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METHOD OF SUPPLYING A PLURALITY OF WIRES

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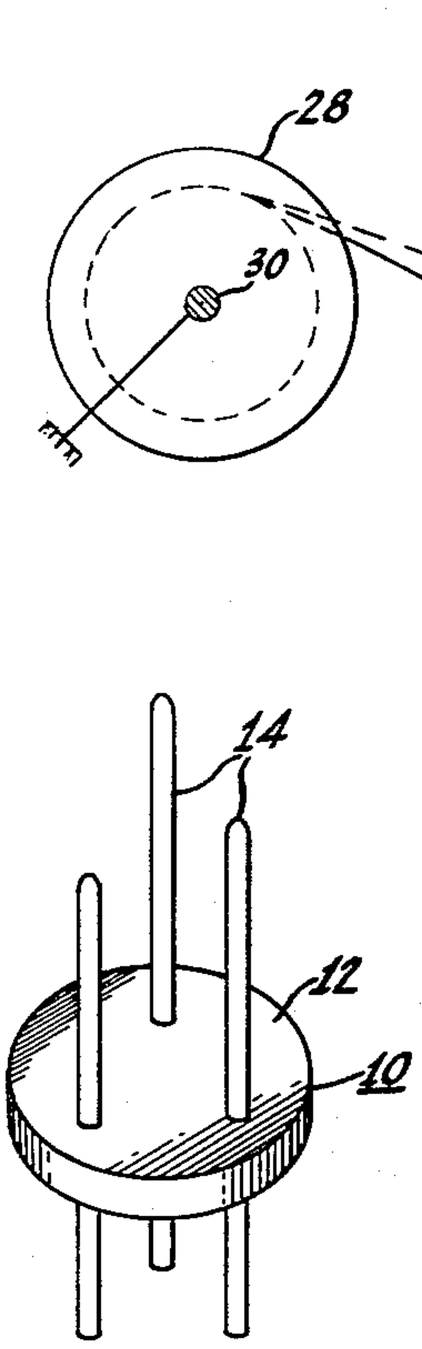


Fig. 1.




Fig. 2.

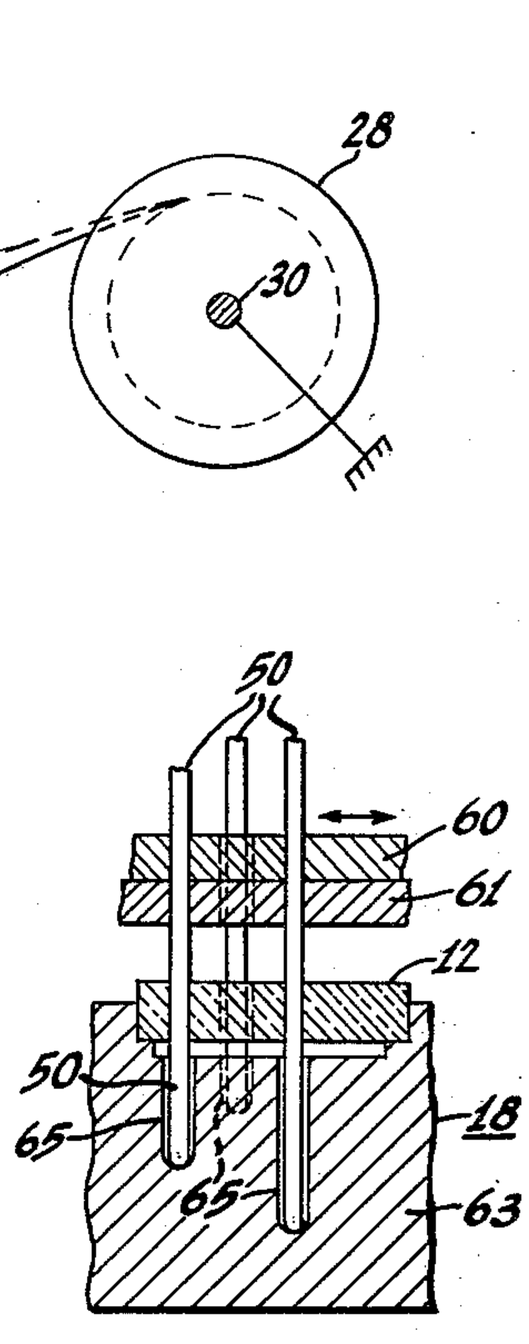


Fig. 3.

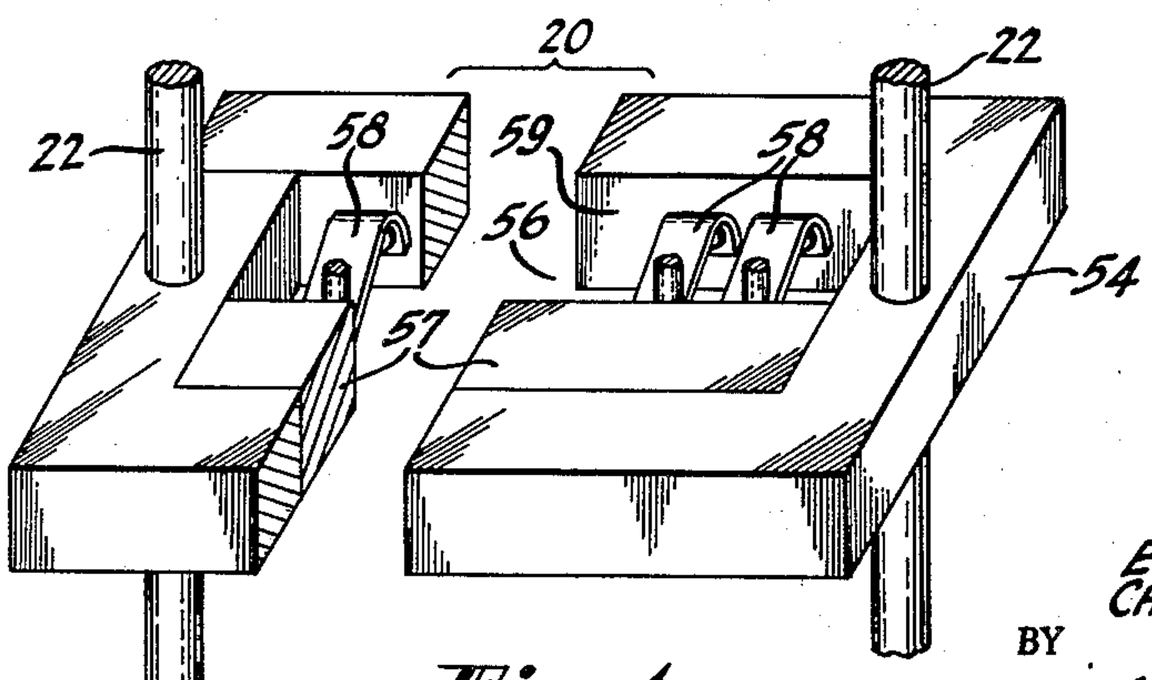


Fig. 4.

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# METHOD OF SUPPLYING A PLURALITY OF WIRES

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This invention relates to a method of feeding wire and particularly to a method of intermittently and simultaneously supplying differing amounts of a plurality of wires.

Although the method of this invention may have utility in a large number of instances wherein a plurality of wires are utilized, the invention will be described in connection with a device used in the manufacture of stems for a certain type of electron tube.

In such electron tubes, the stems comprise a header wafer, usually of ceramic, and a plurality of support and conductive leads extending through bores in the wafer. The leads vary in length and are hermetically sealed to the wafer.

During the fabrication of such stems, according to one method, a plurality of wires extending from supply spools are fed into a stem-forming device where the wires are arrayed in a pattern corresponding to the pattern of bores through the wafer. The wires are then simultaneously fed through the wafer bores until the leading ends of the wires engage positioning stops. The wire feeding is stopped and the wires are then cut. It is desirable that the wires extending into the stem-forming device be untensioned and relatively slack in order that the leading ends of the wires may be readily moved through the wafer bores. To this end, an auxiliary wire feeding means is provided between the wire spools and the stem-forming machine to unreel the wires from the spools at a rate sufficient to maintain slack in the wires as the wires are utilized in the stem-forming machine. Since the stem leads vary in length, the rates at which the several wires are utilized vary, and the amounts of wire supplied by the auxiliary means should also vary.

In the past, each supply spool was provided with a separate auxiliary wire feeding device for feeding or supplying the wire from each spool at the correct rate. For a stem having nine leads, for example, nine separate and individual auxiliary wire feeding devices were employed. Further, if any one of the auxiliary feeding devices broke down, the entire stem-forming apparatus had to be shut down. Also, since all the wires from the auxiliary wire feeding devices converge towards the stem-forming device, the wires would often become entangled with one another in instances when one or more of the feeding devices fed wire at a rate greater than the rate at which the wire was utilized.

An object of this invention, therefore, is to provide a novel and improved method utilizing simple, inexpensive, and reliable apparatus for supplying differing amounts of a plurality of wires to a utilizing device.

A further object of this invention is to provide a novel and improved method for intermittently and simultaneously supplying the correct amounts of a plurality of wires to a wire utilizing device which utilizes the wires in differing amounts.

A still further object of this invention is to provide a novel and improved method of simultaneously unreeling a plurality of wires from supply spools wherein the amount of wire unreeled from each spool is dependent upon the rate at which each wire is utilized.

For achieving these objects in accordance with this invention, a plurality of wire supply spools are mounted for rotation about the axis of the spools. The wires from the spools follow initial paths and converge upon and pass through a single auxiliary wire feeding device



and extend from the wire feeding device into the wire utilizing device. For causing unreeling of the wires from the several spools, the lengths of the paths of the wires from the spools to the wire utilizing device are increased. The leading ends of the wires within the wire utilizing device at this time are fixed against movement towards the spools. As a result, the wires are unreeled from the spools. The increase in the wire path lengths may be accomplished, for example, by moving the auxiliary feeding device in a direction towards the spools for causing the wires to follow paths more indirect than the initial paths from the supply spools to the wire utilizing device. Thereafter, and before the leading ends of the wires are utilized in the stem-forming device, the wires are allowed to go slack by permitting the wires to extend between the supply spools and the stem forming device along the initial paths, as by returning the wire feeding device to its original position. The several wires are then utilized within the wire utilizing apparatus in varying amounts, the amount of slack in the several wires being reduced accordingly. Upon successive cycles of operation of the wire feeding and wire utilizing devices, the amount of wire unreeled from the several spools upon increase in length of the wire paths is dependent upon how much slack remains in the wires after the leading ends thereof have been utilized in the wire utilizing device. Accordingly, the amount of wire unreeled from each spool is dependent upon the rate at which the wire from that spool is utilized, the amount of wire supplied from each spool being independent of the amount of wire fed from the other spools.

In the drawings:

FIG. 1 is a view in perspective of a stem which may be made utilizing the method of this invention;

FIG. 2 is a view in perspective of apparatus for fabricating the stem shown in FIG. 1 and utilizing the method of this invention;

FIG. 3 is a section, at an enlarged scale, along lines 3—3 of FIG. 2; and,

FIG. 4 is a view in perspective, at an enlarged scale, of a portion of the apparatus shown in FIG. 2.

FIG. 1 shows an example of a stem 10 which may be assembled by a wire utilizing device using the method of this invention. The stem 10 comprises a circular wafer 12, usually of ceramic, and a plurality of leads 14, usually of molybdenum, extending through bores through the wafer. The leads are hermetically sealed to the bore walls, as by brazing, and the leads 14 vary in length, as shown. For the sake of simplicity, only three leads 14 are shown, although in one electron tube stem of this type, nine leads are used.

Apparatus for positioning wires through a wafer and cutting the wires to proper length is shown in FIG. 2. The apparatus comprises, from the bottom up, as viewed in FIG. 2, a housing 19 containing therein a wire positioning and cutting unit 18, to be described, a wire check unit 20 fixedly mounted on vertical columns 22, a wire feeding unit 24 slidably mounted on the columns 22, an auxiliary wire feeding unit 26 fixedly mounted on columns 22, and three supply spools 28 mounted for rotation on shafts 30. Wire guide tubes 68 are provided for directing the wires 50 from check unit 20 into housing 19 and into the wire positioning and cutting unit 18, as will be described.

Auxiliary wire feeding unit 26 comprises a funnel-shaped wire guide 34 secured to the end of a piston 36 of an air cylinder 38 mounted on table 40. Upon actuation of air cylinder 38, by suitable valve means, not shown, guide 34 is lifted to the position shown in dotted lines in FIG. 2. The function of the auxiliary wire feeding unit 26 will be described hereinafter.

Wire feeding mechanism 24 comprises a support plate 42 having a central opening 43 into which a pair of blocks 44, which may be made of a suitable plastic, are mounted. A plurality of compression springs 45 serve to urge the two plastic blocks 44 toward each other. Feeding unit 24 may be moved vertically along columns 22 by means of two-arm linkages 47 pivotally attached to support plate 42 and fixed to a shaft 48 rotatably mounted on table 40. Actuation of the shaft 48 for moving the feeding unit 24 vertically along the columns 22 is accomplished by turning a hand wheel 49 fixed to shaft 48.

In operation of the feeding unit 24, the wires 50 are threaded between the two blocks 44 and gripped therebetween by action of the compression springs 45. The gripping of the wires 50 by the feeding unit 24, being of a frictional nature, is dependent upon the material of the blocks and the pressure exerted by the compression springs 45. Vertical movement of feeding unit 24 either causes pulling of the wires 50 by blocks 44 or sliding of the wires between blocks 44 depending upon whether the wires are free to move in the direction of movement of feeding unit 24.

Check unit 20, shown in greater detail in FIG. 4, comprises a support plate 54 fixedly mounted on the two vertical columns 22. The support plate 54 is provided with a central opening 56 into which a pressure block 57 and a plurality of leaf springs 58 are disposed. The leaf springs 58 are secured to the inner wall 59 of the support plate 54 and are spring biased so that their ends bear against the facing surface of the pressure block 57. The leaf springs 58 contact the pressure block 57 at a slight angle and extend therefrom upwardly from the horizontal. Accordingly, a frictional check device is provided wherein a wire 50 may be drawn or pushed downwardly between the pressure block 57 and one of the springs 58, but is firmly grasped against an upward movement therethrough.

As shown in FIG. 3, the wire positioning and guiding unit 18 includes a pair of dies 60 and 61 having bores therethrough, and a wafer positioning block 63 adapted to support a stem wafer 12 at a preselected distance from the dies 60 and 61 with the wafer bores in alignment with the die bores. Block 63 also incluudes a number of wire receiving bores 65 in alignment with the die and wafer bores for controlling the length of the stem leads.

In the operation of the wire positioning and cutting unit 18, the wires are fed, as will be described, through guide tubes 68 (FIG. 2) which direct the wires 50 through the aligned bores in dies 60 and 61, and wafer 12 and block 63. The wires 50 are fed simultaneously, each of the wires, however, being fed a different distance as controlled by bores 65 (FIG. 3). Die 60 is then slid transversely relative to die 61, by means not shown, thereby severing the wires. Although not shown, additional means may be provided for providing brazing washers around the leads and against the wafer for holding the leads in place while the wafer is removed from the apparatus.

To prepare the apparatus to fabricate a stem 10, the wires 50 (FIG. 2) are fed from the rotatable spools 28 through guide 34 in auxiliary wire feeding unit 26, between blocks 44 in wire feeding unit 24, between the springs 58 and block 57 of check unit 20, into guide tubes 68 for providing the proper arrayal of the wires, and into housing 19 containing unit 18 for movement through the aligned bores in dies 60 and 61, wafer 12, and block 63, respectively, upon each cycle of operation of the apparatus.

The stem leads 14 must be perfectly straight, and prior to spooling of the wires 50 onto spools 28, the wires 50 are straightened. Spools 28 are of sufficient size so that the wires are not bent beyond their elastic limit, thereby preserving the straightness of the wires. Also, the arcuate upper portion 34′ of guide 34 has a radius at least equal to that of spools 28. Hence, the straightness of the wires is not affected during feeding of the wires through guide 34.



In the operation of the apparatus, hand crank 49 is actuated for moving wire feeding unit 24 downwardly for pushing the wires 50 past check unit 20 and through the bores in dies 60 and 61, through the wafer bores, and into the wire receiving bores 65. Since wire feeding unit 24 is spring loaded, as described, and since molybdenum is relatively stiff, wire feeding unit 24 simultaneously feeds all the wires until the leading end of each wire engages the end of its associated bore 65. Feeding unit 24 then slides along the wires and the wires cease to advance further. In this manner, varying amounts of the wires 50 are fed by unit 24 as controlled by bores 65. After the wires have been cut by the transverse sliding of die 60 with respect to die 61, wire feeding unit 24 is raised to its original position in preparation for the next cycle of operation. Check unit 20 prevents movement of wires 50 upwardly, as described, wire feeding unit 24 sliding against the wires during its upward movement.

In order to permit relatively easy sliding of feeding unit 24 along wires 50 to prevent scratching or scoring of the surface of the wires, blocks 44 of feeding unit 24 are biased towards one another by relatively weak springs 45. Therefore, in order to prevent slippage between blocks 44 and wires 50 during downward movement of feeding unit 24, it is desirable that the wires extending between the spools 28 and the feeding unit 24 be relatively slack and under little tension.

To this end, the auxiliary wire feeding unit 26 is provided for unreeling the wires from the supply spools 28 at a rate sufficient for maintaining slack in the several wires while not feeding the wires at such an excessive rate as to cause entangling of the wires. As shown in FIG. 2 in solid lines, the wires from the supply spools 28 follow generally arcuate paths converging upon the wire guide 34 and passing therethrough. For causing unreeling of the wires, the air cylinder 38 is actuated to cause lifting of the wire guide 34 and movement of the guide towards the wire spools 28. As shown by dotted lines in FIG. 2, this causes the wires to converge in a region closer to the spools than the region of convergence of the wires while the wire guide was in its lower position, that is, the wires are caused to converge at a faster rate. The wires are thus forced to follow paths which are longer in length than the paths of the wires while the wire guide was in its lower position. Since the spools 28 are rotatable, the wires are thereby unreeled from the supply spools. Enough friction is provided between the spools 28 and shafts 30 to prevent over-travel of the spools. Thereafter, the wire guide 34 is lowered to its original position. The spools do not re-reel the wires, hence, the wires become slack.

Wire guide 34 is of tubular shape and all the wires 50 pass therethrough. Hence, regardless of the tension or degree of slackness of the wires 50, wire guide 34 constrains the wires to follow relatively preselected converging paths from the spools 28 to the wire utilizing apparatus, thereby preventing entangling of the wires with portions of the apparatus. Further, even if large amounts of wire are fed, with wide divergences in the amounts of each wire fed, wire guide 34 always retains control over the wires thereby permitting repeated cycles of operation without the necessity of recapturing and relocating the slack wires.

Hand crank 49 is then rotated for feeding the now slack wires into housing 19 and the wires are positioned and cut as described. Since the wires are used in differing amounts due to the difference in the stem lead 14 lengths, as described, the reduction in slack of each wire also varies. Upon subsequent cycles of operation of the auxiliary feeding device, however, the lifting of the wire guide 34 and the attendant increase in wire path lengths

causes no unreeling of any spool until the slack in the wire from that spool is taken-up. Accordingly, the amount of wire unreeled from each spool is dependent solely upon the rate at which the slack in the wire is reduced, hence, upon the rate at which the wire is utilized in the fabrication of the stems.

In operation, therefore, the amount of slack in each wire will be reduced depending upon how much of each wire is used in a stem-forming operation, but substantially equal amounts of slack will be restored in all the wires upon the lifting and subsequent lowering of guide **34**. The provision of wires **50** having equal amounts of slack prior to each stem-forming operation contributes to a more orderly disposition of the wires and the prevention of entanglement of the wires.

What is claimed is:

1. The method of supplying a plurality of wires from different supply means to a utilization device without overfeeding said wires, said method comprising:

directing the wires from said supply means along paths to converge in a first region between said supply means and said device,

feeding the wires to said device to take up slack in said wires,

directing the wires after said feeding to converge in a region closer to said supply means than said first region to direct said wires along longer paths than said first paths while clamping said wires between said regions and said device to prevent back-feed toward said supply means thereby to draw wire from said supply means, and

then again directing the wires from said supply means along paths to converge in said first region to restore slack to said wires preparatory to further feeding of said wires to said device.

2. The method of supplying a plurality of wires from different supply means to a utilization device without over-feeding said wires, said method comprising:

directing the wires from said supply means along paths to converge in a first region between said supply means and said device,

feeding differing amounts of said wires to said device to differentially take up slack in said wires,

directing the wires after said feeding to converge in a region closer to said supply means than said first region to direct said wires along longer paths than said first paths while clamping said wires between said regions and said device to prevent back-feed toward said supply means thereby to draw wire from said supply means, and

then again directing the wires from said supply means along paths to converge in said first region to restore equal amounts of slack to said wires preparatory to further feeding of said wires to said device.

3. Method of deriving from a plurality of reels of wire a plurality of wire leads of respectively different lengths, said method comprising:



applying a clamping force to each of said wires adjacent to the free-end thereof,

temporarily applying a common unreeling force to said clamped wires to produce substantially equal amounts of slack therein,

moving the free-ends of said wires against the pressure of said common clamping force each a distance dictated by the desired length of the wire-lead to be derived from that wire, whereby the amount of slack remaining in the wire that is allotted to the longest of said leads is less than that remaining in the wires that are allotted to the leads of shorter length,

severing said desired lengths of wire while maintaining said clamping force on the unsevered portion of each wire, and

thereafter re-applying said common unreeling force to said unsevered portions of said clamped wires substantially to re-equalize the amount of slack therein.

4. In the art of manufacturing a device of the kind having an array of wire-leads which extend different distances into said device, a method of providing said device with said plurality of wire-leads from respectively different reels of wire, said method comprising:

bringing the free-ends of said wire-leads into the desired array,

applying a clamping force to each of said wires adjacent to the free end thereof,

temporarily applying a common unreeling force to said clamped wires to produce substantially equal amounts of slack therein,

moving the free-ends of said wires against the pressure of said clamping force into said device each a distance dictated by the length of the wire-lead to be derived from that wire, whereby the amount of slack remaining in the wire that is allotted to the longest of said leads is less than that remaining in the wires that are allotted to the leads of shorter length,

simultaneously severing said plurality of wires in a common plane while maintaining said clamping force upon the unsevered portion of each wire,

and thereafter re-applying said common unreeling force to said clamped wires substantially to re-equalize the amount of slack therein.


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