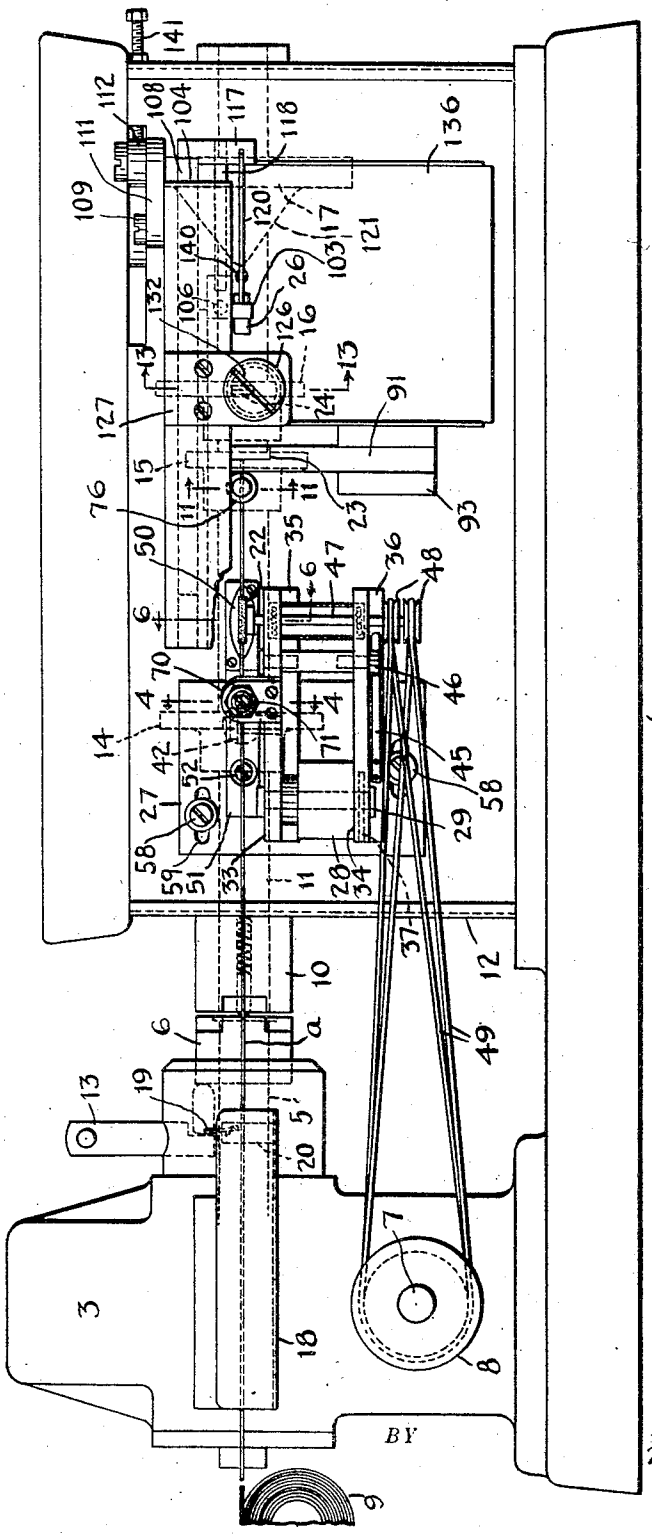
Nov. 21, 1933. J. A. WILLIAMS 1,936,559

FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

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Fig. 1.



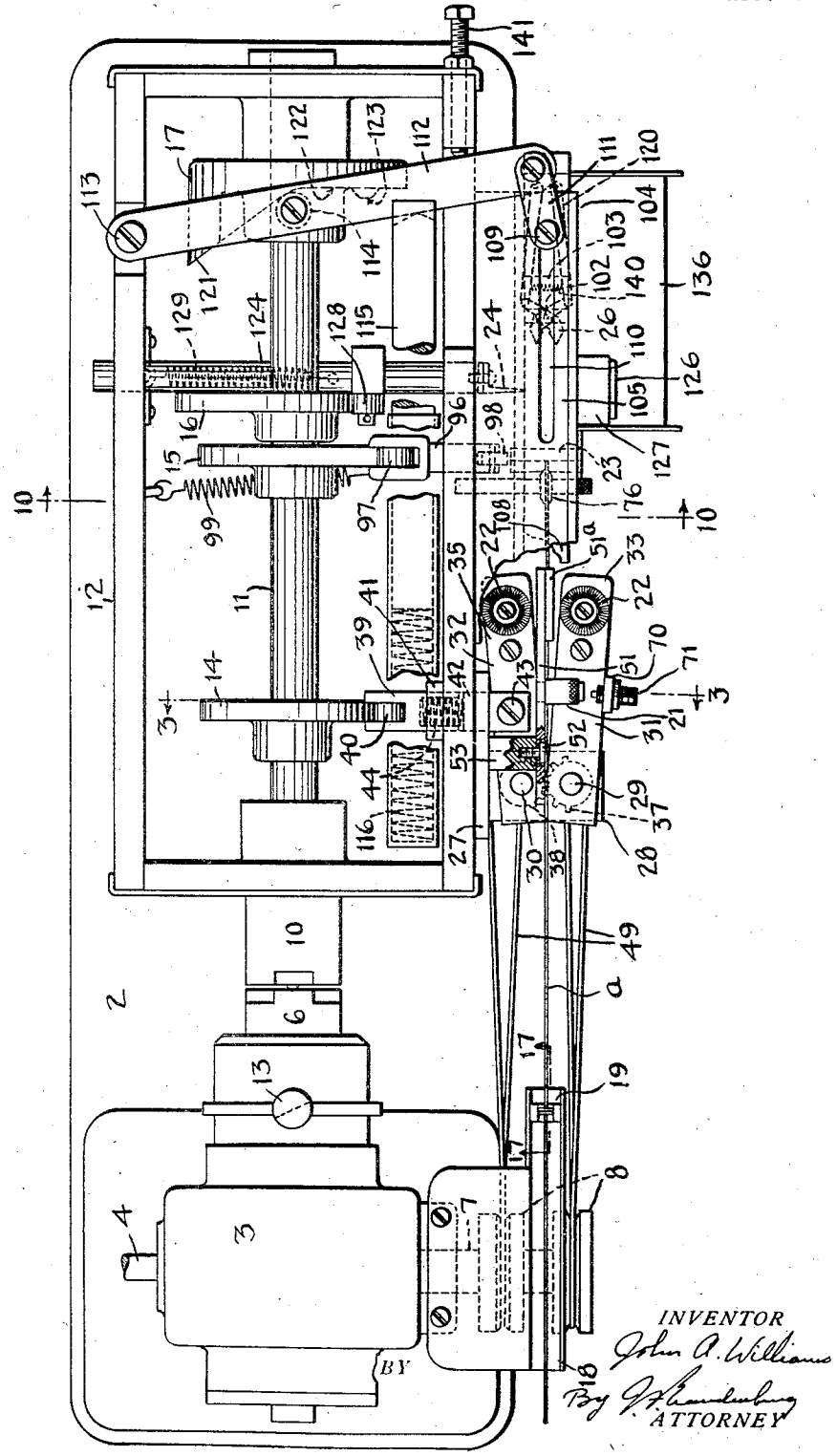
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FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

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Fig. 2.



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FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

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Fig. 3.

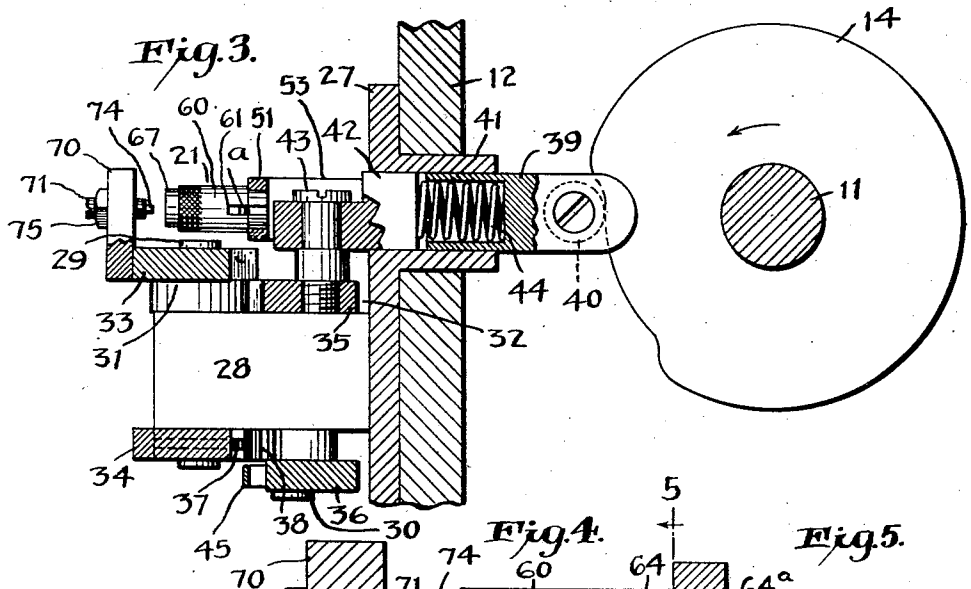


Fig. 4.

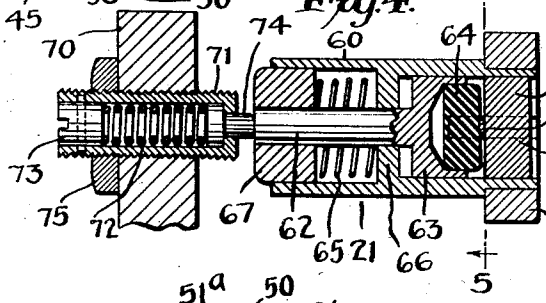


Fig. 5.

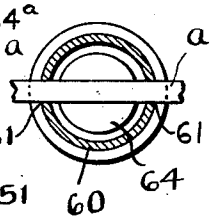


Fig. 6.

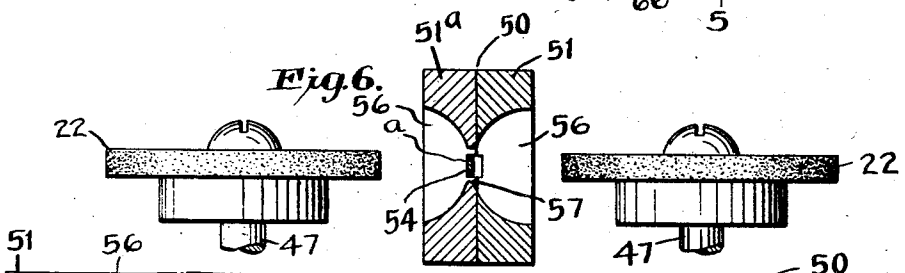


Fig. 7.

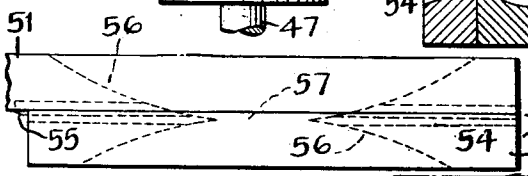


Fig. 8.

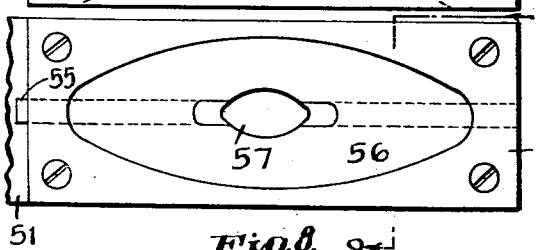
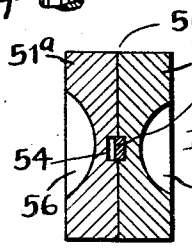


Fig. 9.



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Fig. 10.

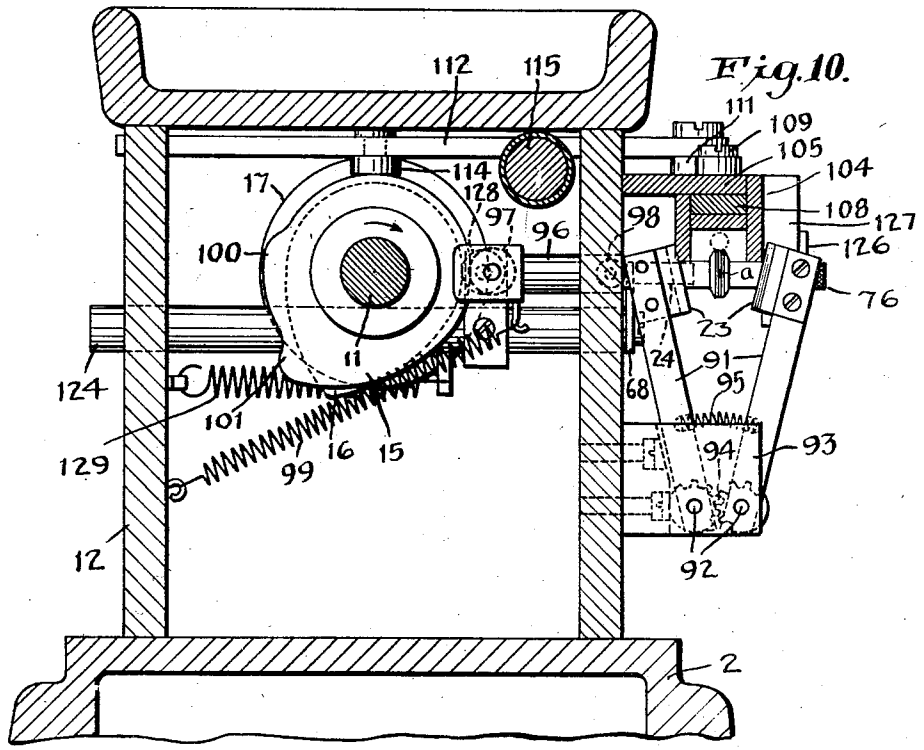


Fig. 11.

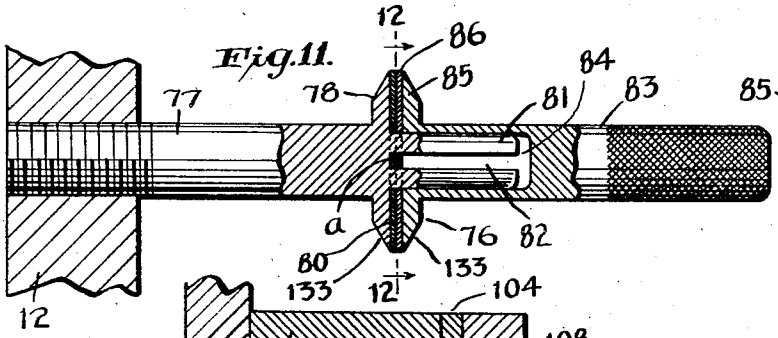


Fig. 12.

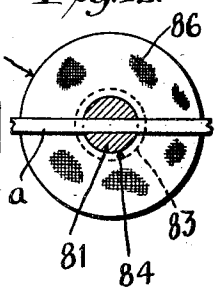
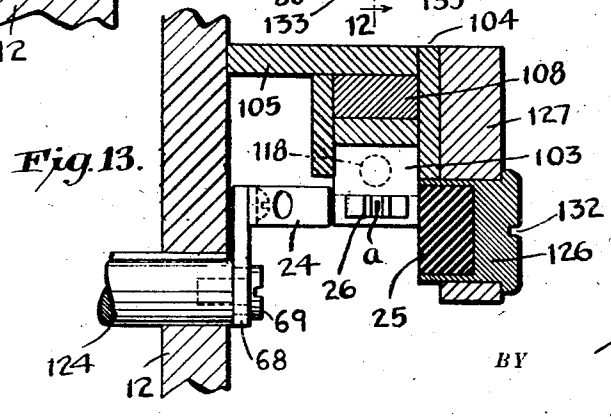


Fig. 13.



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FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

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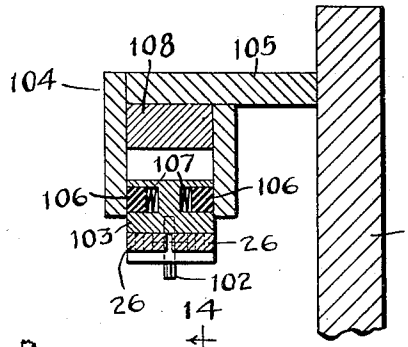


Fig. 14.

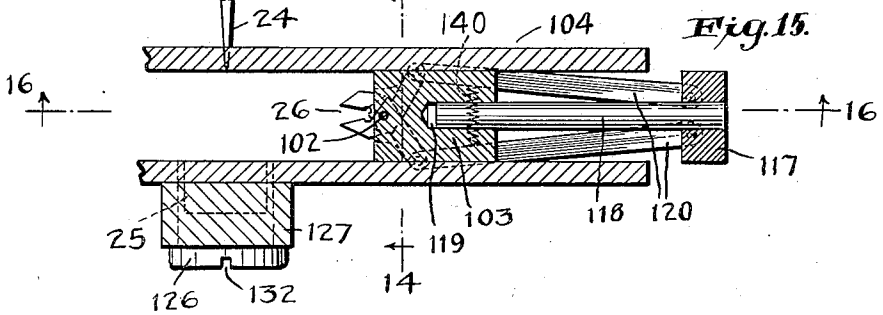


Fig. 15.

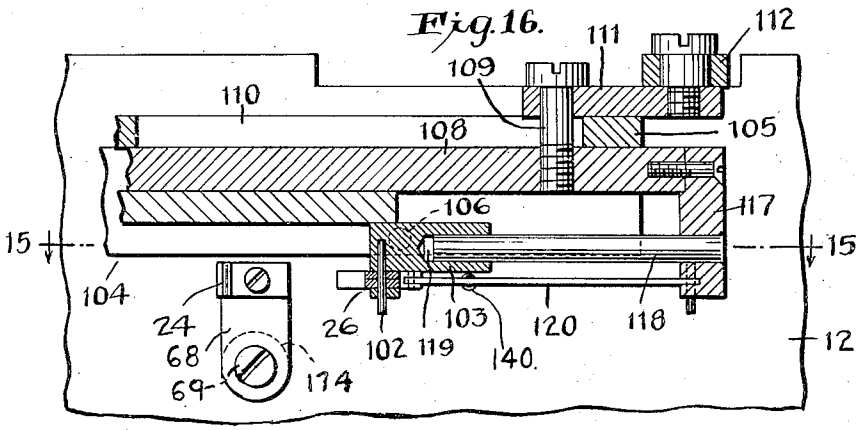


Fig. 16.

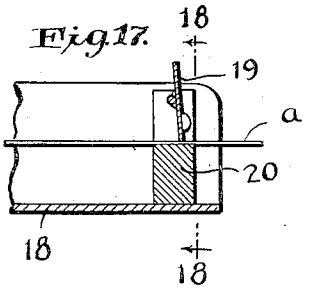


Fig. 17.

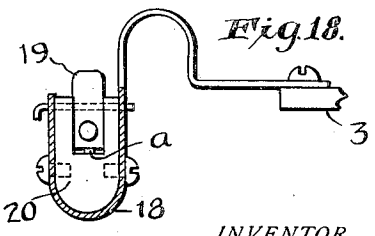


Fig. 18.

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FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

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Fig. 19.

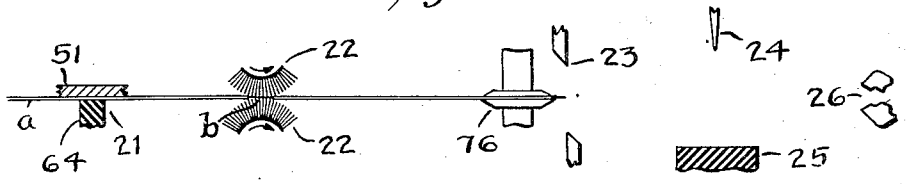


Fig. 20.

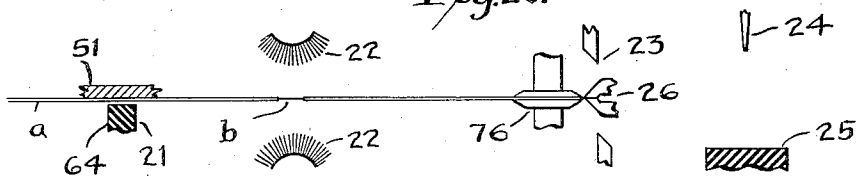


Fig. 21.

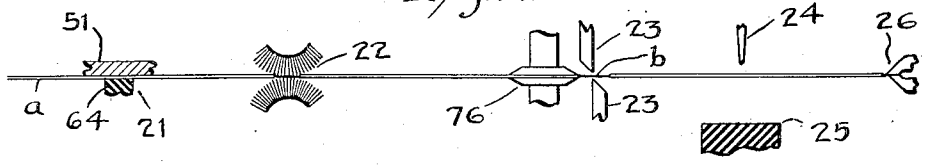


Fig. 22.

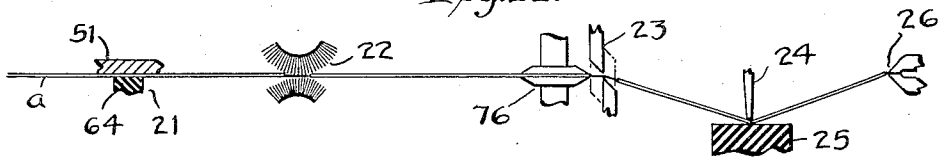
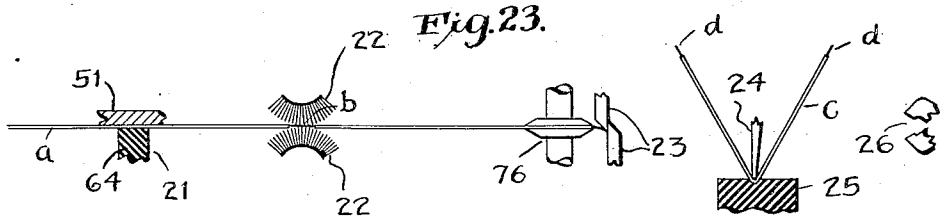


Fig. 23.



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Patented Nov. 21, 1933 1,936,559

UNITED STATES PATENT OFFICE

1,936,559

FILAMENT CLEANING, CUTTING, AND FORMING MACHINE

John A. Williams, Newark, N. J., assignor of one-half to Joseph F. Brandenburg, New York, N. Y.

Application October 31, 1930. Serial No. 492,545

36 Claims. (Cl. 140—2)

This invention embraces a machine for making radio tube filaments from the continuous coated filament wire, that is to say a machine which advances the continuous filament by definite distances, which removes the coating from portions of the filament for two ends of the individual filaments to be produced, which cuts off the exact amount of filament for each individual filament, and which forms the individual filaments into a desired shape, so that the product of the machine is ready for incorporation in the tubes.

The general object of the invention is to provide a machine which performs these operations automatically, accurately and reliably, and has a very high rate of production, and which is well adapted to handle the delicate, coated filament material. A further object is to provide a compact and relatively simple machine. Another object is to provide a machine which is not adversely affected by coating particles and which produces filaments having clean, bare ends.

The invention also embraces the parts and subcombinations of the machine.

In the accompanying drawings, forming part hereof:

Fig. 1 is a side elevation of a preferred embodiment of the machine;

Fig. 2 is a plan view, with portions broken away and in section;

Fig. 3 is a section on a larger scale taken on the irregular line 3—3 of Fig. 1, portions in the outer part of the line of section being in elevation;

Fig. 4 is a section on a still larger scale taken on the line 4—4 of Fig. 1;

Fig. 5 is a section taken on the line 5—5 of Fig. 4;

Fig. 6 is a view partly in elevation and partly in section on the line 6—6 of Fig. 1, with the filament included in the line of section;

Fig. 7 is a plan view of the guide shown in Fig. 6 which positions the continuous filament in relation to the cleaners and exposes a short length of the filament to the cleaning action;

Fig. 8 is a side elevation of this guide;

Fig. 9 is a section taken on the line 9—9 of Fig. 8, omitting the filament;

Fig. 10 is a section taken on the line 10—10 of Fig. 2;

Fig. 11 is a view partly in elevation and partly in section on the line 11—11 of Fig. 1;

Fig. 12 is a section taken on the line 12—12 of Fig. 11;

Fig. 13 is a section taken on the line 13—13 of Fig. 1;

Fig. 14 is a section taken on the line 14—14 of Fig. 15;

Fig. 15 is a section taken on the line 15—15 of Fig. 16;

Fig. 16 is a section taken on the line 16—16 of Fig. 15;

Fig. 17 is a section taken on the line 17—17 of Fig. 2;

Fig. 18 is a section taken on the line 18—18 of Fig. 17; and

Figs. 19 to 23 are schematic views illustrating operation.

The machine has a base 2, at one end of which is a drive unit 3 adapted to receive power through a shaft 4, preferably from a motor. This unit contains appropriate gearing, not necessary to illustrate, for driving two power delivery shafts at coordinated speeds. One of these shafts, indicated at 5 in Fig. 1, lies in the direction of the length of the base, and carries a slidable clutch element 6, while the other shaft, marked 7, projects transversely from the unit and carries a pair of pulleys 8, 8.

A spool or reel 9 of the coated filament wire is mounted preferably on an extraneous support. It is desirable to provide a regulable brake or tension adjuster in connection with the filament supply, but it has not been thought necessary to illustrate this.

The clutch element 6 can be engaged and disengaged at will with a clutch element 10 on the rear end of a longitudinal operating shaft 11, which is mounted in bearings in and extends through a box frame 12 secured to the base. The clutch element 6 is shifted by manipulation of a handle 13, the particular details of this manual control being immaterial.

The shaft 11 carries a series of cams 14, 15, 16 and 17, controlling certain operations of the machine which will be explained in due course.

At this point it may be convenient to follow the continuous filament *a* from the reel 9. The course is lengthwise at one side of the machine, which may be termed the front. It passes first through a trough 18, which is provided in this particular form of the machine to keep the rear end of the continuous filament, when the supply is exhausted, from dropping into the pulleys 8 and the belts which they drive.

A back check 19 is conveniently mounted on this trough, though there is no reason why it should not be placed farther along in the course of the filament. The function of this device is to prevent any unintended rearward displacement of the filament. It is a species of clutch,

and preferably, though not necessarily, comprises a pivoted dog resting by gravity at an inclination on the filament *a* at a point where the filament passes over a support 20. A clutch of this kind will permit free forward movement of the filament while always preventing rearward movement.

At a station corresponding to the outer part of the section line 3—3 in Fig. 2, there is another clutch 21 (Figs. 4 and 19–23), which is operated to permit the filament to be periodically advanced and to hold the filament when or after it has been advanced a distance corresponding to the amount to be cut off and formed. This clutch holds the continuous filament against displacement by the action of cleaners 22, which are located beyond this clutch. This clutch, when in action, preferably holds the filament against movement rearward as well as forward, though the former is not absolutely necessary, and it is mechanically actuated to grasp and release the filament.

The cleaners 22 remove the coating, or coatings, from a definite short length of the continuous filament at a definite distance back from its forward end, the distance being preferably two individual filament lengths from the advance end. The length of the spot on the filament bared by the cleaners has to be quite accurate. The preferred form of cleaners will be described hereinafter, but under the general aspect of the invention the nature of the cleaning means can be varied.

At a point beyond the cleaners there is a severing station, where an individual filament length is cut off by a cutter 23 (Fig. 10). The relations are such that the filament is cut in the middle of a spot *b* (Figs. 19–23) from which coating has been removed, so that each bared spot eventually forms two bare ends of two individual filaments.

Beyond the cutting station, there is a forming mechanism for bending the filaments into the required shape, and a simple kind of forming mechanism suitable for bending V filaments *c* (Fig. 23) has been illustrated. The bare ends of these filaments are marked *d*, and it will be understood that the reason for these bare or uncoated ends is to enable the individual filaments to be welded to the electrical leads of the radio tube. This particular forming mechanism comprises a blade 24 and a self-conforming die 25 (Figs. 13 and 14–23).

The continuous filament is advanced periodically, preferably by a gripper 26, which approaches and seizes the protruding bared end of the continuous filament, retreats and eventually releases the end.

The construction of the specific preferred embodiment of the machine will now be described in more detail.

A supporting plate 27 is adjustably secured to the front wall of the frame by screws 58, which, in conjunction with slots 59 in the plate, enable this support to be adjusted lengthwise of the course of the filament. The plate carries a bracket 28 on which are pivoted at 29 and 30 two arms 31 and 32, which extend forward in the direction of movement of the continuous filament and carry the cleaners 22 at opposite sides of it. The arm 31 may comprise upper and lower bars 33 and 34 above and below the bracket, these bars being suitably united together, and the arm 32 may similarly comprise two united bars 35 and 36. The arms are interconnected by gear segments 37 and 38 to move in unison toward and from each other. The arms thus connected are actuated by the cam 14, which acts upon the arm 32 through a resilient connection. For this purpose a thrust bar 39 having a roller 40 bearing on the cam is guided in a guide 41, in which is also guided a piece 42 loosely pivoted at 43 to the bar 35 of the arm 32, a fairly stiff spring 44 being interposed between the parts 39 and 42 as a compensating thrust transmitter. The action of the cam is to swing the arms and the cleaners toward each other, applying the clutch 21 and bringing the cleaners into contact with the filament. A spring 45 (Figs. 1 and 3) secured to the bar 36 of arm 32 and pressing against a stud 46 projecting from the bar 34 of arm 31 serves to move the arms apart under control of the cam.

Cleaners in the nature of scrapers, grinders, buffers or brushes may be used for removing the coating from the filament. Rotary cleaners are particularly advantageous and I find that brushes, in particular brushes having fine wire bristles, have special advantages. These rotary disclike brushes are carried in horziontal planes above the forward ends of the arms 31 and 32 at the level of the filament, and their shafts 47 pass downward through the bars of the arms and carry small pulleys 48, which are connected by two belts 49 with the two drive pulleys 8. The connections are such that the cleaners are constantly rotated at high speed in opposite circular directions, and that the peripheral movement at the regions where they will act on the filament is toward the forward end of the filament, that is to say the brushes tend to move the filament forward rather than backward, this tendency, however, being entirely resisted by the clutch 21.

A positioner 50 is provided for positioning the filament in relation to the cleaners. This positioner is preferably in the nature of a guide which exposes a comparatively short length of the wire to the action of the cleaners. It preferably comprises a bar 51, which extends longitudinally adjacent one side of the path of the filament, and a face block 51^a secured to the bar. The rear end of the bar 51 is shown secured by a screw 52 (Fig. 2) to a fixed block 53 in a manner permitting of longitudinal adjustment of the positioner. A guide groove 54 (Fig. 9) is formed in the inner face of the part 51^a to receive the filament *a*, which is shown in Fig. 6 as being of flattened section and guided with its greater transverse dimension vertical, that is to say with its sides opposed to the cleaners.

If the flat face of the bar 51 formed the inner wall of this guide passage, the thin filament would tend to wear a way into the plane of cleavage between the two parts, and to prevent this it is desirable to make the groove in the part 51^a deeper than the approximate thickness of the filament and to provide the bar 51 with a rib 55, so that this rib projects laterally part way into the guide groove, with the result that the actual passage for the filament is offset from the plane of cleavage.

The positioning guide thus formed is hollowed out at both sides to accommodate the peripheries of the cleaners 22, and these lateral cavities 56 communicate with each other at the middle so as to form an opening 57 in which the filament is exposed. The extent of this opening lengthwise of the filament might be made to determine the length of the spot on the filament which can be freed of coating, but it is preferable to make the opening longer than the maximum length of

the spot to be cleaned, and to employ another means, which will be described, for regulating the length of the cleaned spot.

At this point it will be convenient to describe the clutch 21 and the manner in which it is operated.

A thimble 60 (Fig. 4) is set removably into an opening in the bar 51, which as will be remembered lies along one side of the course of the filament. The walls of this thimble have slots 61 to provide a guide passage for the filament. A plunger 62 guided in the thimble has a socketed head 63 which receives a removable pad 64 of soft rubber or other yielding material to press against the side of the filament, thereby holding it against a plug 64^a held removably in the thimble. Owing to the cushion element 64, injury to the filament is avoided and the holding action is particularly effective. A light spring 65 interposed between an internal shoulder 66 of the thimble and a head 67 fixed to the outer end of the plunger releases the pressure of the clutch on the filament when the plunger is not pressed in. The bodily movement of the clutch need be very slight.

The plunger 62 is pressed in by the inward movement of the arm 31. For this purpose the bar 33 of said arm is shown provided with a lug 70, through which a barrel 71 is screwed. This barrel contains a compression spring 72 which bears at the rear end against a plug 73 fixed in the barrel and at the inner end against the head of a pin 74 which protrudes slidably through a hole in the inner end of the barrel in line with the plunger 62. In this way a thrust device is provided, so that when the cam 14 actuates the arms 31, 32 to bring the cleaners into contact with the filament, or before the cleaners come into action, the clutch 21 is applied to the filament to keep it from being displaced, and in particular to keep it from being dragged forward by the rubbing of the cleaners. Inward movement of the arm 31 causes the pin 74 to push against the head of the clutch plunger 62, actuating the clutch to hold the filament, and as the arms continue to move the spring 72 yields until the end of the barrel 71 strikes the end of the clutch plunger, whereupon further inward movement of the arms and of the cleaners is stopped.

The thrust element which has been described can be accurately adjusted toward or from the clutch plunger 62, by releasing a lock nut 75 and screwing the barrel 71 slightly in or out in the lug 70, the outer end of the barrel having a kerf for the application of a screw-driver. This regulates the degree to which the cleaners 22 are pressed against the filament. This affords a means for regulating the cleaning action and, by varying the extent to which the yielding peripheries of the cleaners are flattened against the sides of the filament, to cause the resulting cleaned spot to be shorter or longer, as desired. Very accurate adjustment of the length of the cleaned spot can be secured in this manner.

At a definite position, which is preferably an individual filament length beyond the cleaners, the cutter 23 is located, and immediately behind the cutter there is a positioning and wiping guide 76. This guide positions the filament in proper relation for the cutters and also positions the resulting new end of the continuous filament at the proper point to be seized by the gripper 26. The device also has a gentle, non-positive holding action on the filament.

This positioner is shown in detail in Figs. 11 and 12. It comprises a stud 77 projecting from the side of the frame 12 and having an enlargement 78 provided with a facing 80 of velvet or other soft material. An extension 81 of the stud projecting beyond this facing is slotted at 82 to form the top and bottom of a guide passage for the filament and to constitute a resilient split post for the reception of a removable complementary part of the positioner consisting of a stem 83 having a socket 84 which can be pushed over the split post. This stem has an enlargement 85 similar to the enlargement 78 and likewise furnished with a facing 86 of velvet or the like.

The soft facings 80, 86 bear gently against the filament and wipe off loose filament particles, which would otherwise give trouble. This dust-remover, other forms of which will suggest themselves, is preferably incorporated with the positioner which has just been described, but that is not essential. It will be observed that the wiper elements 80, 86 are readily removable and replaceable.

The positioner 76 is so located that when the filament is advanced the cleaned spot *b* which was last produced is brought just beyond the positioner, and the cutter 23 is mounted and operated to cut the filament in the exact center of the cleaned spot. The cutter clearly illustrated in Fig. 10 comprises two shear blades, designated by the numeral 23, fixed to the upper ends of a pair of arms 91 which are pivoted at 92 to a bracket 93 fixed to the frame 12. These arms are geared together at 94 and are pressed apart by a spring 95. The cam 15 actuates the cutter through a thrust element 96 guided in the wall of the frame and having rollers 97 and 98 at its opposite ends to cooperate with the cam and with one of the two arms 91, respectively, a spring 99 being provided for retracting this element. The cam 15 is shaped to allow the shear blades 90 to separate widely enough to allow the gripper 26 to pass between them. After the gripper has retreated, a portion 100 of this cam causes the blades to approach the filament and at the proper moment a further elevation 101 causes the cutter to sever the filament with a quick snip at the proper moment.

The gripper 26, which operates at the front end of the course of the filament, will now be described, and at this point reference may be had to Figs. 14–16. It comprises a pair of jaws designated by that reference numeral 26, these jaws being pivoted on a pin 102 projecting from a slide block 103. This block is slidable between the sides of a longitudinal guide structure 104 which is carried by and beneath a shelf 105 projecting from the front of the frame 12. Friction shoes 106 in this block are urged by springs 107 against the sides of the guide, to produce a yielding resistance to movement of the block. Another slide 108 is guided in an upper portion of the guide structure, and this slide is connected by a pin 109, operating in a slot 110 of the shelf, to a link 111, which in turn is pivoted to the outer end of a cam lever 112 pivoted to the frame at 113 and having a roller 114 to bear against the cam 17. A guided plunger 115 pressed by a spring 116 (Fig. 2) serves to keep the cam lever against the cam and to cause the gripper to retreat at the proper time. A bracket 117 projecting downward from the slide 108 carries a longitudinal rod 118, and the end of this rod fits slidably in a socket 119 of the block 103 in such manner as

to support the block 103, though obviously many of these details may be varied.

The bracket 117 is connected by links 120 with the tails of the gripper jaws. These links are so arranged that the first effect of the rearward movement of the slide 108 under the action of the cam 17 is to open the jaws, the slide 103 not moving for the moment. When the jaws are opened as far as they will go, which may be determined by stop shoulders on the jaws, or when the rod 118 comes in contact with the closed end of the socket 119 of the slide 103, the open gripper is moved bodily toward the end of the filament. Conversely, the first effect of forward movement of the slide 108 controlled by the cam under pressure of the spring 116, is to close the gripper jaws together on the end of the continuous filament, after which the continued pulling transmitted through the links 120 draws the gripper, and with it the filament, in the forward direction. The directions "forward" and "rearward" as here used have reference to the direction of travel of the continuous filament. It will be observed that the gripper is of such type that the greater the pull of the links 120 the more firmly the jaws seize the filament end.

The jaws are pressed together by a light spring 140, which does not, however, keep the jaws from being opened when rearward thrust is exerted through the links 120.

The cam 17 has a main camming portion 121 constituting an up-slope and a down-slope which control the rearward and forward movements of the gripper. The low part 122 of the cam corresponds to a period of dwell of the gripper at the forward position. The point at which the gripper comes to rest, and consequently the length of filament which is withdrawn at each cycle of operations, is determined by an adjustable stop screw 141 which limits the forward movement of the gripper lever 112. This cam also has a slight rise 123 so positioned as to open the jaws at the proper moment to release the end of their individual filament for the forming operation about to be described.

The former blade 24 is secured to the front end of a former bar 124, which slides in the frame 12 at right angles to the course of the continuous filament (Figs. 2, 10, 13, 16). The self-conforming cushion die 25 is located at the opposite side of the filament, and these parts are capable of being separated sufficiently to let the gripper 26 pass between them. Both parts might be actuated to move toward and from each other, as in the case of other instrumentalities which have been described, but simplicity is served by reciprocating only the former blade. The die 25 is preferably a plain pad of soft rubber held in a circular holder 126 set tightly in an opening in a support 127 fixed to the front of the guide structure 104.

As shown in Fig. 16, the former blade is fixed to a piece 68, which is removably secured to the end of the bar 124 by a screw 69.

The former bar 124 has a roller 128 coacting with the cam 16, and a spring 129 retracts the former bar. Throughout the embodiment of the machine which has been illustrated, cams are used which positively actuate the controlled instrumentalities in one direction, springs being employed to supply the power for movement in the reverse direction under the control of the cams, but it will be understood that this is a detail and that the particular form of driving mechanisms, and whether they act positively in one or two directions, is a matter of preferred mechanical design.

The cam 16 is shaped to cause the former 24 to recede far enough to clear the path for the gripper 26 on its rearward and forward travels, and to advance transversely of the terminal filament length at the proper time and for the proper distance to press it against and into the surface of the die pad to produce a definite bending of the individual tube filament, the former then retreating out of the way again.

The mechanisms are so timed by the shaping and setting of the cams, all of which will be understood by the mechanic, that the former blade encounters the terminal filament length while it is still connected with the continuous filament and while its forward end is still held or retained by the gripper 26. It is desirable, in fact, that the individual filament stay held at both ends in this way until the filament is reliably engaged by and between the forming instrumentalities 24 and 25. Consequently, the cutter 23 is not actuated by cam 15 to cut off the individual filament, and the gripper 26 is not released by the minor elevation 123 of cam 17, until the terminal filament length is definitely or virtually engaged by and between the forming elements, whatever their specific nature or actuation, in a manner to preclude possibility of the individual filament becoming displaced relatively to the former. The initial flexure of the terminal filament length while it continues to be held at both ends produces no undue tension in the filament beyond the clutch 21, and in this connection it may be noted that in practice the end of the filament is withdrawn somewhat between the pressure of the gripper jaws, which pressure is due at this time solely to the spring 140.

The terminal filament length having been sufficiently engaged by the former mechanism, the cutter cuts off the filament length at the middle of the bare spot *b*, and the gripper is opened to free the forward end of the individual filament completely. The blunt blade 24 presses the bend in the individual filament farther into the die pad and the portions of the filament are free to assume angular positions corresponding to the requisite degree of bending.

The employment of a piece of soft rubber or like yielding material as a cushion-surface die for this operation is of great advantage. Experiment with shaped dies of unyielding material resulted in much breaking or weakening of the filaments, and this difficulty has been satisfactorily overcome by the provision of the present die. A piece of rubber having an original flat surface is preferred, but obviously the surface could be grooved beforehand, or a rigid die backing more or less shaped might be covered with a layer of the yielding material.

In this instance the cushion-surface die, or self-conforming die as it may be called, is held in a cup 126 which can be turned or otherwise shifted in the fixed support 127 in a manner to expose fresh portions of the surface of the rubber to the former blade, when any particular portion of the rubber pad becomes too much indented or unduly fouled with coating particles. The axis of the cup 126 is therefore preferably eccentric to the former blade, and a kerf 132 is provided so that the holder can be turned by a screw driver. The pressure of the former blade against the cushion-surface die being moderate, a fairly tight frictional holding of the cup in

its support is sufficient, but manifestly many of these details may be varied.

It is possible for the action of the gripper 26 in grasping, withdrawing and holding the end of the continuous filament, to be affected by coating particles, and a means is provided for overcoming this difficulty. The object is to free the faces of the gripper jaws of coating dust, and while this may be accomplished in specifically different ways, a simple expedient is to bevel the peripheries of the enlargements 78 and 85 of the filament wiper and positioner 76. These bevels are marked 133. When the gripper is moved rearward it comes to a stop with its jaws open and embracing the tapered nose thus presented. The first effect of the then ensuing forward movement of the slide 108 is to close the jaws toward each other, and consequently if the jaws do not engage the nose when they move rearward over it, they do so when they are withdrawn from it. In this way the jaws are freed of the particles which they may carry. As soon as the gripper rides off the nose it closes upon the projecting end of the continuous filament and draws it forward. The means for freeing the filament itself of loose particles has already been described.

The operation of the machine has been described in connection with the description of the construction, but it will be briefly reviewed. The schematic views, Figs. 19–23, will be of assistance.

In Fig. 19 a cycle of operations has been completed. A filament length has been cut off and formed and has been delivered from the machine through a chute 136, not previously referred to. The cleaners 22 are still cleaning a spot *b* of the proper length a filament length behind the bare end of the continuous filament, which then protrudes from the positioner 76. The clutch 21 is holding the filament behind the cleaners. The cutters 23 are spaced apart, and the former 24 and former-die 25 are also spaced apart to clear the way for the gripper 26. The gripper is open and can be understood to be starting or about to start on its rearward travel under the action of the cam 17.

In Fig. 20, the gripper has executed its rearward movement, has cleaned itself against the nose of the positioner 76 and has closed upon the bare end of the continuous filament. The cleaners 22 and the clutch 21 have just opened, and the cutters and the forming instrumentalities are still well separated, all of these matters being governed by the cams.

In Fig. 21 the gripper has drawn the continuous filament forward a distance corresponding to an individual filament length and is at rest, still holding the end of the filament. The cleaners 22 have closed on the continuous filament at a new point and are in the act of removing coating from a spot which will furnish two bare filament ends. The clutch 21 has also been actuated to clasp the filament behind the cleaners, so that the cleaners do not drag the filament. The action of the clutch 21 is so timed that it is applied after the gripper 26 has come to rest in its forward, dwell position and just before the cleaners 22 come into action on the filament. The cutters 23 have been brought close to the bare spot *b* in the filament just beyond the positioner 76, and the former blade 24 has been brought close to the middle of the individual filament element.

Fig. 22 illustrates a condition a brief instant later than the condition of Fig. 21. All is the same except that the former 24 has flexed the middle of the terminal filament length against the cushion-die 25, or so close to it that the filament length is controlled by the forming means and can not get out of position or shift so as to alter the equal proportions of the filament at opposite sides of the bend. The cutter is now actuated by its cam to sever the individual filament about to be formed and the gripper is controlled by its cam so as to free the front end of the severed filament.

Fig. 23 shows the stage immediately following, in which the former blade has pressed the otherwise free individual filament far enough into the cushion die to produce the intended bending.

If the rise 123 on the cam 17 is only a local elevation, the gripper 26 will close again immediately after opening to release the front end of the filament, but that is unimportant. As soon as the gripper is started rearward by the cam 17 it will have been opened in any event.

In Fig. 23 the formed filament *c* with its two bared ends *d* is ready to be released by the forming mechanism and to be delivered from the machine, whereupon the former blade 24 will move out of the way and the gripper will proceed rearward to take hold of the new end of the continuous filament and draw it forward an exact distance, after which the operations will continue in the same cycle.

A feature of the machine of much practical value is its capability of producing filaments of different lengths, say from an inch to an inch and a quarter. Adjustment of the screw 141 regulates the amount of the continuous filament which is drawn forward by the gripper 26 and thereby the length of the individual filaments. When any change of this character is made it is necessary also to change the position of the cleaners lengthwise of the course of the filament, and this is accomplished by loosening the screws 58 and shifting the plate 27, which supports the cleaner arms, a proper distance forward or rearward, after which the screws are tightened again. The positioner guide 50 associated with the cleaners may also be adjusted at its fastening 52 if necessary. In addition, the point at which the former blade 24 bends the filament must be altered, and while this could be accomplished by an adjustment of the former blade, it is more convenient to remove one blade from the former bar 124 and to apply another blade which is offset forwardly or rearwardly with respect to the blade which was removed. This may be considered an adjustability of the former.

I realize that numerous changes and modifications may be made in the matters of construction and operation which have been described, that parts of the invention can be used in specifically different organizations of a similar nature, and that parts of the machine may be employed to advantage without others, as for example to cut off and form measured filaments without removing coating, or to remove coating and to cut off the accurate filament lengths without forming in the machine. The machine which has been described is to be regarded as being illustrative of a practical embodiment of the complete and preferred form of execution of the invention rather than in a limiting sense.

I claim:

1. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament,

means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filaments the ends of which have been bared.

2. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament, means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filaments the ends of which have been bared, said forming means comprising a blade and a cushion surface.

3. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament, opposed rotary cleaners for removing the coating from a short length of the filament back of its end, means for moving said cleaners into and out of contact with the filament, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filaments the ends of which have been bared.

4. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament, a clutch for holding the filament after each withdrawal, means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filaments the ends of which have been bared.

5. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament, a clutch for holdinng the filament after each withdrawal, opposed rotary cleaners for removing the coating from a short length of the filament back of its ends, said cleaners operating beyond the point where the filament is clutched and rubbing thereon in a forward direction, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filament the ends of which have been bared.

6. A machine of the character described, comprising the combination of means for periodically gripping the end of a continuous coated filament, withdrawing it a predetermined distance and eventually releasing it, guides for the filament, a clutch for holding the filament against longitudinal movement after each withdrawal, a backcheck for preventing retrograde movement of the filament when said clutch is opened, means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filaments the ends of which have been bared.

7. A machine of the character described, comprising the combination of means for periodically advancing a continuous coated filament a predetermined distance, means for removing the coating from a definite short length of the filament back of its end, means for severing the filament in the middle of each region thus cleaned, and means for forming the successive individual filament the ends of which have been bared.

8. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament such as used for radio tubes, means for removing the coating from a short length of an intermediate portion of the filament back from the end of the filament, and means for severing the filament in the middle of each region thus bared.

9. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament such as used for radio tubes, and opposed rotary cleaners for removing the coating from a short length of an intermediate portion of the filament back of its end.

10. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament such as used for radio tubes, and opposed rotary brushes for removing the coating from a short length of an intermediate portion of the filament back of its end.

11. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament such as used for radio tubes, opposed cleaners for removing the coating from a short length of an intermediate portion of the filament back of its end, and means for moving said cleaners into and out of contact with the filament.

12. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament such as used for radio tubes, cleaning means for removing the coating from a short length of an intermediate portion of the filament back of its end, and a guide for positioning the filament in relation to said cleaning means.

13. The combination of cleaning means for removing the coating from a short intermediate length of a coated filament back from the end of the filament, so that a substantial coated length of filament remains between the cleaned section and the end of the filament, and a guide for positioning the filament in relation to said cleaning means, said guide being constructed to expose a limited extent of the filament to the cleaning action.

14. Electrical filament forming means comprising a former for contact with the filament wire, and a cooperating cushion surface for causing the wire to bend to form a filament element.

15. Electrical filament forming means comprising a former for contact with the filament wire, a cooperating cushion pad for causing the wire to bend to form a filament element, and eccentric means for shifting said pad to oppose different portions of its surface to the former.

16. The combination of means for periodically advancing a coated filament, cleaning means operative to remove the coating from a predetermined short length of the filament back of its end, a clutch for grasping the filament back of the cleaning means, a cutter operating in front of the cleaning means, and a positioning guide for the filament back of the cutter.

17. The combination of a gripper and means for operating the same periodically to approach and grip the end of a continuous coated filament

and to withdraw the same a predetermined distance, means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each bared portion, and means for freeing the gripper of coating dust before it engages the bared end of the continuous filament.

18. The combination of a gripper and means for operating the same periodically to approach and grip the end of a continuous coated filament and to withdraw the same a predetermined distance, means for removing the coating from a short length of the filament back of its end, means for severing the filament in the middle of each bared portion, a guide for positioning the filament immediately behind the region where it is cut, and gripper cleaning means associated with said guide to be engaged by said gripper just before it seizes the protruding bared end of the continuous filament.

19. In a machine for making electrical filament elements, the combination of means for gripping the end of a continuous filament, mechanism to peridocially operate the gripping means to pull the filament wire forward the length of a filament element and then release the wire, and means for severing successive filament elements.

20. In a machine for making electrical filament elements, the combination of means for gripping the end of a continuous filament, mechanism to periodically operate the gripping means to pull the filament wire forward the length of a filament element and then release the wire, means for severing successive filament elements, and means for forming the elements.

21. The combination of a pair of arms connected to move toward and from each other in unison, means for operating said arms, rotary filament cleaners carried by said arms, and a filament clutch operated by one of the arms.

22. In a machine for making electrical filament elements, the combination of a clutch for holding the filament wire, said clutch comprising a fixed part and a plunger movable toward and from said part, and a cam controlling said plunger.

23. In a machine of the character described, the combination of a clutch for holding the filament wire, said clutch comprising a fixed part, a yielding pad and a holder for said pad movable toward and from said fixed part, and a cam controlling said holder.

24. An automatic machine of the character described comprising means for periodically advancing a continuous coated filament such as used for radio tubes, means for severing individual filaments therefrom, means for removing coating so as to provide the elements with bare ends while the intermediate portion remains coated, and means for forming the individual filaments.

25. In a machine of the character described, a gripper comprising cooperative relatively movable gripping elements, a slide to which they are pivoted, a cam lever, links connecting said gripping elements with the cam lever, and yielding means for resisting movement of said slide so that on movement of the gripper in one direction its elements are separated while on movement in the opposite direction they are closed.

26. In a machine of the character described, a reciprocatory gripper to seize the forward end of a continuous filament and withdraw the same, said gripper comprising a pair of jaws, a spring urging said jaws together, and cam-actuated mechanism controlling the gripper, including link means, operated by the initial movement of said mechanism toward the filament, to open the gripper jaws.

27. In a machine of the character described, the combination of means for periodically advancing a continuous coated filament, means for removing coating from a short length of the filament back of its end, means for severing the filament in the middle of the spot thus bared, and means for wiping the filament to remove loose coating particles.

28. In a machine for making electrical filament elements, means for feeding a continuous coated filament through the machine, a positioner through which the coated filament passes, and a wiper of soft material associated with said positioner for cleaning loose particles from the filament.

29. In a machine for making coated electric filament elements, the combination of opposed cleaners, means for operating the cleaners to remove the coating from short portions of a coated filament, means for pressing said cleaners against opposite sides of the filament, and means for regulating the pressure.

30. In a machine of the character described, the combination of opposed cleaners for removing the coating from a short intermediate portion of a coated filament, a guide for positioning the filament between said cleaners, said guide being constructed to expose a limited extent of the filament to the cleaners, means for pressing the cleaners against the filament, and means for regulating the pressure.

31. The combination of means for periodically gripping the end of a continuous filament, withdrawing it a predetermined distance and eventually releasing it, means for severing successive individual filaments from the continuous length, means for forming each individual filament, and means for operating the instrumentalities so that each individual filament is in the engagement of said forming means before the severing and before the release of the gripper.

32. The combination of means for periodically gripping the end of a continuous filament, withdrawing it a predetermined distance and eventually releasing it, means for severing successive individual filaments from the continuous length, means for forming each individual filament, and means for operating the instrumentalities so that each individual filament is in the engagement of said forming means while it is still connected with the continuous filament.

33. The combination of opposed rotary cleaners for removing coating from a portion of a coated filament, guide means for holding the filament between the cleaners, and a mechanically operated clutch for holding the filament against the drag of the cleaners.

34. In a machine for making electrical filament elements, the combination of a reciprocatory gripper for periodically advancing a coated, continuous filament a distance substantially equal to the desired length of filament element, a cutter for severing the filament at a given point, and means for regulating the extent of the travel of the gripper to control the length of the filament elements cut off.

35. In a machine of the character described, the combination of a reciprocatory gripper for periodically advancing a continuous coated filament, a cutter for severing the filament at a given point, cleaners for removing coating from a short length of the filament back of the cutting station, means for regulating the distance to which the filament is advanced by the grip-

per, and means enabling the positions of the cleaners to be adjusted lengthwise of the filament.

36. In a machine of the character described, the combination of a reciprocatory gripper for periodically advancing a continuous coated filament, a cutter for severing filament at a given point, cleaners for removing coating from a short length of the filament back of the cutting station, a former operative beyond the cutting station, means for regulating the extent of travel of the gripper, means enabling the positions of the cleaners to be adjusted lengthwise of the filament, and a means of adjustment enabling the forming action to be centralized with respect to the individual filament which is cut off.

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