This invention relates generally to apparatus for automatically loading material into a magazine. More particularly it concerns the automatic stacking of work pieces into a magazine. The work pieces may comprise spacers in the form of thin plates of insulating material used to position and support electrodes within an electron tube. They may be made, for example, of mica.

An automatic machine is usually used to assemble the parts of electron tubes. The spacers used in such a machine are selected from a suitably positioned supply magazine. When the supply of spacers in the magazine is depleted the magazine must be reloaded.

Magazine loading procedures previously used have proven cumbersome and have required the continuous attention of an operator. Heretofore, operators picked spacers out of a supply reservoir, where they were piled in a random fashion, and placed them one above the other in a magazine adapted to hold a stack of these spacers. The manual stacking of the spacers was a laborious and time-consuming process. Particularly, the repeated handling of the spacers together with the consequent requirement for additional man power to operate the tube-making machinery has been a substantial cost factor.

This invention provides a compact and efficient mechanism for loading spacers into a magazine which requires little attention from an operator. Accordingly, some of the important objects of the invention are:

1. To provide an apparatus for the automatic loading of spacers into a magazine.
2. To provide automatic means for orienting spacers in a stacked position within a magazine.
3. To provide apparatus for the assembly of spacers in a stack within a magazine from a disorganized pile of spacers within a reservoir.
4. To obviate the necessity of continuous operation by an operator of an apparatus for stacking spacers within a magazine.
5. To decrease the cost of producing electron tubes.

In order to accomplish these and other objects we provide apparatus for automatically loading spacers from a disoriented reservoir pile and stacking them within a magazine. The apparatus includes a conveyor to feed spacers out of such a pile and onto a conveyor track where the spacers are carried one behind the other to an end of the track. At the end of the conveyor track the spacers are dropped onto the platform of a lowering elevator adjacent this end. The lowering elevator includes walls defining an elongated space within which rests the magazine referred to. The magazine, in turn, is provided with walls that define a channel adapted to hold spacers. As the spacers successively drop onto a platform within the elevator and form a stack, the elevator lowers the platform within the aforementioned elongated space and thus also within the channel of the magazine. When the magazine channel is fully stacked with spacers riding on the platform, the platform is moved out of the magazine through a slot in the bottom of the magazine; a stack of spacers is thus left within the magazine. The now loaded magazine is removed for use in an automatic tube assembly machine and an empty magazine is put in its place. Another platform in the elevator is then positioned at the top of the elongated space adjacent the end of the conveyor track and the cycle is repeated for loading a stack of spacers into the empty magazine.

While the invention is pointed out with particularity in the appended claims it may be best understood from the following detailed description and drawings where like numerals refer to like parts. The embodiment described is presented solely for illustrative purposes and not by way of limitation.

In the drawings:

Figure 1 is a partially cut-away elevational view of a preferred embodiment of the invention.

Figure 2 is a perspective view of the magazine shown in Figure 1.

Figure 3 is a top plane view of the embodiment shown in Figure 1.

Figure 4 is a fragmentary view of the discharge bracket shown in Figure 3.

Figure 5 is a sectional view taken on line 5—5 of Figure 3.

Figure 6 is a sectional view taken on line 6—6 of Figure 5.

Figure 7 is a schematic diagram of the wiring system used in the embodiment shown in Figure 1.

Referring now to the drawing in greater detail there is shown in Figure 1 an apparatus for loading spacers into a magazine. The apparatus includes a table 10 supported on legs 12 and having a shelf 14. Mounted on the shelf 14 is a vibrator 18 for powering the vibrator conveyor unit 18.

The conveyor 18, mounted on the vibrator 16, may be any unit which is commonly used for energizing conveyors. For example, it may be a vibrator known in the trade as a Syntron Vibrator. A lowering elevator 20 is supported on the shelf 14 and adjacent the conveyor 18. The elevator is shown inclined from the vertical with respect to the conveyor. The inclination is provided in this embodiment so as to position the top of the elevator adjacent the conveyor 18 and at the same time allow clearance between the bottom of the elevator and the vibrator 16. Thus the angle of inclination of the elevator is not critical and any substantially vertical position will suffice provided, of course, the top of the elevator is positioned adjacent the conveyor.

Within the lowering elevator 20 are three walls whose sides define an elongated space forming an elevator well which is open at one side. The magazine 22 is inserted into the well through the open side, and onto a movable magazine support 25, by moving the magazine in a direction into the plane of the drawing. After the magazine is inserted into the elevator well, a lever 23, connected to the magazine support 25, is lifted raising the magazine up into its operating position immediately below the end of the conveyor. The support 25 locks in the raised position. When the magazine has been fully stacked with spacers the lever 23 is lowered unlocking and lowering the support 25. The magazine is thus moved down and out of its operating position. The latch 24 is then opened and the magazine removed from the well.

Figure 2 shows the aforementioned magazine 22 in perspective. Spacers 26 are shown positioned within a channel 28 in the magazine. The spacers 26 rest on a block 30 shown at the bottom of the magazine channel. The dimensions of the block are such that the block may move freely in a vertical direction within the magazine channel and at the same time fit closely enough to the magazine walls defining the channel so that spacers can not wedge between the block and the walls. A plate 32 at the bottom of the magazine forms an end support
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A conveyor track 76 leads upwardly from the reservoir 74 in a counterclockwise direction. The vibrator unit below the conveyor unit energizes the conveyor track 76 so that it oscillates first arcuately upward and in the direction of ascent of the track and then arcuately downward and in the direction of descent of the track. The arcuate oscillatory motion moves the spacers 26 upwardly on the track 76. A rail 79 guides the spacers on the track orienting them in line with each other. The track 76 ends in a discharge bracket 78. The spacers move up the track until they reach an opening 80 in the discharge bracket 78 where they fall through it. When the magazine has been filled to a predetermined height, and the tripping of the micro-switch has de-energized both the vibrator unit 16 and the chain powering motor 84, the chain is manually rotated by an operator, by the counterclockwise turning of a knob 86 connected to the chain, as shown in Figure 1, until the elevator platform carrying the stack of spacers is moved down through the bottom plate slot of the magazine and out of the elevator well leaving a stack of spacers, and the block on which it rides, in the magazine. A clutch 88 allows the operator to override the chain powering motor when the knob 86 is manually turned. The now fully stacked magazine is removed and replaced with an empty magazine.

In Figure 4, a fragmentary view of the discharge bracket of Figures 3 and 5 is shown. In the discharge bracket 78 large enough to freely pass spacers through it, yet it is small enough to guide each of the successive spacers passing through the opening onto the preceding spacer supported immediately below the opening. The magazine 22, which rests below the discharge bracket 78, has its spacer-containing channel immediately below the discharge bracket and in registry with it. The dimensions of the bracket opening and the magazine channel are substantially the same: slightly larger than that of a spacer.

Referring to Figures 5 and 6, the prongs 82 of the discharge bracket 78 are shown extending into the magazine 22. The prongs fit loosely into the magazine and position the bracket opening 80 in registry with the magazine channel 28 so that the prongs guide spacers into the channel.

A light beam from the photoelectric light source passes through the light-beam slot 40, as shown in Figure 5, to the photoelectric relay 48 shown in Figure 3. When the spacers 26 riding on the block 30 are stacked to a height blocking the light beam and preventing it from passing through the light beam slot 40, the vibrator unit 16 is de-energized. The micro-switch 72 turns off the conveyor and stops the rotation of the chain. Each linked screw is positioned on the chain at a point such that, when its corresponding platform attains its predetermined low position within the well, the linked screw attains its predetermined point along the travel of the chain. At that point the screw actuates a roller 70 connected to an arm 71 which trips the micro-switch 72. The micro-switch 72 controls both the vibrator 16 which energizes the conveyor 18 and the power means which rotates the chain 60. When the micro-switch is tripped both the vibrator and the chain power motors are de-energized. The vibrator 16 and the chain power motors 84 are shown powered by a 110 volt power source. The vibrator 16 which actuates the helical conveyor is shown connected for energization by a 220 volt power source. The photoelectric light source 46 and the photoelectric relay 48 are shown powered by another 110 volt power source. The vibrator 16 is connected in series with a normally closed 2-pole relay 90 and the circuit controlling the chain powering motor 84 is in operation except when the relay 90 is deenergized. When the linked screw actuates the normally closed micro-switch 72, the normally-closed 2-pole relay 90 is de-energized closing the circuit to the vibrator 16 through one of its poles 94. The elevator motor 84 is connected in series with the other pole 92 of the same relay. In addition, the elevator motor 84 is also connected in
series with the photoelectric relay 48. The photoelectric relay 48 is operative to open its relay circuit when illuminated by the light source 46. The vibrator is in operation when the micro-switch is closed; the elevator motor is in operation only when both the micro-switch is closed and the illumination on the photoelectric relay is interrupted (closing the photoelectric relay).

Tracing the circuit powering the motor 84, when the 2-gang line switch 96 is closed current from one line 98 of the power line passes through the first gang 100 of that switch, through the first-gang fuse 102 in the same switch, through the first pole 92 of the normally closed 2-pole switch into a magazine motor 104, to which current then flows through the photoelectric relay pole 104 when its contacts are closed, i.e., when the solenoid circuit 106 is opened by the interruption of the light beam 52, and then returns to the grounded line 108 of the power source. In the resting state of the normally closed micro-switch 72, current flows from one line 105 of the power source through the light switch 96, through the micro-switch 72, through the solenoid 110 of the 2-pole relay 98, and then back to the grounded line 108 of the power source. Current in the circuit powering the vibrator 16 enters one line 98 of the power source and then through the switch 96 and contacts 102 of the second pole 94 of the 2-pole relay 90 to the vibrator 16, and then returns through the second fuse 112 and the second gang 114 of the line switch to the center line 116 of the power source. Current in the circuit powering the light source 46 and the photoelectric relay 48 enters through line 116 of the power source and flows through the light switch 96, through the light source and the photoelectric relay which are connected in parallel, and returns through the line switch 96 to the grounded line 108 of the power source.

While the preferred embodiment shown is adapted to stack pieces into a magazine, it will be appreciated that the invention is not limited to the stacking of spacers but may be used to stack other parts. For example, the dimensions of the aforementioned apparatus may be changed and parts of a different size and shape substituted for the electron tube spacers.

It is apparent from the foregoing description of an automatic magazine loader embodying our invention that a novel and advantageous apparatus is provided, not only for mechanizing operations that have heretofore been performed manually, but also for a more uniform stacking of spacers within a magazine to contribute to a better and faster operation of automatic tube assembly machines in which the magazines are used.

What is claimed is:

1. Apparatus for loading parts into a magazine comprising a reservoir adapted to store parts, a lowering elevator adjacent said reservoir and adapted to receive parts, and a conveyor extending into said reservoir and into said elevator and adapted to carry parts from said reservoir to said elevator, said elevator extending into said reservoir and adapted to receive parts from said elevator and comprising a frame adjacent said conveyor, a single upper rotatable sprocket mounted on an upper portion, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, and a single endless chain meshingly stretched for travel around said sprockets, said endless chain extending into said magazine and carrying at least one platform supported only on said chain and adapted to receive parts from said conveyor, whereby said parts are loaded from said reservoir by said conveyor and said elevator into said magazine.

2. Apparatus for loading spacers into a magazine comprising reservoir means adapted to store spacers, a magazine removabley mounted adjacent said reservoir means and adapted to receive spacers, vibrationally powered feeding means extending into said reservoir means and having an end extending into said lowering means and adapted to transfer said spacers from said reservoir means to said lowering means by vibrational oscillation of said feeding means, and feeding control means adapted to regulate the transfer of spacers from said reservoir means by said feeding means to said lowering means, said lowering means defining an elongated space below said feeding means and extending into said magazine, said magazine having vertically extending and oppositely disposed side walls for providing a lateral guide for said spacers during their travel therein and being disposed within and above said space and said magazine, said lowering means defining said elongated space below said feeding means and adapted to receive spacers from said lowering means, whereby said magazine is insulated from the vibrational movements of said feeding means, said lowering means comprising a frame adjacent said feeding means, a single upper rotatable sprocket mounted on a upper portion of said frame, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, a single endless chain meshingly stretched for travel around said sprockets, and at least one platform supported only by said single chain and adapted to travel into said magazine, said lowering means defining an elongated space below said feeding means whereby said spacers are loaded from said reservoir means by said feeding means and said lowering means into said magazine.

3. Apparatus for loading parts into a magazine including a parts receiving opening in a top portion thereof and a slot in a bottom portion thereof, said apparatus comprising a reservoir adapted to store parts; a conveyor extending into said reservoir and adapted to carry parts out of said reservoir; a discharge bracket connected to said conveyor and extending into said magazine, said bracket adapted to orient said parts into position for discharge from said conveyor into said magazine; a lowering elevator adjacent said conveyor and having a portion defining a space below said discharge bracket, said elevator including a frame in spaced relation to said bracket and adapted to support said magazine within said space in a loose fit in registry with said bracket, a single upper rotatable sprocket mounted on an upper portion of said frame, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, a single endless chain meshingly stretched for travel around said sprockets, and at least one platform supported only on said chain and adapted to travel into said magazine, said space in a direction into said magazine through said parts receiving openings and out of said magazine through said slot therein, said platform being adapted to supportably receive parts from said discharge bracket during a portion of its travel within said space; power means to rotate said chain in a direction lowering said platform into said space when said platform is on the side of the chain adjacent said conveyor; and power control means for energizing said power means only when said platform is in a predetermined position with respect to said discharge bracket whereby the loading of said parts from said reservoir into said magazine is regulated.

4. A device for loading spacers into a magazine including a spacer receiving opening in a top portion thereof and a slot in a bottom portion thereof, said device comprising a frame, a single upper rotatable sprocket mounted on an upper portion of said frame, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, a single endless chain meshingly stretched for travel around said sprockets, at least one platform mounted only on said chain and adapted to supportably receive spacers and to travel into said magazine in a direction through said spacer receiving opening and out of said magazine through said slot therein, power means connected to said chain for moving said
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chain in a closed path, and power control means for automatically adjusting the position of said platform in accordance with a predetermined relation so as to maintain the level of said upper surface of successively topmost spacers at a substantially constant elevation.

5. A device for automatically loading spacers into a magazine including a spacer receiving opening in a top portion thereof and a slot in a bottom portion thereof; said device comprising a resilient spacer conveyor; a conveying extending into said reservoir and adapted to carry spacers out of said reservoir; a lowering elevator connected to said conveyor and adapted to receive spacers from said reservoir; a platform comprising a reserve of said spacers; a vibration conveyor extending into said reservoir and having a discharge end; power means connected to said conveyor and adapted to power said conveyor so as to carry spacers out of said reservoir by vibrational oscillations; a lowering elevator connected to said conveyor and adapted to receive said spacers from said reservoir; a single upper rotating sprocket mounted on an upper portion of said frame, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, a single endless chain meshingly stretched for travel around said sprockets, and at least one platform mounted solely on said chain and adapted to supportingly receive spacers from said conveyor and to travel into said magazine in a direction through said spacer receiving opening and out of said slot therein; power means connected to said chain for moving said chain in a closed path, one portion of said path being disposed adjacent to said power means, and another portion of said path being disposed remote from said conveyor, said at least one platform being hinged for horizontal extension when carried by said chain along the portion of the path thereof adjacent to said conveyor and vertically dis tended when carried by said chain along the portion of said path from said conveyor; said conveyor is adapted to be folded into an out-of-the-way position during its travel along the portion of said path remote from said conveyor, and power control means for automatically adjusting the position of said platform in accordance with a predetermined relation so as to maintain the level of successively topmost spacers carried on said platform at a substantially constant elevation whereby the feed of said spacers from said reservoir into said magazine is regulated.

6. Apparatus for stacking spacers, said apparatus comprising: a reservoir means adapted to store spacers; conveyor means extending into said reservoir means and adapted to convey spacers out of said reservoir means, lowering means connected to said conveyor means and adapted to receive spacers from said conveyor means, said conveyor means having a space defining a discharge end and provided with prongs mounted on said conveyor at opposite sides of said space and extending into said lowering means for providing a lateral guide for said spacers during their travel from said conveyor into said lowering means, said lowering means defining an elongated space below said conveyor and comprising a frame in spaced relation to said conveyor means, a single upper rotatable sprocket mounted on an upper portion of said frame, a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, a single endless chain meshingly stretched for travel around said sprockets along a side adjacent said conveyor during part of its travel and extending into said platform whereby said spacers are successively stacked on said platform; power means connected to said chain for moving said chain in a direction lowering said platform into said reservoir and power control means including a photoelectric relay for controlling said power means and a lamp positioned for actuation of said relay, said relay and lamp in spaced relation to the upper surface of successively topmost spacers on said platform whereby the position of said platform is automatically adjusted in accordance with a predetermined relation so as to maintain the level of said upper surface of successively topmost spacers at a substantially constant elevation.

7. In a stacking device, a reservoir adapted to provide spacers; a vibration conveyor extending into said reservoir and having a discharge end; power means connected to said conveyor and adapted to power said conveyor so as to carry spacers out of said reservoir by vibrational oscillations; a lowering elevator connected to said conveyor and adapted to receive said spacers from said conveyor; said elevator defining an elongated space below said conveyor and comprising a frame adjacent to and space insulated from said discharge end, whereby said frame is space insulated from the vibrational motion of said conveyor; a single upper rotatable sprocket mounted on an upper portion of said frame and a single lower rotatable sprocket mounted on a lower portion of said frame, said sprockets in substantially vertical relation to each other, an endless chain meshingly stretched for travel around said sprockets along a side adjacent said conveyor during part of its travel and extending into said reservoir whereby said spacers are successively stacked on said single chain and adapted to successively receive said spacers in a vertical stack on said platform when said platform is positioned within said space; power means for rotating said chain in a direction lowering said platform within said space; power control means for controlling said chain power means so as to rotate said chain positioning platform within said space in a predetermined relation with respect to said conveyor; a switch connected to said elevator and operable to control said conveyor power means and said chain power means; and at least one linked screw mounted on said chain, said linked screw in spaced relation to said switch and operable to actuate said switch when said platform attains a predetermined position whereby the successive stacking of said spacers on said platform is regulated.

8. A stacking device for loading spacers into a magazine comprising: a reservoir adapted to store spacers; a conveyor extending into said reservoir and into said magazine; power means connected to said conveyor and adapted to power said conveyor so as to carry spacers out of said reservoir; a lowering elevator connected to said conveyor and adapted to receive said spacers from said conveyor; said elevator extending into said magazine and defining an elongated space below said elevator whereby said platform is adapted to be folded into an out-of-the-way position during its travel along the portion of said path remote from said conveyor; said conveyor is adapted to be folded into an out-of-the-way position during its travel along the portion of said path remote from said conveyor, and power control means for automatically adjusting the position of said platform in accordance with a predetermined relation so as to maintain the level of successively topmost spacers carried on said platform at a substantially constant elevation whereby the feed of said spacers from said reservoir into said magazine is regulated.

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switch and operable to actuate said switch when said platform attains a predetermined position whereby the successive stacking of said spacers in said magazine is regulated.

9. Apparatus for loading work pieces into a magazine adapted to receive said work pieces comprising a reservoir for work pieces, lowering means adjacent to said reservoir and adapted to receive work pieces, said lowering means being connected to said magazine, and conveyor means extending into said reservoir and having an unloading end extending into said magazine, said conveyor means being adapted to carry work pieces from said reservoir to said lowering means whereby work pieces are transferred from said conveyor means by said lowering means into said magazine, said conveyor means being vibrationally powered and adapted to be space insulated from said magazine at the portion thereof adjacent to said unloading end of said conveyor means for insulating said magazine from the vibrational motion of said conveyor means.

10. Apparatus for loading parts into a magazine comprising reservoir means for parts, lowering means adjacent to said reservoir means and adapted to receive parts, feeding means extending into said reservoir means and having an unloading end extending into said lowering means and adapted to transfer said parts from said reservoir means to said lowering means by vibrational oscillations, said feeding means and said lowering means being space insulated from each other at said unloading end, whereby the vibrational movements of said feeding means are isolated from said lowering means, said lowering means being supported on a single vertically disposed endless chain and extending into said magazine, and feeding control means adapted to regulate the transfer of parts from said feeding means to said lowering means whereby the feed of said parts from said reservoir means by said feeding and lowering means into said magazine is regulated.

11. Apparatus for loading spacers comprising a reservoir for spacers; a conveyor adapted to convey spacers out of said reservoir; a vibrator connected to said conveyor, said conveyor having a discharge bracket adapted to orient said spacers into position for discharge from said conveyor; elevator lowering means comprising a receiving portion adapted to receive said spacers from said conveyor, said receiving portion being in vertical registry with said discharge bracket and defining an elongated space below said discharge bracket, and a single endless chain powered for movement in one direction only carried by said lowering means and extending in and above said space, said chain having at least one platform supported solely by said single chain and adapted to supportingly receive spacers from said discharge bracket; power means connected to said chain for moving said chain in a closed path, one portion of said path being disposed adjacent to said conveyor and another portion of said path being disposed remote from said conveyor, said at least one platform being hinged for horizontal extension when carried by said chain along the path thereof adjacent to said conveyor and vertically distented when carried by said chain along the portion of said path remote from said conveyor, whereby said platform is adapted to be folded into an out-of-the-way position during its travel along the portion of said path remote from said conveyor; and feeding control means adapted to regulate the transfer of spacers from said conveyor to said lowering means whereby the feed of said spacers from said reservoir to said conveyor onto said platform is regulated.

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