

**Supply Feedstock For
Workpiece Finishing Machine**

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Background And Summary Of The Invention

The present invention relates generally to supply feedstocks for workpiece finishing machines and, more particularly, to a supply feedstock having a plurality of individual workpieces successively arranged for separation
5 by a workpiece finishing machine and sequential presentation to a loading means.

Robotic assemblers or loaders are used quite often in the manufacture of the electronic components. Such components include cellular telephones, pagers and the like.
10 In the assembly of these electronic components it is beneficial to have certain portions of a component if not the entire component such as circuit boards assembled by automated machineries such as robotic loaders assemblers and welders. These robotic devices may include an arm which
15 picks up a single part from a predesignated pickup location and moves it to a location where it is subsequently inserted or installed onto a portion of the circuit board or other portion of the electronic component. In order to maintain production line efficiencies, the robots need to have the
20 individual parts repeatedly presented to them in a predesignated orientation and location. Deviation from this orientation and location may result in an electronic component which is lacking a particular part. Many electrical parts used in the assembly of such electronic
25 components are delicate in nature because they are often stamped and formed from a thin sheet metal, and therefore, presenting the parts to a robot by way of a part hopper may

lead to jamming of the overall system and possible damage to the part as well as obvious downtime of the production line.

To achieve a constant flow of parts to a robot, various types of feedstocks have been developed which deliver a plurality of individual parts to an assembly means. Some types of these feedstocks are often referred to as carrier strips or carrier tapes. One such type of carrier tape is known as "debossed tape and reel" and consists of a plastic carrier tape with a plurality of recessed pockets or openings formed therein along the longitudinal extent of the tape. A part is placed in each of the pockets and a plastic sealing tape or bonding tape is adhesively applied to the carrier tape, thereby sealing the parts in their respective pockets. The carrier tape is fed into a robot assembler and the seal tape is peeled away and the part removed and installed. Both the seal tape and the carrier tape are then discharged to waste by the robot. Examples of such constructions are described in U.S. Patent Nos. 4,712,675 and 4,781,953. However, human insertion of the parts into the pockets is often required and the two-part nature of the debossed tape is expensive. Additionally, a specific orientation of the parts in the pocket must also be maintained for pick-up by the robot loader.

Another type of carrier type is known by the tradename of "GPAX" and is described in U.S. Patent Nos. 4,583,641 and 4,757,895. In a GPAX-type structure, a carrier type is provided with a plurality of holes and intervening slots punched into it for its longitudinal extent. The holes are adapted to engage legs or stubs of each electrical part to insure proper and secure positioning of the part on the tape. A plastic bonding tape overlays the carrier tape and parts and is pressed or stitched into the carrier tape between adjacent parts. This bonding tape offers protection

to the parts and retains the parts in place on the carrier tape. This type of carrier tape construction shares certain disadvantages with the debossed tape and reel construction previously described. For example, the assembled tapes are
5 composed of multiple pieces and thus increases the amount of waste generated by the process. Neither of these constructions include or even suggest a carrier type or supply feedstock which is created during the forming of the parts contained within the carrier tape.

10 The present invention is directed to a supply feedstock which overcomes the aforementioned disadvantages and provides benefits not obtainable with the aforementioned constructions.

In accordance with the principles of the present
15 invention, a supply feedstock intended for use in a finishing machine is provided in the form of a succession of individual workpieces, or parts, arranged in sequential order in a continuous coil or belt. The continuous coil takes on the appearance of a bandolier of individual
20 workpieces. The workpieces are arranged in adjacent, or side-by-side, order by a series of webs which interconnect adjacent workpieces along the length of the feedstock. The webs are attached to the workpieces at points where they are easily trimmed off by, for example, a punch press or die in
25 a finishing machine which sequentially separates the workpieces from the feedstock and presents the workpiece to a robotic loader or assembler.

In another principal aspect of the present invention, each web is disposed outside of the general parameter of
30 each workpiece to reduce the amount of waste generated during separation of workpieces from the feedstock as well as to permit the forming of the workpiece in place within

the feedstock. The webs may also contain a suitable means for indexing feedstock within the finishing machine.

In yet another principal aspect of the present invention, each workpiece formed within the feedstock
5 includes a surface which is presented to a robotic loader after trimming of the workpiece from the feedstock. This presentation surface may be planar, or it may be defined by workpiece sidewall portions which form edges of the presentation surface. These sidewalls cooperate with the
10 presentation surface and define an engagement space which is engaged by a part positioning horn or other suitable means of the finishing machine.

Accordingly, it is an ~~object~~ of the present invention to provide an improved supply feedstock for finishing
15 machines which trims a part from the feedstock and presents the part to a robotic loader or assembler.

Another ~~object~~ of the present invention is to provide a supply feedstock containing a plurality of individual workpieces intended for use in a finishing machine having
20 means for separating an individual workpiece from the feedstock and subsequently presenting the workpiece in sequential order to a robotic loader or assembler, wherein the feedstock includes a plurality of individual workpieces arranged sequentially in adjacent fashion and in a
25 predetermined spacing, each of the workpieces being maintained and interconnected with each other by integral, planar webs, which maintain the workpieces in their predetermined spacing.

Yet another ~~object~~ of the present invention is to
30 provide a supply bandolier for a finishing machine wherein the bandoliers in the form of a continuous belt of workpieces arranged in side-by-side order, the workpieces being interconnected by web portions extended between

adjacent workpieces which web portions are discharged to waste during separation of the workpieces from the bandolier, each of the workpieces having a robot presentation surface disposed between the associated web portions, the presentation surface further including an engagement space which is adapted to engage a part presentation means of the finishing machine.

These and other features and ~~objects~~ of the present invention will become apparent from a reading of the following detailed description.

Brief Description Of The Drawings

In the course of the following detailed description, reference will be made to the attached drawings wherein like reference numerals identify like parts and wherein:

FIG. 1 is a plan view of a supply feedstock constructed in accordance with the principles of the present invention;

FIG. 2 is an elevational view of FIG. 1;

FIG. 3 is a general perspective view showing how the supply feedstock of FIG. 1 is constructed;

FIG. 4 is an exploded perspective view, partially in section of an individual workpiece and workpiece positioning means;

FIG. 5 is an elevational view of a workpiece finishing machine adapted to use a supply feedstock of FIG. 1;

FIG. 6 is a plan view of the finishing machine of FIG. 5, with a feedstock engaged by the machine;

FIG. 7 is a cross-sectional view of the machine of FIG. 5. taken along lines 7-7 of FIGS. 5 & 6;

FIG. 8 is a perspective view of an alternate embodiment of a feedstock in accordance with the present invention; and,

FIG. 9 is a plan view of another embodiment of a feedstock in accordance with the present invention;

Detailed Description Of The Invention

5 Referring to the drawings, and in particular FIGS. 1-3, there is shown a supply feedstock 100 constructed in accordance with the principles of the present invention. The feedstock 100 is intended for use in a workpiece finishing machine 10 (shown in FIGS. 5-7) as part of an
10 overall automated production line suitable for the assembly of components which may be handled and assembled by robots such as electronic components.

As illustrated, the feedstock 100 typically takes the form of a bandolier 102 having a plurality of individual
15 workpieces 104 disposed adjacent each other in a side-by-side relationship. The workpieces 104 are interconnected and governed in a predetermined spacing apart from each other by plurality of webs 106 which extend between adjacent workpieces for the entire length of the bandolier 102 in the
20 manner shown. The webs 106 include a generally planar portion 108 which is disposed in a common plane with a surface 110 of each workpiece 104. The webs 106 may further include leg, or stem, portions 109 which extend from the planar portions to adjacent workpieces 104. The webs 106
25 interconnect the head and tail portions, respectively 112a, 112b of each of the work pieces 104.

Each workpiece 104 of the feedstock 100 preferably includes a presentation surface 110. This surface 110 may have multiple edges 112, 114 which extend around the
30 perimeter of the presentation surface 110 and the workpiece 104. The edges 112, 114 may contain integral sidewalls 116, 118 which extend outwardly from the surface 110. As will be noted later, these edges 112, 114 and sidewalls 116, 118

cooperate to define an engagement space, or pocket, 120 of each workpiece 104 which is adapted to receive a workpiece positioning means. Although five sidewalls are shown (including the four sidewalls 116, 118 and the presentation surface 110) as defining the engagement space 120, it will be noted that a lesser number of sidewalls will suffice. The workpiece 104 may also be substantially planar in nature and include a rib (not shown) formed integrally or some other suitable means therein which provides a point or means for engaging a workpiece positioning means.

The bandolier 102 is preferably formed from a thin gauge sheet metal and may be advantageously formed from a coil 130 of sheet metal passing through a progressive die wherein the coil 130 is sequentially stamped and formed into the final feedstock structure as shown in the drawings. It is conceivable that the bandolier 102 and its associated workpieces 104 may be constructed from other suitable materials, such as plastics or composites, depending on the structural characteristics of the materials.

FIG. 3 best illustrates how the feedstock 100 is formed. A metal coil 130 is fed into a progressive die wherein registration, or indexing, openings 121 may be punched into the coil 130 at predetermined locations along the sides 131 of the coil 130. The workpiece 104 is shown in this Figure as a perforated shield and the perforations 132 are formed by successive punches of the die. Next, the workpiece sidewalls 118 which cross a longitudinal axis L of the coil 130 are formed by striking a slot 134 in the coil 130 between the perforated areas 133 which will eventually define the finished workpiece 104. Additional slots 136 are subsequently punched in the opposing sides 131 of the coil 130 which serve to define the sidewalls 116 of the workpiece 104 which do not intersect the axis of the coil but which

may be parallel to such an axis. After the sidewalls 116, 118 are defined in the coil 130, the sidewalls 118 are formed by stamping the same so that they angularly extend away from the surface 110 of the workpiece 104. The
5 remaining sidewalls 116 are similarly stamped so that they also angularly extend away from the surface 110 of the workpiece and such that the four sidewalls 116, 118 cooperate together with the presentation surface 110 to define an engagement space or pocket 120 in each workpiece
10 104.

Returning to FIG. 1, it can be seen that the web planar and leg portions 108, 109 lay outside the edges of the workpieces 104 which are generally parallel to the axis of the bandolier 102. The webs 106 are trimmed from the
15 workpiece 104 when a workpiece 104 is separated from the bandolier 102 in serial order such as by way of a punching or trimming die 32 (FIGS 5 & 6). The webs serve to maintain the workpieces 104 in a predetermined spacing between adjacent workpieces and in a generally parallel relationship
20 which parameters are tailored to the feeding and trimming operations of the finishing machine 10. Additionally, with the feedstock 100 in a bandolier format, it may be easily rolled around a reel for attachment and insertion into a finishing machine 10.

25 Turning now to FIG. 5, a workpiece finishing machine 10 is shown in which the feedstock 100 of the present invention is used to provide individual workpieces 104 for presentation to a robotic loader or assembler 11. This finishing machine 10 is the subject of my co-pending patent
30 application, entitled "Workpiece Finishing and Presentation Machine", Serial No. _____, filed simultaneously herewith. As described in the specification of that application, the finishing machine 10 is preferably

numerically controlled and includes a supply area 12, a feed area 14, a trim area 16 and a workpiece presentation area 18. Generally, the feedstock 100 is fed into the finishing machine 10 and moved to the trimming area 16 whereby a
5 trimming means sequentially separates each workpiece 104 from the feedstock 100 and moves each separated individual workpiece 104 into the positioning area 18 into a predetermined location for pick-up by robotic loader or assembler 11 (shown in phantom).

10 The feedstock 100 is mounted on a supply reel 20 and engages a tensioning roller 22 to apply a preselected amount of tension to the feedstock 100 to prevent the same from prematurely advancing within the machine 10 and to take up any slack which may occur during operation of the machine.
15 The leading edge of the feedstock 100 is threaded into the feed area 14 wherein one or more feedstock clamps 24 engage the feedstock 100, particularly the webs 106 thereof. The clamps 24 are mounted to a sliding means 27 which reciprocates horizontally along the axis of the feedstock
20 100 and machine. When the clamps 24 reciprocate, they engage the webs 106 and move the feedstock along a machine feedpath. Each clamp 24 includes a lower base member 25 which contains a channel 29 defining a passage through which the feedstock 100 passes. The clamps 24 also include
25 vertically reciprocatable cover plates 26 which clamp the part in place during the reciprocating feed movement of the clamps 24. The cover plates 26 also serve to prevent the feedstock 100 from buckling along its length while advancing through the finishing machine 10.

30 Disposed between the feed area 12 and the trim area 16 is a feedstock locating means 28 which includes one or more vertically moveable feedstock indexing pins 30 which are adapted to engage the opening 121 of the feedstock webs 106.

These pins 30 are utilized to ensure proper alignment of the feedstock 100 within the machine 10. The pins 30 are initially inserted into the web openings 121 and the machine 10 is energized. The pins 30 are then released and the
5 machine 10 activated. The feed clamps 24, slider mechanism 27 and positioning means 36 are preferably operated by way of pneumatic pressure regulated by a suitable regulating means and which are synchronized by way of a suitable controller such as a programmable numerical controller.

10 With the feedstock 100 positioned properly, air is supplied to the feed clamps 24 which grip the feedstock and advance it into the trim area 16. The feedstock 100 enters a cutting cylinder 32 wherein a cutting punch 34 is retracted upwardly into a an open or ready position. Simultaneously,
15 a workpiece positioning means 36 advances into a cavity, or nest, 40 located in the cutting cylinder 32 underneath the cutting punch 34. As the die closes, the cutting punch 34 contacts the workpiece 104, it shears off the webs 106 interconnecting the workpieces 104 together at the points on
20 connection between the leg portion 109 and the workpiece 104. Simultaneously, the workpiece 104 is pushed into the nest 40 underneath the cutting cylinder 32 and is forced into engagement with the workpiece positioning means 36, shown illustrated as an air-operated reciprocating part horn
25 42.

The horn 42 is mounted on an air-operated reciprocating carriage assembly 43 which reciprocates in and out of the cutting cylinder 32 along path P. The horn 42 preferably has a configuration generally complementary to the
30 engagement space 120 formed in the workpiece by the sidewalls thereof 116, 118. The horn head 43 enters the workpiece engagement space 120 and engages the presentation surface 110 of the workpiece 104. It simultaneously

retracts downwardly to clear the cutting cylinder 32 while its associated slider mechanism retracts out of the cutting cylinder 32 and into the machine presentation area 18 whereby the horn 42 then extends vertically into a
5 predetermined position for pick up by a robotic loader or assembler 11. The horn 42 may include a workpiece sensor 46 such as an optical sensor 48 disposed within a area of the horn head 44 where a portion of the workpiece overlies it and indicates to the machine controller that a workpiece 104
10 is in place on the horn 42.

FIG. 8 illustrates an alternate embodiment of a feedstock 200 according to the invention, wherein a bandolier 202 of workpieces 204 are interconnected by webs 206 attached to the head and tail portions (or opposing
15 ends) 212a,212b, respectively of the workpieces 204. The workpieces 204 include multiple sidewalls 214,216 which terminate in a lower rim or lip 215 which surrounds the machine engagement space 220 and defines an end thereof. A machine engagement surface 210 is located at the top of this
20 space 220 and it cooperates with the sidewalls 214,216 to define the space 220. The webs 206 include planar portion 208 outside of the workpiece head and tails 212a,212b and are interconnected thereto by legs portions 209.

FIG. 9 illustrates yet another embodiment wherein
25 feedstock 300 has its workpieces 304 arranged in serial and spaced order by continuous webs 306 extending the entire length of the coil 302. The workpieces 304 have an engagement space 320 defined therein by sidewalls 314,316. Legs 309 extend from web planar portions 308 and connect to
30 the workpiece rim 315. The webs and rim lie in a common plane.

Certain advantages and benefits are achieved by the present invention such as a reduction in the overall waste

generated by the finishing process inasmuch as the webs 106 do not extend along the entire length of the bandolier 102 in the form of marginal control strips. Additionally, because the webs 106 maintain a predetermined spacing
5 between adjacent workpieces 104, the bandolier 102 may accommodate non-planar or multi-dimensional workpieces, i.e., ones having a plurality of angularly disposed members, such as sidewalls 116, 118 which cooperate with the engagement surface 110 to define the machine presentation
10 means engagement space 120 without compromising the overall integrity of the feedstock. Additionally, the feedstock webs 106 provide points of engagement for the finishing machine clamps 24 to advance the feedstock 100 through the machine 10.

15 It will be seen that while certain embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art the changes and modifications may be made therein without departing from the true spirit and scope of the invention.



I CLAIM:

1. Supply feedstock intended for use in a workpiece finishing machine for separating a single workpiece from the feedstock and presenting the workpiece to a loading means after separation, wherein said feedstock comprises a plurality of individual workpieces
5 assembled in the form a continuous coil, each individual workpiece having a machine engagement surface, said individual workpieces being disposed side-by-side in a predetermined spacing in a generally parallel relationship with each other and being
10 interconnected successively with one another adjacent opposite ends of said workpieces by an integral web portion extending between said individual workpieces generally perpendicular to said individual workpieces, each said web portion being driven to waste as a
15 separate waste piece when separated from said workpiece.
2. Feedstock of claim 1, wherein each workpiece has two web portions associated with it, one web portion interconnecting one end of a workpiece to an adjacent workpiece and a second web portion interconnecting an
5 opposite end of said workpiece to said adjacent workpiece to maintain said individual workpieces in said predetermined spacing and generally parallel relationship, and wherein said workpieces and said web portions are integrally formed from a metal.
3. Feedstock of claim 1, including two web portions interconnecting adjacent workpieces together, workpiece machine engagement surfaces and said web portions being disposed in a common plane.



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4. Feedstock of claim 1, wherein each of said individual workpieces includes multiple side portions extending outwardly from said machine engagement surface, said side portions and said machine engagement surface cooperating to define an engagement space of said workpiece adapted to receive a presentation means of said finishing machine.
5. Feedstock of claim 4, wherein said side portions are generally perpendicular to said web portions.
6. Feedstock of claim 1, wherein said continuous coil is made of a metal and said workpieces are stamped and formed by a progressive die within said coil.
7. Feedstock of claim 1, further including at least one side portion extending from each of said workpieces generally perpendicularly from said machine engagement surface, said side portions being interposed between said workpieces and said web portions.
8. Feedstock of claim 1, wherein each of said web portions are generally planar members.
9. Feedstock of claim 8, wherein each of said web portions includes two leg members extending from said planar members, the leg members interconnecting said flat planar members to said workpieces.
10. Feedstock of claim 1, wherein said web portions are attached to corners of said workpieces.

11. Feedstock of claim 8, wherein said webs include means for engaging an indexing means of said finishing machine, said indexing means engaging means being disposed in a flat planar portion of said web portions.

12. A bandolier of workpieces intended for use in a workpiece finishing machine for presenting an individual workpiece to an automated workpiece loading means and having means within the machine for separating individual workpieces from the bandolier during the successive presentation of said workpieces to said loading means and discharging a non-workpiece portion of said bandolier to waste during presentation of an individual workpiece, individual workpieces of said bandolier being joined adjacent one another, wherein said bandolier comprises a plurality of individual workpieces assembled in the form of a continuous belt; each workpiece having a presentation surface, the presentation surface being defined by multiple edges of said workpiece, two of said edges extending generally parallel to a longitudinal axis of said belt and two of said edges extending non-parallel to said belt axis, said individual workpieces being disposed generally adjacent another in a predetermined spacing and being interconnected successively with one another adjacent the parallel and non-parallel edges of said workpieces by individual webs, the webs extending between individual workpieces for the length of said bandolier generally parallel to said belt axis, each of said webs being adapted to be discharged to waste as separate waste pieces when separated within said machine from said individual workpieces, said webs



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maintaining said individual workpieces in said predetermined spacing.

13. The bandolier of claim 12, wherein each of said webs includes a planar portion, said planar portions and said workpiece presentation surface being disposed in a common plane.
14. The bandolier of claim 13, wherein said webs further maintain said workpiece presentation surfaces of adjacent workpieces in said common plane within said finishing machine.
15. The bandolier of claim 12, wherein said workpieces and said webs are integrally formed from a metal.
16. The bandolier of claim 12, wherein said webs each include a planar portion and a pair of leg portions extending said planar portion and adjacent workpieces, said planar and leg portions being disposed generally outside said parallel edges of said workpieces.
17. The bandolier of claim 12, wherein said webs include stems attached to said workpieces at intersections of said workpiece parallel and non-parallel edges.
18. The bandolier of claim 12, wherein at least one of said webs includes means for receiving a starting means of said finishing machine.
19. A bandolier of workpieces intended for use in a workpiece finishing machine for presenting an individual workpiece to an automated workpiece loading



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means and having means within the machine for separating individual workpieces from the bandolier during the successive presentation of said workpieces to said loading means and discharging a non-workpiece portion of said bandolier to waste during presentation of an individual workpiece, individual workpieces of said bandolier being joined adjacent one another, wherein said bandolier comprises a plurality of individual workpieces assembled in the form of a continuous belt, each workpiece having a presentation surface, the presentation surface being defined by multiple edges of said workpiece, two of said edges extending generally parallel to a longitudinal axis of said belt and two of said edges extending non-parallel to said belt axis, said individual workpieces being disposed generally adjacent another in a predetermined spacing and being interconnected successively with one another adjacent the parallel and non-parallel edges of said workpieces by individual webs, the webs extending between individual workpieces for the length of said bandolier generally parallel to said belt axis, each of said webs being adapted to be discharged to waste as separate waste pieces when separated within said machine from said individual workpieces, said webs maintaining said individual workpieces in said predetermined spacing, said webs further including a planar portion, the web planar portions and said workpiece presentation surface being disposed in a common plane, said webs further maintaining said workpiece presentation surfaces of adjacent workpieces in said common plane within said finishing machine.



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20. Supply feedstock intended for use in a workpiece finishing machine for separating a single workpiece from the feedstock and presenting the workpiece to a loading means after separation, wherein said feedstock comprises a plurality of individual workpieces
5 assembled in the form a continuous coil, each individual workpiece having a machine engagement surface, said individual workpieces being disposed side-by-side in a predetermined spacing in a generally parallel relation with each other and being
10 interconnected successively with one another adjacent opposite ends of said workpieces by two integral web portions extending between head and tail portions of said individual workpieces generally perpendicular to said individual workpieces, each of said web portions
15 being adapted to be driven to waste as separate waste pieces when separated within said finishing machine, said web portions maintaining said individual workpieces in said predetermined spacing and generally parallel relationship, said web portions including
20 means for engaging an indexing means of said finishing machine, said indexing means engaging means being disposed in a flat planar area of said web portions, said web planar portions defining means cooperating with a feed assembly of said finishing machine to feed
25 said workpieces through said finishing machine.
21. Feedstock of claim 1, including two web portions interconnecting adjacent workpieces together, said workpiece machine engagement surface and said web portions being disposed in different planes.



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22. Feedstock of claim 1, wherein said web portions are attached to opposing ends of said workpieces.
23. The bandolier of claim 12, wherein each of said webs includes a planar portion, and wherein said planar portions and a portion of said workpiece defining an end of said workpiece presentation surface are disposed in a common plane.