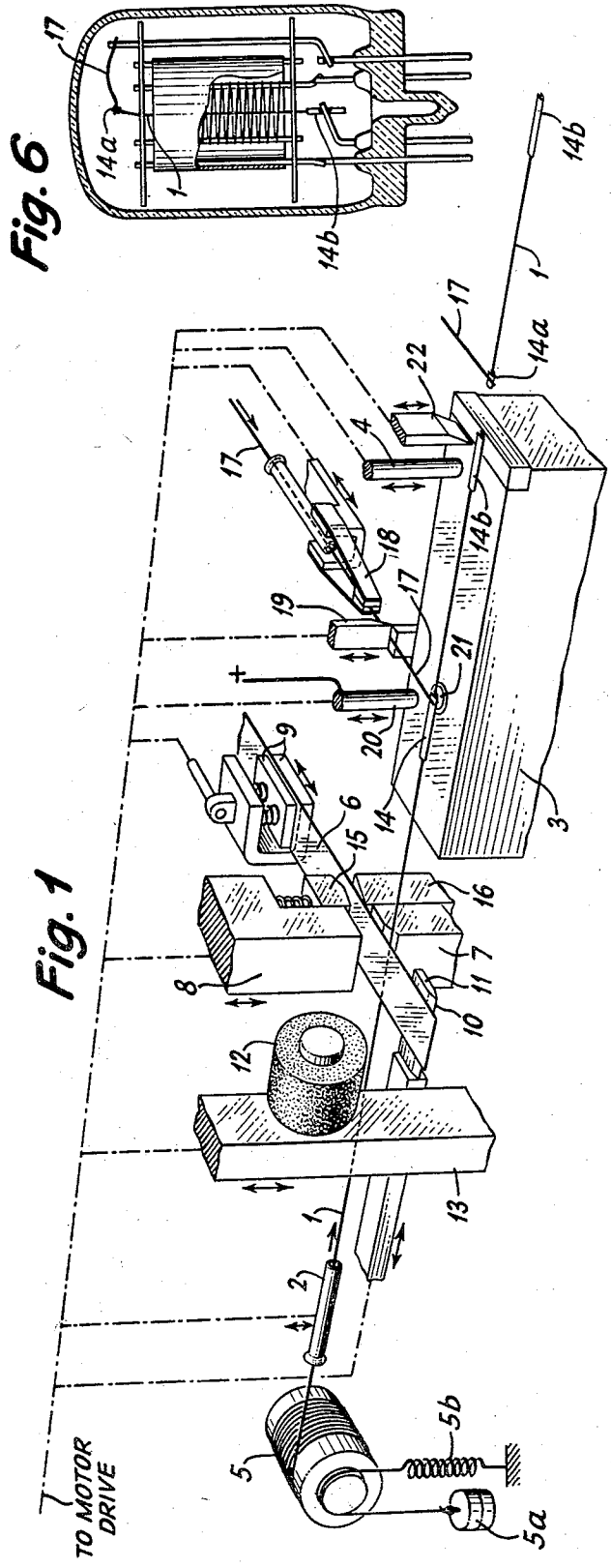
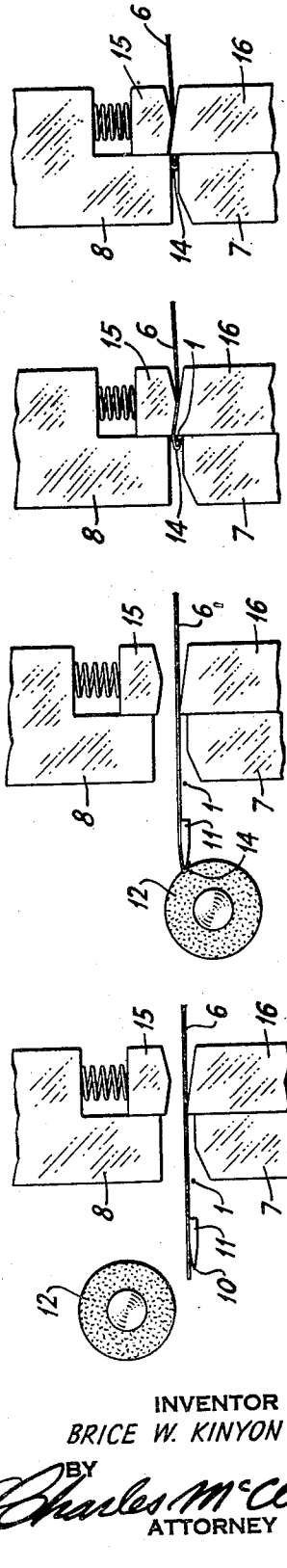
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FILAMENT-MAKING MACHINE AND METHOD

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FILAMENT-MAKING MACHINE AND METHOD

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My invention relates to filament manufacture, particularly to machines and methods for preparing filaments for radio tubes, lamps and devices in which fine filament wire must be mounted.

The connections between the ends of fine filament wire and the relatively heavy lead-in conductors in such devices as radio tubes are difficult to make because the filament wire so easily breaks. Attempts have been made to weld the wire to soft metal tabs or connectors which may then be welded to the lead-in conductors. Where the wire to be mounted may be less than .001 inches in diameter, hand application of the tabs is tedious and expensive and is too slow for factory practice, and machines for applying the tab wires have so far proven impractical.

An object of my invention is a machine for applying connectors to the ends of fine filament wires, such as filaments for radio tubes, lamps and the like.

A more specific object of my invention is an improved machine for attaching metal tabs to the ends of fine filament wires.

My improved machine folds a thin rectangular piece of sheet metal around the filament wire and crimps the folded piece to firmly grip the wire and make good electrical contact with the wire, without kinking or straining the wire.

Specifically, my improved filament making machine comprises means for feeding a metal ribbon transversely across slightly tautened filament wire. The end of the ribbon is then bent to form a hook whereupon the ribbon is retracted so that the hook engages the filament and draws it between an anvil and swaging tool to crimp the hooked portion of the ribbon tightly upon the wire. Preferably during or shortly after the crimping operation, the end of the ribbon is cut off near the crimped portion and the wire is freed with an attached tab. My machine is positive, smooth and fast in operation and yet imposes no breaking strains on the fine wire.

The characteristic features of my invention are defined in the appended claims and the preferred embodiment thereof is described in the following specification and shown in the accompanying drawing in which Figure 1 shows in perspective the positional relation of the more important elements of my novel machine, Figures 2, 3, 4 and 5 show, respectively, the operating sequence of the hook forming, crimping and cut-off mechanism of my machine, and Figure 6 shows a radio tube with a filament prepared on my machine.

Filament wire 1 is pulled forward step-by-step, and to the right in Figure 1, through guide tube 2. The wire is preferably pulled across the top of table 3, either by tweezers in the hands of an operator or feeding jaws, not shown, operated by and in synchronism with the machine. After each forward movement the wire is held against the top of the table by the hold-down tool 4. A slight drag may conveniently be placed on the reel 5 from which the wire is fed so as to tension and straighten the relatively long span of wire between the guide tube 2 and table 3. Metal ribbon 6 is reciprocated transversely across the wire 1, and between the anvil 7 and swaging tool 8, over the central portion of the unsupported span. The spring pressed jaws 9 of the ribbon feeding mechanism grip the ribbon with sufficient pressure to reciprocate the ribbon, but the grip is loose enough to permit the jaws to slide on the ribbon when held by the swaging tool and anvil.

The ribbon is fed forward to bring its end slightly beyond the sharpened edge 10 of the flat mandrel 11. The roller 12 of thick resilient material, such as a cylinder of rubber having about the consistency and firmness of automobile tire tread, is carried on a slide 13 vertically across the edge of the mandrel. As shown in Figure 3 downward movement of the roller folds the end of the ribbon around the edge of the mandrel and places an open hook or tab portion 14 in its end. Upon retraction of the mandrel the ribbon is moved to the right until the hook engages the wire and drags it to the position shown in Figure 4 over the anvil. Downward movement of the swaging tool 8 first brings the spring pressed holding die 15 into contact with the ribbon to hold the ribbon firmly against the cut-off tool 16. Further downward movement of the swaging tool shears the ribbon against the hook between the sharpened edges of the swaging and cut-off tools, and at the same time crimps the two sides of the hook firmly upon the filament, as shown in Figure 5. To prevent the ribbon from rubbing the wire, and yet insure the engagement of the wire and hook, the guide tube 2 may be reciprocated in a vertical direction, in synchronism with the reciprocations of the ribbon. By tapering the front edge of the mandrel, the hook cannot be caught and straightened during rearward travel of the ribbon.

If desired a second short length of wire may be welded to the tab. Such an additional wire 17, called the anchor wire, is often used as a tensioning support in radio tubes for one end of the filament. The anchor wire is fed forward step-by-step through the light spring-pressed jaws 18 of the feeding mechanism and through the cut-off blades 19. The end of the anchor wire is pushed forward to a position over one end of the tab on the table between the electrode 20 and electrode 21, electrode 21 being a metal rod with a smooth end flush with the table top. Electrode 20 descends upon the anchor wire and tab to weld them together and to hold the anchor wire and filament while the jaws 18 slide back upon the anchor wire for a new bite.

Each forward movement of the filament carries the tab under the cut-off knife **22**, which preferably is adjusted to cut the tab near the end and adjacent the attached anchor wire. The finished filament assembly with its two tabs **14***a* and **14***b* may be mounted in a radio tube as shown in Figure 6.

In other tubes where the filament is not tensioned by a spring wire welded to the tab, it may be desired to cut the tab by knife **22** into two approximately equal lengths.

A convenient drag for the reel **5** comprises, according to one of the features of my invention, a free weight **5***a* and a spring **5***b* balanced on a cord over the hub of the reel. As the wire is unreeled, the hub-to-cord friction raises the weight and relieves the spring, and when the desired length of the wire has been pulled out and fixed under hold-down tool **4**, the weight settles and holds the wire in tension. It has been found that by placing the weight and the spring, respectively, on the rearward and forward sides of the hub, that the adjustment of the frictional drag is less critical than other spring or weight combinations.

The trimming and splitting knives usually used in making the ribbon stock, draw a small but rather sharp burr along one surface of the ribbon at its edges. The ribbon is preferably fed to the machine so that these burrs are turned away from the filament wire and only the smooth side of the ribbon is folded and pressed against the wire. Hence, the ends of the tab, from which the wire emerges, is tapered or funnelled and free of sharp corners that might break the wire. The low number of broken filaments, further, is attributed to the fact that the wire is only slightly bent during manufacture. When the hook engages the filament and drags it on to the mandrel, the relatively long section of wire between the guide tube and table is but slightly deflected at its center, hence obviating all sharp bends in the wire. Further, the swaging tool pressure is easily adjusted so that the tab can be firmly clamped without crushing or straining the wire in the tab. For convenience of illustration and clarity of description, the drive mechanism, common to the various elements of the machine, is shown diagrammatically with dot-dash lines.

Particularly good results have been obtained in preparing filaments for radio tubes of the type commercially known as the 1R5 or 1S4. In these tubes the filament wire is .0008 inch in diameter, .875 inch long, and is coated with a thin film of electron emissive oxides such as barium-strontium oxide. The tab material consists of nickel ribbon .002 inch thick and .296 inch wide. The completed tab is .004 inch thick by .013 inch to .018 inch wide. With my novel machine operators easily prepare 500 to 600 complete filament assemblies per hour, as compared to about 100 filament assemblies per hour prepared by hand. The material wastage by my machine, further, is materially reduced.

I claim:

1. A machine for making filaments comprising means for tensioning a relatively long span of filament wire, means for feeding a metal ribbon in a direction laterally across the wire, an anvil and a swaging tool above the anvil, a mandrel with a sharpened edge parallel to the wire, a roller with a resilient surface, driving means to move said roller across said edge of the mandrel to form a hook on the end of the ribbon around said edge, means to draw the ribbon lengthwise and to engage the filament with the hook and to draw the hook onto the anvil, and means to cut off the hooked end of the ribbon.

2. A machine for manufacturing filaments comprising a table, a reel for feeding filament wire toward the top of said table, a holding tool for pressing the end of the wire against the top of the table, and means for biasing said reel in a winding direction to tension said wire between the reel and tool, means for feeding a thin metal ribbon transversely across the span of wire, means for forming a hook in the end of said ribbon, means for longitudinally moving said ribbon to engage said wire by said hook, and a swaging tool and anvil for crimping said hook upon said wire.

3. A machine for manufacturing filaments comprising means for tensioning a length of filament wire, an anvil adjacent the wire and intermediate the ends of the span, means for passing a metal ribbon transversely across the wire, means for forming a hook in the end of the ribbon, means for drawing the ribbon lengthwise to engage the wire with said hook, means for crimping the hook upon the wire, and means for cutting the ribbon from the crimped hook.

4. A machine for manufacturing filaments comprising a table and a wire reel spaced from the table, means for tensioning a span of wire between the reel and table as the wire is fed step-by-step over the table, means for folding and crimping a metal tab around said wire, means for feeding a second wire across said tab and means for welding said second wire to said tab, and means for cutting the tab in two adjacent the weld.

5. The combination in a filament making machine comprising a flattened mandrel with a sharpened edge, means for feeding metal ribbon across said mandrel, a roller, with resilient surface material, mounted to reciprocate across the sharpened edge of the mandrel to fold the end of the ribbon around said edge.

6. The method of fabricating filament assemblies comprising tensioning a relatively long span of filament wire, feeding a metal ribbon laterally across said wire near the center of said span and projecting the end of the ribbon slightly beyond the wire, then forming a hook in said end of the ribbon, withdrawing the ribbon across the wire to engage the filament with the formed hook and deflecting the center portion of the filament span to draw the filament into the bight of the hook, crimping the hook upon the wire and finally cutting the closed hook from the ribbon.

7. The method of fabricating filament assemblies comprising lightly tensioning a relatively long span of filament wire, said wire being unsupported except at the ends of the span, forming a hook in the end of a thin metal ribbon, engaging the filament wire with said hook near the center of said span and moving the hook out of alignment with said ends of the span to draw the filament into the bight of the hook, crimping closed said hook to hold said wire, and then cutting the ribbon parallel to the wire and adjacent to the hooked and crimped end.

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