provision of an elaborate gas tight casing around the spraying wheel and electric contact or conductor, while in Figures 8 to 11 of the drawings, this form of the apparatus is shown in a further modification wherein there is substituted for the wheel type of contact or conductor shown in Fig-

ure 1, a non-rotary but vibratory brush contact or conductor.

The following description will therefore apply to either of the modified forms of the invention as illustrated in Figure 7, and in Figures 8 to 11, in all respects, with the exception of the mechanical construction and type of electric contact or conductor used. The hub or wheel 1 carrying the peripheral ring 1A of metal to be sprayed is mounted on a fixed spindle 3B secured and held horizontal in a suitable frame, and said hub or wheel 1 is constructed similarly to the hub or wheel shown in Figures 1 to 5 of the drawings, comprising the hub or wheel 1, peripheral ring 1A, spindle 3B, disc 18 on the end of the latter, flange 18A around the periphery of the disc 18, and rotary wire brush 19 secured to and rotatable with the hub or wheel 1.

The method of applying the drive to the hub or wheel 1 in the present case is preferably by means of a suitable belt 30 driving a pulley 31 secured to the hub or wheel 1.

The contact or conductor can be provided by means of a further hub or wheel 2, of exactly similar design mounted on a horizontal fixed spindle 4B, formed or secured to the outer end of an arm 32, the other end of which is drilled to provide holes 33A, by means of which it is passed and is freely slidable on a pair of guide pins 33 secured to but insulated from the frame by means of non-conducting material 34, or said contact or conductor can be provided by means of a brush or wipe contact 47 suitably detachably held in the outer end of the arm 32 as shown in Figures 8 to 11 of the drawings.

The holes 33A in the arm 32 are formed of somewhat greater diameter than the diameter of the guide pins 33, thereby providing sufficient slack to permit a certain amount of lateral play in the outer end of the arm 32 to which is secured the contact or conductor wheels or brush, while further lateral movement of said arm 32 in order that the contact or conductor may be moved towards or away from the hub or wheel 1, as desired, in order to contact or break contact between the peripheral ring 1A, such contact or conductor is effected by moving the inner end of the said arm 32 along the guide pins 33.

A spring 35 pressing against the arm 32 normally tends to move the latter on the guide pins 33 so as to bring or move the same towards the hub or wheel 1, while said arm 32 is connected by means of a link 36 and pivoted lever 37 to a considerably stronger spring 38, the normal tendency of which upon the arm 32 is to move the latter along the guide pins 33 in a direction away from the hub or wheel 1. The pivoted lever 37 has secured to it at 37A, a cord insulated wire or the like 39, the other end of which can be connected to a convenient form of foot lever or pedal (not shown) by means of which the said lever 37 can be moved against the action of the spring 38, thereby removing the arm 32 from the influence of said spring and permitting the spring 35 to act and move said arm 32 in a direction towards the hub or wheel 1.

Each or either of the hubs or wheels 1 and 2 can be provided with quick detachable and removable covers 40 and 40A adapted to be attached to the rims of the hubs or wheels 1 and 2 by means of studs or projections 41 on their internal peripheries engaged in bayonet slots 42 in the edges of the rims of the said hubs or wheels 1 and 2.

The projections enclosing and defining such bayonet slots are preferably provided by means of spring metal insets 42A to allow for an unequal expansion or contraction of the hub or wheel and cover 40 due to heating of the former, and thereby eliminating possibility of the cover 40 and 40A becoming locked in position.

A set screw 43 is passed through the cover 40 into the edge of the rim of the hub or wheel to prevent movement of the studs or projections 41 in the bayonet slots 42 so long as said set screw is in position, and said cover 40 is slotted radially and formed to provide fan blades adapted to catch and deliver to the bearings of the hub or wheel, air to cool the said bearings.

In operation of the above described machine, electric current is (in the case of direct current) passed to the hub or wheel 1 and ring 1A, and thence arcs to the contact or conductor or (in the case of alternating current) arcs alternately from the ring 1A to the contact or conductor and from the latter to the former; the most efficient spraying however, only taking place upon the arcing from the ring 1A to the contact or conductor owing to the fact that the latter is formed of high fusing point metal which is impervious to the action of the arc.

The metal spray is formed in exactly the same manner as hereinbefore described in connection with the enclosed type of apparatus illustrated in Figures 1 to 5 of the drawings, two separate and distinct sprays being produced and projected out of the arc as shown at (*a*) and (*b*), in Figures 7 and 8.

The spray projected at (*a*) is that expoded by the breaking of the arc and by the magnetic effect of the latter on the metallic particles. This spray, however, is only of value when produced and sprayed in an atmosphere of some inert gas or re-agent, as directly it comes into contact with the atmosphere it is resolved by combination with the elements of the latter into oxides, nitrates and other combinations of the metal, and as such is rendered useless for the purposes of depositing on surfaces. This spray is there-

fore (in the apparatus shown in Figures 7 to 11) intercepted and caught by means of a baffle 45 suitably supported and positioned directly in the line of projection of such spray (*a*) which, with reference to Figure 7, is outwardly and downwardly in the direction of the rotating ring of metal to be sprayed from a line drawn from the point of peripheral contact of the spring 1A of metal to be sprayed and contact or conductor 2A at right angles to a straight line drawn from the center of the said ring of metal to be sprayed and the center of the contact or conductor.

The spray (*b*) is produced by the fused particles from the ring 1A which are drawn out of the arc and projected by the influence of the centrifugal force produced by the rapid rotation of the hub or wheel 1 and ring 1A thereon, the path of projection of such spray (*b*) being as indicated in Figures 7 and 8 of the drawings, where it is quite free and independent of the spray (*a*).

The spray produced at (*b*) not being in so finely divided a state, or at so high a temperature as the spray produced at (*a*), is not affected by contact with the atmosphere and does not change its metallic characteristics and is therefore capable of being directly deposited on the surface to be coated in the presence of air.

The spray utilized in this type of machine is therefore that projected at (*b*) under the influence of the centrifugal force, the drag exerted by the hub or wheel 1 and ring 1A causing the final direction of such spray to be substantially downwards.

The article or the like to be coated can therefore be conveniently manipulated by the operator in the line of such spray (*b*) and a shield or tray 46 can be provided in the lower part of the machine to catch such of the spray as is not received on such article or the like.

If desired, a nozzle can be provided adjacent to the point of contact and arcing between the peripheral ring 1A and the contact or conductor, and a suitable chemical re-agent such as nitrogen delivered therefrom on to the arc, and the spray issuing therefrom, with a result that this form of machine may be utilized for the production of spray in an atmosphere of gas or the like for the purpose of preventing oxidation or the like of the spray (*a*) and consequently enabling a finer spray to be obtained.

The peripheral rings 1A and 2A are preferably not applied directly on to the rims of the hubs or wheels 2, as owing to the heat generated by the device in operating and to the fact that such peripheral rings and hubs or wheels are composed of metals having different expansion or contraction characteristics, difficulty would be experienced in keeping the rings a neat fit on the hubs during operation, while, on the apparatus cooling off, danger of the rings seizing on the rims of the hubs would be experienced.

Circular bands 48 of thin springy metal cut so as to present a plurality of slightly offset tongues 48A are therefore passed on the rims of the hubs or wheels 1, and the peripheral rings 1A are passed on such bands 48, the spring tongues of which allow for contraction and expansion of the peripheral rings while retaining same in good electrical contact with the hubs or wheels.

Suitable keys or feathers 49 are set in the rim of the wheels or hubs to engage slots or recesses in the peripheral rings to ensure the latter rotating with said hubs or wheels.

An alternative method of securing the peripheral ring on the hub or wheel is illustrated in Figure 14 of the drawings, and consists in providing an interrupted undercut dovetail groove 50 in the flange of the hub or wheel 1, with correspondingly cut projections 51 on the side of the ring 1A adapted to be engaged in said interrupted groove 50 in the manner of a bayonet joint and the rings 1A then turned to enter said projections 51 in said grooves 50.

As the greatest expansion is usually experienced in the material of which the ring 1A is composed, the latter on expanding will tighten the inclined faces of the projections 51 against the inclined sides of the grooves 50, while on the apparatus cooling, the said ring 1A will contract to free the projections 51 and grooves 50, and so enable the ring 1A to be easily removed and replaced.

What I claim as new and desire to secure by Letters Patent is:—

1. A method of creating a metallic spray comprising the rotation at a high speed and in a regular form of a mass of the metal to be sprayed, and the rapid arcing and shorting of electric current at high amperage between a point or points on the surface of the revolving mass of metal and an electric conductor or contact in intermittent make and break electrical contact with the latter.

2. A method of creating a metallic spray comprising the breaking down into metallic particles of portion of a rapidly revolving mass of metal to be sprayed by means of rapidly intermittent arcing and shorting of a high intensity electric current between the surface of said mass of metal to be sprayed and a conductor or contact in intermittent make and break contact with the latter, and the delivery of such metallic particles out of the electric arc under the influence of the magnetic repulsion exerted by the said arc and the centrifugal action produced by the devolving mass of metal.

3. A method of creating a metallic spray comprising the rotation at a high rate of speed of a mass of metal to be sprayed: intermittently contacting with the surface of the mass of metal to be sprayed of an elec-

tric conductor or contact: the placing of the mass of metal to be sprayed and the said electric conductor or contact under electric potential to produce between them intermittent arcing and shorting of such electric current, whereby metallic particles are broken down from the surface of the rotating mass of metal to be sprayed, carried into the arc and delivered thence where desired by the continued action thereon of the centrifugal force created by rotation of the metallic mass combined with the explosive effect of the breaking arc and the magnetic repulsion produced by the latter.

4. Means for the purpose specified, comprising a rotatable disc of the metal to be sprayed; means for placing the particles comprising said disc under centrifugal stress, an electric contact or conductor placed in intermittent make and break contact with a portion of the surface of the disc: and means for passing electric current at high amperage to and between said rotating disc and the said intermittently contacting electric contact or conductor.

5. Means for the purpose specified, according to claim 4, wherein the rotatable disc is mounted upon a hub rotatable on a non-rotatable spindle, and wherein the metal to be sprayed is applied to said hub in the form of a removable and renewable peripheral band or ring.

6. Means for the purpose specified, according to claim 4, wherein the electric contact or conductor comprises a rotatable wheel mounted on a spindle capable of adjustment onto or out of contact with the wheel or disc carrying the metal to be sprayed, and wherein means for passing electric current at high amperage are provided between said rotatable wheel and the spindle thereof.

7. Means for the purpose specified, according to claim 4, wherein the electric contact or conductor comprises a rotatable wheel or disc having applied to its periphery removable and renewable band or ring of the metal to be sprayed.

8. Means for the purpose specified, according to claim 4, wherein the electric contact or conductor comprises a non-rotatable brush of high fusing point material held and mounted so as to be capable of being brought in and out of vibratory contact with the ring or band of metal to be sprayed around the periphery of the rotatable disc or wheel.

9. Means for the purpose specified, according to claim 4, wherein the means for conducting the electric current to the rotating disc or wheel comprises a stationary drum or ring connected to the electric source of supply and positioned concentrically with and in line with the axis of the rotatable disc or wheel to which latter is secured a circular wire collector brush adapted to rotate with said disc or wheel and maintain electrical contact between the inner surface of the stationary ring or drum and the disc or wheel so long as the latter rotates.

10. Means for the purpose specified, according to claim 4, wherein electrical conduction to the rotatable disc or wheel is provided by means of a circular wire collector brush secured to the latter and rotatable therewith inside, a stationary ring or drum connected to the electric source of supply and wherein the wires comprising said collector brush are inclined in a direction opposite to the direction of its rotation and are adapted by reason of the centrifugal force created by the rotation of said collector brush to tend to straighten radially and come into contact, or contact more efficiently with the inner surface of the said stationary ring or drum.

11. Means for the purpose specified, comprising a pair of rotatable discs or wheels mounted on non-rotatable spindles which are adjustable towards or away from each other, rings or bands of metal to be sprayed positioned around the peripheries of said discs or wheels and rotatable therewith, either or both of said discs or wheels acting as a positive electrode while the other disc or wheel acts as a contact or conductor capable of being brought in intermittent contact with the positively charged disc or wheel and so provide a negative electrode for the production of an electric arc between said discs or wheels, and wherein the rings or bands around the peripheries of the rotatable discs or wheels can be composed of different metals.

12. Means for the purpose specified comprising a rotatable disk, a peripheral band on said disk, with the band of the metal to be sprayed, means for placing particles comprising said band under centrifugal stress, an electric contact arranged for intermittent make and break contact with the surface of the band, and means for passing electric current at high amperage to and between said band and electric contact.

13. Means for the purpose specified comprising a rotatable disk, a peripheral band on said disk, with the band of the metal to be sprayed, expansible and contractible means arranged between the disk and band, means for placing the particles comprising said band under centrifugal stress, an electric contact arranged for intermittent make and break contact with the surface of the band, and means for passing electric current at high amperage to and between said band and electric contact.

14. Means for the purpose specified comprising a rotatable disk, a peripheral band on said disk, with the band of the metal to be sprayed, expansible and contractible means arranged between the disk and band including a circular band of metal, means for placing the particles comprising said band under centrifugal stress, an electric contact

arranged for intermittent make and break contact with the surface of the band, and means for passing electric current at high amperage to and between said band and electric contact.

In testimony whereof, I have affixed hereto my signature.

THEO EUSTACE BRIDGER.