

June 8, 1943.

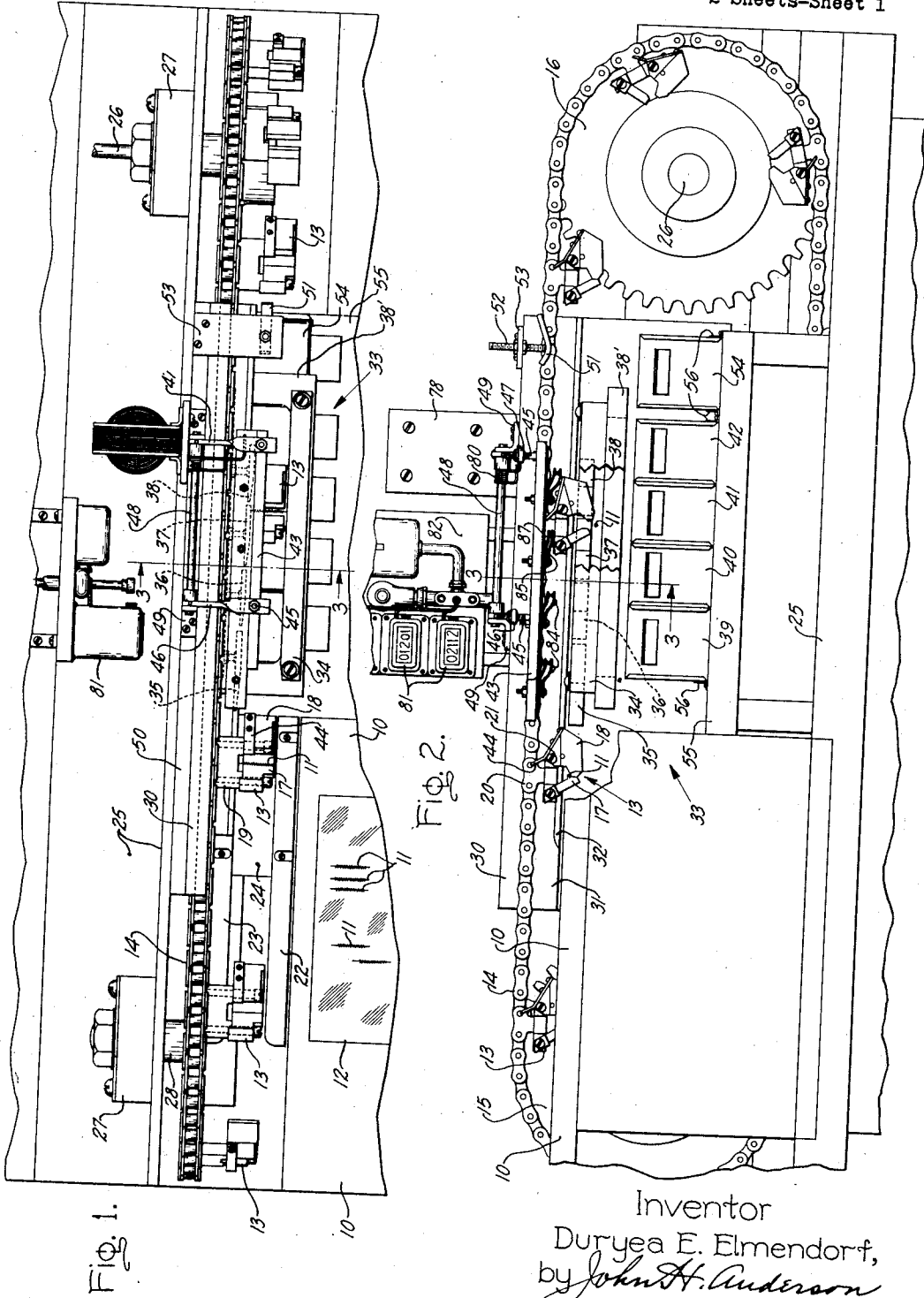
D. E. ELMENDORF

2,321,191

FILAMENT SORTING APPARATUS

Filed Sept. 26, 1940

2 Sheets-Sheet 1



Inventor  
Duryea E. Elmendorf,  
by *John H. Anderson*  
His Attorney.

June 8, 1943.

D. E. ELMENDORF

2,321,191

FILAMENT SORTING APPARATUS

Filed Sept. 26, 1940

2 Sheets-Sheet 2

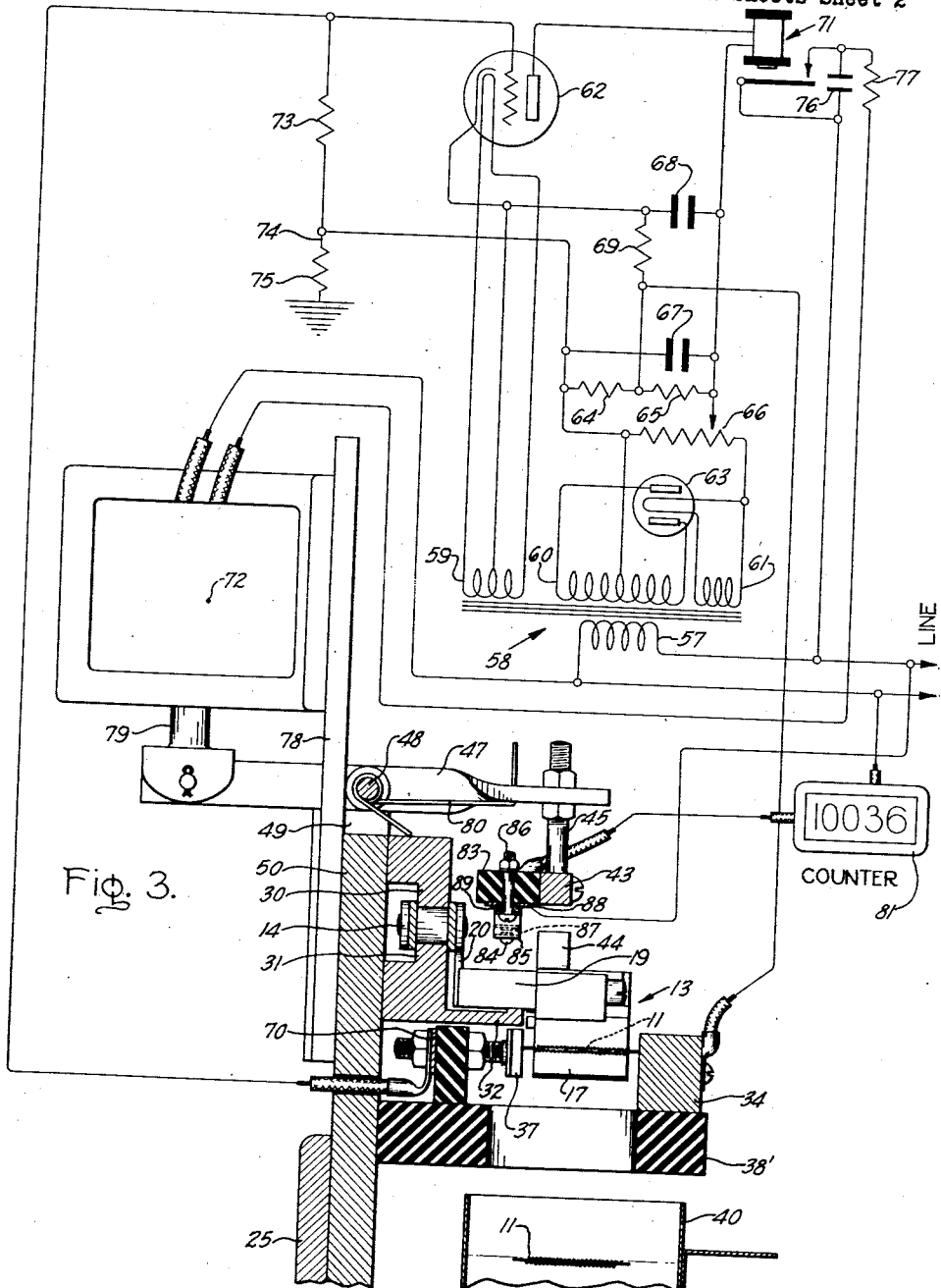


Fig. 3.

Inventor:  
Duryea E. Elmendorf,  
by *Jakob H. Anderson*  
His Attorney.

# UNITED STATES PATENT OFFICE

2,321,191

## FILAMENT SORTING APPARATUS

Duryea E. Elmendorf, Cleveland, Ohio, assignor  
to General Electric Company, a corporation of  
New York

Application September 26, 1940, Serial No. 358,565

3 Claims. (Cl. 209—82)

My invention relates to the manufacture of incandescent lamps and more particularly to apparatus for automatically sorting lamp filaments according to length.

Present day incandescent lamps are quite sensitive in their characteristics to very minute differences in length of the filaments since the said filaments are of concentrated form, generally coiled or coiled-coil, and they materially affect the operating conditions of the lamps if improperly proportioned. On the other hand, it is not always possible to manufacture filaments commercially to the exact specifications desired in present manufacturing practices. For instance, the filaments are likely to be made with variations in the pitch of their coils and with corresponding variations in overall length although containing the specified amount of wire. Such filaments are satisfactory if these variations are considered and proper allowances made in the mounting thereof so that they have the desired effective length. Modern high speed mounting apparatus is constructed so that any appreciable variation in length of the filaments prevents them from being handled satisfactorily. It is therefore desirable to separate filaments of different lengths into groups and to use each group in mounting apparatus adjusted to handle that particular group.

The principal object of my invention is to provide apparatus for automatically sorting filaments into groups of very limited variations in length.

Another object of my invention is to provide automatic sorting apparatus of such extreme sensitivity as to permit its use in separating coiled, coiled-coil and other shaped filaments as to length. Coiled, coiled-coil and other shaped filaments are comparatively flexible and therefore very difficult to measure accurately.

Other objects and advantages of my invention will appear from the following detailed description of a species thereof and from the accompanying drawings.

In the drawings Fig. 1 is a plan view of apparatus comprising my invention; Fig. 2 is a side elevation thereof; and Fig. 3 combines a vertical section through the apparatus at one of the sorting stations thereof along line 3—3 of Figs. 1 and 2 and a wiring diagram of the electrical actuating means of said apparatus.

The sorting apparatus disclosed in the drawings is combined with a table 10, only partially shown in Figs. 1 and 2, which forms the means of receiving the filaments 11. An operator is stationed adjacent the forward edge of the table 10 and, in the usual procedure, places a quantity of the filaments 11 in a single pile thereon and then separates said filaments from each other with the aid of a pair of tweezers. These fila-

ments 11 can then be inspected under the additional illumination provided above and below the frosted glass plate insert 12 in the work surface of the table 10. The said filaments are then transferred one at a time to the moving buckets 13 passing from left to right along the back edge of the table. The buckets 13 are mounted at regular intervals along a chain 14 extending around the sprockets 15 and 16 at opposite ends of the device and form parts of a carrier by which the filaments are advanced thru the sorting apparatus of the device.

Each filament 11 must reach the sorting apparatus separately in order that it be treated without interference from any of the others, and the operator's procedure is to inspect a single filament at a time and then transfer said filament to the bucket 13 which is located adjacent the table 10 at that particular moment. The filament 11 must lie in a normal relaxed position in the bucket 13 so that it extends to its true length and is placed into the trough formed by the fixed and movable sections 17 and 18 respectively thereof which keep it in a straight line. The fixed section 17 of the bucket 13 is fastened directly to block 19 on a special link 20 of the chain 14 whereas the movable section 18 thereof is pivoted on the screw 21 extending from said block 19 and is so distributed thereabout that it swings against the fixed section 17 by its own weight and forms the trough. The buckets 13 are shorter than the filaments 11 and in their course of movement are carried between the stationary guide bars 22 and 23 which assist the operator in positioning the filaments 11 centrally therein. The guide bars 22 and 23 are mounted on a portion 24 of the frame 25 of the device which extends between the upper and lower sections of the chain 14 and only roughly position the filament 11 so that the central coiled-coil portion in this instance is wholly contained within the bucket 13 while the ends of the filament, which are of single coil form, extend from the opposite ends of the bucket.

The order of movement of the carrier which advances the buckets 13 from left to right at a uniform speed is created by the driving force of an electric motor and speed reducer (not shown) coupled to the shaft 26 supporting sprocket 16. The shaft 26 is mounted in a bearing 27 held by a vertically extending portion of the frame 25 of the device and corresponds to shaft 28 supporting sprocket 15 which is similarly supported. Midway in front of the table 10 the chain 14 passes between the upper and lower guide rails 30 and 31 respectively (Figs. 1, 2 and 3) which keep it in a straight path of movement, and shortly thereafter the block 19 thereon slides onto the rest 32 extending from rail 31 which keeps the bucket 13 up in place.

The sorting apparatus 33 is located to the right of the table 10 in the path of movement of the buckets 13 and performs the dual purpose of dividing the filaments 11 into five different groups depending on their length and counting the number of filaments 11 placed in four of the groups. Both the sorting and the counting means are operated by the engagement of the ends of the filament 11 with the bar contacts 34, 35, 36, 37 and 38 on opposite sides of the path of movement which are arranged so as to provide a gradually narrowing path of definite width which the filament 11 must bridge at some point. Bar contact 34 is mounted to one side of the path of movement of the bucket 13 whereas the other bar or segment contacts 35, 36, 37 and 38 are mounted one after the other along the opposite side of said path and are nearer the bar segment 34 so as to reduce the width of said path by very minute steps all within the normal range of length of the filaments 11. Normally the filament 11 entering the sorting apparatus is not located in the exact center of the bucket 13 and it engages either the bar contact 34 or segment contact 35 first and is moved endwise in the bucket 13. If the filament 11 is then of greater length than the spacing between the contacts 34 and 35, it will complete an electrical circuit therebetween which will cause it to be dropped from the bucket 13 before said bucket 13 is moved further along the path. Most generally however, the filament 11 does not have a length equal to the width of the spacing between the contacts 34 and 35, and it is carried further along by the bucket 13. In this particular instance each of the succeeding segment contacts 36, 37 and 38 are .5 mm. nearer the bar contact 34 than the segment contact 35 and the filament 11 will finally reach a point where it will complete a circuit between the bar contact 34 and one of the segment contacts 36, 37 or 38 and be dropped from the bucket 13.

The electrical means connected to the contacts 34, 35, 36, 37 and 38 brings about the release of the filament 11 by causing the movable section 18 of the bucket 13 to be tipped away from the fixed section 17 thereof so that said filament 11 falls free of said bucket 13. The release of the filament 11 is effected almost immediately after it completes the circuit between the contacts so that it will fall through an opening in the block 33' and into the particular container 39, 40, 41, or 42 located below the segment contact 35, 36, 37 or 38 which it has engaged. This arrangement of the containers 39, 40, 41 and 42 causes each to receive only filaments of one length. Since the position of the bucket 13 at the moment the circuit is completed controls the distribution of the filaments 11, the first container 39 in the series receives all filaments 11 of greater than the established maximum length and the three following containers 40, 41 and 42 receive filaments 11 progressively shorter in .5 mm. steps. The movable section 18 is tipped by a downward movement of the metal bar 43 which extends over each of the sorting stations and which engages the finger 44 attached to said movable section 18. The metal bar 43 is supported by the studs 45 which engage the extended ends of the arm 46 and the lever 47 which, in turn, are attached to the horizontal rod 48 held by the brackets 49. The brackets 49 are mounted on the upper edge of the vertically disposed plate 50 running parallel to the center portion of the carrier which is attached

to an upstanding flange on the frame 25 and which is the common means of support for the guide rails 30 and 31 and the insulating block 33'. If the filament is so short that it passes between the last segment contact 38 and the bar contact 34 without completing the circuit therebetween, it is released when the finger 44 engages the stationary cam 51 and opens the bucket 13 during the normal movements thereof. The cam 51 is stationary and is supported by the stud 52 which engages the arm 53 fastened to the upper surface of the plate 50. The filaments 11 released at this station fall into the container 54 which rests on the table 55 in the manner of the other containers 39, 40, 41 and 42 and are all shorter than the established minimum. The four guides 56 on the upper surface of the table 55 keep the containers 39, 40, 41, 42 and 54 in place and yet permit them to be removed so that they can be emptied. The containers 39, 40, 41, 42 and 54 form the segregating means for the filaments 11.

The bar contact 34 and the segment contact 35, 36, 37 and 38 together with the other electrical means provide a particularly effective and desirable means of sorting the filaments 11 in that said means is extremely sensitive and is capable of measuring the filaments 11 without bending or applying force to them in any way. The filament 11, being of relatively slight cross-section and of considerable length, is very flexible and is difficult to measure in a free unstrained condition.

Excepting the contacts 34, 35, 36, 37 and 38, the electrical means is comprised of two main parts; one of which is the discharge tube control means which detects when the filament 11 completes an electrical circuit between the contacts located at each station; and the other of which is the means of supplying the necessary currents to the control means. The electrical connections are such that the primary 57 of the transformer 58 of the current supply means is connected to the line, and the secondaries 59, 60 and 61 thereof are connected to the heater of the Thyatron discharge tube 62, the plates (anodes) of the rectifier tube 63 and the cathode of said rectifier tube 63 respectively. A center tap on the secondary 59 of the transformer 58 is connected to the cathode of the Thyatron 62. The resistances 64 and 65 and potentiometer 66 adjust the voltage of the current supply to suit the requirements of the Thyatron control means and the condenser 67 smooths out the current.

When a filament 11 is not in the detecting circuit, the voltage drop across the resistance 64 causes the grid of the Thyatron to be sufficiently negative with respect to the cathode thereof to prevent the flow of current from said cathode to the plate (anode) and the current supply proceeds in charging the condenser 68. If however only a very brief connection is made between the bar contact 34, which is connected through resistance 69 to the cathode of the Thyatron, and one of the segment contacts 35, 36, 37 or 38, which are all connected together by the metal strip 70 and to the grid of the Thyatron, the grid is made less negative and current flows between cathode and plate (anode). The plate (anode) of the Thyatron is connected through the actuating coil of the relay 71 to the current supply and the condenser 68 and any flow of current in this circuit operates the relay 71 which connects the solenoid 72 to the line. The solenoid 72 in turn provides the means of lowering the bar 43 and

opening the bucket 13. The condenser 68 gives up the current required to create the flow of current through the Thyatron 62 and the relay 71 and is soon discharged whereupon the voltage drop across the resistance 69 is such that said Thyatron 62 will no longer pass current. When the flow of current ceases due to the exhaustion of the condenser 68 the current supply immediately begins to recharge said condenser 68 as the grid is again in control of the Thyatron. If the detecting circuit is complete when the condenser 68 becomes fully charged, the cycle of events is repeated causing the relay 71 and the solenoid 72 to be operated again.

In event it is desired to change the speed with which the cycles of operation of the detecting means are repeated, the potentiometer 66 can be adjusted to apply more or less voltage to the condenser 68 so that it is charged with more or less rapidity. The resistance 73 in the current supply lead to the grid causes the negative grid bias to be reduced to nearly zero voltage very quickly even though the connection between the filament 11 and one or both of the contacts is very poor and has considerable resistance. The ground connection 74 which is made to the frame 25 of the device through the resistance 75 prevents any electrical charge being built up in the frame 25 from leaking off through the buckets 13 and the filament 11 in such a manner as to disturb the operation of the device.

The condenser 76 and resistance 77 shown adjacent the relay 71 are for reducing arcing at the contacts thereof and for reducing the flow of current in the circuit controlled thereby to reduce the speed of operation of the solenoid 72 respectively. The solenoid 72 is mounted adjacent the rearwardly extending end of the lever 47 on the upwardly extending arm 78 held by the plate 50 and engages said lever 47 through the armature 79. The weight of said armature 79 and the expanding force of the spring 80 which engages the forward end of the lever 47 ordinarily keep the bar 43 in the up position and the motion of the armature 79, brought about by the solenoid 72, lowers the bar 43.

The sorting and counting means are operated in combination with each other as the downward motion of the bar 43 causes the filament to be registered on one of four counters 81 (only two of which appear in Fig. 2) mounted on the board 82 should the filament 11 be dropped in one of the first four containers 39, 40, 41 and 42. The counters 81 are commercially available products and are operated by independent electrical circuits controlled by a like number of pairs of contacts on the bar 83 of insulation carried by the bar 43. The contacts are located on the bar 83 in such a manner that the insulation button 84 on the lower contact 85 of each pair strikes the block 19 supporting the bucket 13 when said bucket 13 is below that particular pair of contacts and the bar 43 is moved down. Each of these contacts 85 are connected to one of the counters 81 through a screw 86 held by bar 83 and are bent upward into engagement with the other contact 87 of each pair by engagement with the block 19. In this manner the side of the line connected to contact 87 by means of a wire and the metal strip 88 is connected to contact 85 and the counter 81, and said counter 81 is actuated since it is already connected to the other side of the line. The metal strip 88 extends along the lower surface of the insulating bar 83 and connects each of the upper contacts 87 together. An insulating sleeve

89 separates the screw 86 and the contact 85 from contact 87 and metal strip 88 so that ordinarily there is no connection therebetween.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A device for sorting flexible filaments according to length comprising a carrier for supporting a filament and advancing it to each of a plurality of stations in turn, means located at each succeeding station providing a pair of spaced fixed contacts for making electrical connections to the ends of the filament, said pairs of contacts forming a gradually narrowing path of a width corresponding to the normal range in length of the filaments, and means for releasing the filament from the carrier upon engagement of its ends with both contacts of one pair to complete an electrical circuit therebetween comprising a condenser connected across an electronic control tube, means for charging said condenser, said tube having a grid connected to each pair of contacts for activating the tube when a filament bridges a pair of contacts, such activation causing a discharge of the condenser through the tube, and means actuated by the discharge of the condenser for releasing the filament from the carrier.

2. A device for sorting filaments according to length comprising a carrier for supporting a filament and advancing it to each of a plurality of stations in turn, means located at each succeeding station providing a pair of spaced contacts for making electrical connections to the ends of the filament, said pairs of contacts forming a gradually narrowing path of a width corresponding to the normal range in length of the filaments, and means for releasing the filament from the carrier upon engagement of its ends with both contacts of one pair and completion of an electrical circuit therebetween comprising a condenser, a discharge tube having a cathode, anode and control grid, the cathode and anode being connected to opposite sections of said condenser, means for charging said condenser and providing sufficient negative bias to the control grid to prevent a discharge in said tube, electrically operated means connected between the anode and one section of the condenser for releasing the filament from the carrier, and means connecting one contact of each pair to the control grid and the other to said last-mentioned means so that the completion of a circuit between any one pair of contacts reduces the grid bias and causes a discharge to occur between anode and cathode to discharge the condenser and actuate said release means.

3. In a device for sorting filaments according to length, spaced fixed contacts, means for carrying the filaments between said contacts to bridge them and complete an electrical circuit therebetween, and means for effecting release of said filaments from said carrying means upon completion of said circuit comprising a condenser, an electronic discharge tube having a cathode, anode and grid, and release mechanism including a magnetic coil, said condenser being connected in series with the said coil across said tube, means for charging said condenser and providing sufficient negative bias to the control grid to normally prevent a current flow through the tube and the coil, and an electrical circuit including the said contacts and the grid for reducing the grid bias when the circuit is completed by the bridging of a filament across the contacts to cause the condenser to discharge and energize said coil.

DURYEA E. ELMENDORF.