

Automatic Defect Detecting/Correcting System for
a Tape-Mounted Electronic Components Assembly

The present invention relates to an automatic defect
5 detecting/correcting system for a tape-mounted electronic
components assembly, which system is designed automatically
to detect various types of defects in the production process
of a tape-mounted electronic components assembly to be used
for the automatic mounting of small electronic components on
10 a printed circuit board, etc., and to correct such detected
defects and wind the tape on a take-up reel.

Fig. 6 shows an example of a tape-mounted electronic
components assembly (hereinafter abbreviated to "Tape A"),
wherein 1 is a tape-like body consisting of cardboard or
15 plastics, the numeral 2 indicates a large number of housing
cavities formed in the body 1 at regular intervals, the
numeral 3 indicates chip resistors and other small electronic
components housed in the cavities 2, and 4 is a top film
consisting of an adhesive tape applied to the body 1.
20 Furthermore, tape feeding perforations 5 are formed along one
side of the body 1 at regular intervals.

Tape "A" automatically receives a small electronic
component 3 in each cavity 2 of the body 1 in a taping machine
and is supplied with a top film 4 thereon, and then discharged
25 to be wound on to a take-up reel. In this case, however, if
any defect is found, it must be manually corrected.

Defect correction of Tape "A" has been conventionally
performed after the tape, produced by the taping machine and
wound on the reel, is transferred to a different place and
30 then manually detected for various types of defects, thereby
making it necessary to retain personnel and a place only for
defect detecting/correcting purposes.

Furthermore, the defect detecting/correcting degree
differs depending upon differences in the skill of the defect
35 detecting/correcting personnel, in the timing of defect
detection, etc., and defective products may be shipped as
conforming products.

Still further, since there is a time lag (of about 1 day to 0.5 days) between a components taping process and a defect detection/correction process, there have been such problems that continuous occurrence of defects due to malfunction of a components taping machine can not be quickly dealt with.

Accordingly, it is an object of the present invention to provide an automatic defect detecting/correcting system for a tape-mounted electronic components assembly, which system is designed to detect and correct defects during the period between the time when a tape-mounted electronic components assembly exits from a taping machine, and the time when it is wound at the take-up section, and is also designed to decrease the risk of overlooking defective portions of a tape-mounted electronic components assembly, to eliminate the necessity for special defect detecting/correcting personnel and a dedicated place for such operations, and to improve on the operating rate of a taping machine so that such problems with conventional defect detecting/correcting methods, as described above, can be resolved.

The present invention consists in an automatic defect detecting/correcting system for a tape-mounted electronic components assembly, comprising a storing section which temporarily stores a length of the tape-mounted electronic components assembly fed from a taping machine producing a tape-mounted electronic components assembly having electronic components carried at regular intervals on a tape, a defect detecting section which detects defects in the tape-mounted electronic components assembly fed from said storing section, a defect correcting section at which detected defects can be corrected, and a take-up section which winds the defect-detected/corrected tape-mounted electronic components assembly on to a reel, the storing section having at least one pair of parallel shafts movable towards and away from each other by drive means and mounting rollers about which the tape-mounted

electronic components assembly is wound in several turns in advancing from the taping machine to the defect detecting section, whereby the length of the tape-mounted electronic components assembly temporarily stored in the storing section is variable by moving the shafts towards and away from one another.

When a sensor detects that the tape-mounted electronic components assembly has been fed into the storing section, the distance or spacing between the parallel shafts of the storing section gradually becomes larger, whereby the tape-mounted electronic components assembly which is wound onto the rollers of the parallel shafts, preferably in the same direction, for subsequent feeding to the defect detecting section, is gradually and temporarily stored in this storing section.

When defect detection from externally of the tape is started by the defect detecting section, causing the tape-mounted electronic components assembly to be withdrawn from the outlet of the storing section, the process is detected by a sensor, causing the parallel shafts of the storing section to start closing together, as a result of which the tape-mounted electronic components assembly temporarily stored in the storing section moves towards the defect detecting section. The tape-mounted electronic components assembly which has passed through the defect detecting section, then moves on towards the defect correcting section. In this defect correcting section, various types of defects are manually corrected and, while the defects are being corrected, this portion of the tape-mounted electronic components assembly must be brought to a stop.

However, while a tape-mounted electronic components is stopped in this defect correcting section, it is also being continuously fed into the storing section from the taping machine. Since the distance between the parallel shafts in the storing section is gradually made larger during this period so that the tape-mounted electronic components assembly is temporarily stored, it is unnecessary to stop the taping machine.

When defect correction of the tape-mounted electronic components assembly is completed in the defect correcting section and the tape-mounted electronic components assembly is then wound on to the take-up reel of the tape take-up section, the parallel shafts in the storing section gradually come closer, thereby dispensing the tape mounted electronic components assembly from the storing section.

In order that the present invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is a side elevational view showing an automatic defect detecting/correcting system according to the present invention,

Figure 2 is an enlarged perspective view of a first embodiment of the storing section,

Figure 3 is an enlarged perspective view of a second embodiment of the storing section,

Figure 4 is an enlarged side view of a defect detecting section,

Figure 5 is an enlarged perspective view of the defect correcting section, and

Figure 6 is an enlarged, partially cutaway view in perspective of an example of a tape-mounted electronic components assembly.

As illustrated in Figure 1, an automatic defect detecting/correcting system for a tape-mounted electronic components assembly consists of a storing section 12 where a length of Tape "A" exiting from a taping machine 11 is temporarily stored, a defect detecting section 13 which detects various types of defects of the Tape "A" coming out of the storing section 12, a defect correcting section 14 where the defects detected in the defect detecting section 13 are corrected, and a take-up section 15 where the thus defect-detected/corrected Tape "A" is wound up on to a take-up reel.

As shown in Fig. 2, the first embodiment of the storing section 12 is such that a pair of fixed shafts 22,23 are arranged one behind the other in horizontal, parallel and upper positions of the case 21, with movable horizontal shafts 24,25 being arranged under each of these shafts 22,23. Each movable shaft 24,25 is arranged to be lifted by means of an appropriate drive means so that it moves towards and away from its associated fixed shaft 22,23 in the upper section of the case.

This first embodiment is also such that a length of Tape "A" can be temporarily stored on a plurality of rollers 26,27,28 & 29, provided in shafts 22,23,24,25 in a freely rotatable manner, by winding the Tape "A" going towards the defect detecting section 13 from the taping machine 11, about each of these rollers 26,27,28 & 29 several turns in the same direction, and by allowing each pair of shafts 22,24 and 23,25 to depart from the positions where each associated pair of shafts is close together.

Either of the rollers 26,28 at the input side transmits a signal to the lift drive means of the movable shafts 24,25 when Tape "A" is fed from the taping machine 11, in order to serve as detecting rollers at the input side which allow the movable shafts 24,25 to be simultaneously lowered from the lifted position.

When an external defect detecting examination of the tape is started, thereby moving Tape "A" out to the output side, either of the rollers 27,29 at the output side detects this process and transmits a signal to the lift drive means of the movable shafts 24,25, in order to serve as detecting rollers at the output side which allow the movable shafts 24,25 to be lifted.

Fig. 3 illustrates a second embodiment of the storing section 12, which has such a configuration that a fixed shaft 22 and a movable shaft 24 are arranged, as a set, in the upper

and lower positions of the case 21, respectively in order to allow the movable shaft 24 to move towards or away from the fixed shaft 22 in a horizontal condition by means of an appropriate drive means, with Tape "A" being wound successively about a plurality of rollers 26,28 provided on the fixed shaft 22 and also on the movable shaft 24 so as temporarily to store a length of the tape.

In this second embodiment, a sensor at the output side is provided at a roller at the outlet side of either the fixed shaft 22 or the movable shaft 24.

The number of sets of fixed and movable shafts 22, 24 provided in the storing section 12 is not limited to those given in the first and second embodiments, and a multiple number of sets may be acceptable. The larger the number of sets of fixed and movable shafts, the longer is the length of Tape "A" that can be temporarily stored.

The number of sets of fixed and movable shafts is preferably even and this allows Tape "A" to be aligned in line at the inlet and outlet of the storing section, thus providing for advantages of space.

Furthermore, the sensors to be provided at the input and output sides of Tape "A" are not necessarily required to be equipped on the fixed shaft 22 and the movable shaft 24, and a detecting roller or a sensor may be separately provided.

In the storing section 12 as described above, the concept that a tape-mounted electronic components assembly "A" is wound between the fixed shaft 22 and the movable shaft 24 in the same direction, is extremely useful for the tape-mounted electronic components assembly "A".

As shown in Fig. 6, a tape-mounted electronic components assembly "A" houses chip-like small electronic components 3 in cavities 2 of a tape-like body 1, with a top film 4 being applied over the entire top surface of the tape-like body 1 or with perforations 5 avoided. Therefore, when a tape-mounted electronic components assembly "A" is wound round the fixed shafts 22, 23 and the movable shafts 24, 25 of the storing section 12 in the same direction, the top film 4 will always be positioned on the outer periphery, thereby allowing the top film 4 to be pushed against the tape-like body 1, as a result of which dislocation of the top film 4 can be eliminated and damage of the tape-like body 1 accordingly prevented.

Furthermore, when a tape-like body 1 is made of cardboard and its folding direction is not constant, peeling of the tape-like body 1 takes place, resulting in a defect. However, when it is folded in only the one direction, such peeling can be prevented.

Still further when a tape-mounted electronic components assembly "A" is folded in only the one direction, it will be necessary to form perforations 5 only on one side of the tape-like body 1, thereby making it possible to apply a top film 4 on the entire top surface with an adhesive, as a result of which such advantages as

increased productivity and firm adhesion of the top film 4 on a tape, etc. are obtained.

Fig. 4 shows details of a defect detecting section 13, wherein the numerals 30 and 31 are tape feed rollers, either of which is to be provided with a backstop clutch (not shown).

The numerals 33 and 34 are a pair of front and rear film defect sensors. Tape "A" between the feed rollers 30, 31 is bent downwards by a plurality of, for example, 5 guide rollers 35, 36, 37, 38 & 39, thus forming a circular arc. The numeral 41 is a sensor for detecting defects and positional failure of components.

The defect correcting section 14 as described above consists, as shown in Fig. 5, of a flat plate 45, and Tape "A" passes across this flat plate 45 and about a sprocket 46 for tape drive and is then wound on a take-up reel 48.

On the outer periphery of the sprocket 46, a plurality of projections 47 are provided for engagement with perforations 5 of Tape "A" so that Tape "A" can be wound on the take-up reel 48 with no slippage caused.

Furthermore, the reel 48 is driven by a torque motor (not shown) so that undue force is not imposed on Tape "A" even when travel of Tape "A" is stopped for defect correcting work, etc.

In the aforementioned embodiments, when Tape "A" is fed from the taping machine 11 into the case 21 through the inlet hole 50 of the case 21 shown in Fig. 2, a detecting roller at the input side detects this process, whereby the movable shafts 24, 25 start lowering at the same time and after Tape "A" is wound on each roller 26 of the fixed shaft 22

provided in the upper section of the case 21 at the input side and also on each roller 28 of the movable shaft 24 provided in the lower section of the case 21 at the input side while curving in the same direction, it is further wound on each roller 27 of the fixed shaft 23 provided in the upper section of the case 21 at the output side and also on each roller 29 of the movable shaft 25 provided in the lower section at the output side while curving in the same direction, thus storing Tape "A" in the storing section.

When a defect detecting operation of the tape is started and Tape "A" advances towards the defect detecting section 13 through the outlet hole 51, the detecting roller at the output side detects it, thereby causing the movable shafts 24, 25 to start lifting, as a result of which Tape "A" is formed into an arc by the rollers 35 thru 39 between the feed rollers 30, 31 of the defect detecting section 13, and it passes through the defect correcting section 14 and the sprocket 46, and is then wound on the reel 48.

In the aforementioned defect detecting section 13, adhesion failure of the top film 4 is detected by light reflection from a raised area of the film 4 at the defective components, with sensors 33, 34 being reflective optical sensors, because the top film 4 is a transparent body.

When a defect is detected, it is necessary to stop this defective portion of Tape "A" on the flat plate 45 of the defect correcting section 14 for subsequent correction thereof. At this time, the take-up reel 48 and the sprocket 46 are caused to stop.

Thus, the taping machine 11 is still operating even when Tape "A" is caused to stop, and Tape "A" can be temporarily stored in the storing section 12 by allowing the movable shafts 24, 25 of the storing section 12 to gradually lower during this period.

When defect correction is completed, the sprocket 46 is rotated again to wind up Tape "A" on the take-up reel 48.

The present invention provides the advantages enumerated as below, through the configuration and operation as described above.

An automatic defect detecting/correcting system for a tape-mounted electronic components assembly according to the present invention is so configured that a tape-mounted electronic components assembly coming out of a taping machine is temporarily stored in the storing section, and detected for defects in the defect detecting section and that when a defect is detected, it is corrected in the defect correcting section and then wound at the take-up section. Therefore, in comparison with the conventional method of detecting and correcting defects in a different place, the present invention provides an advantage of reducing possibilities that defective components are overlooked and shipped. Furthermore, it also offers another advantage of reducing the number of defect detecting/correcting personnel.

A still further advantage is that, as a tape-mounted electronic components assembly is continued to be temporarily stored in the storing section, it is not necessary to stop a taping machine even when a tape is temporarily stopped for

defect correction, take-up reel change or other purposes,
thus improving the operating rate of the taping machine.

CLAIMS

1. An automatic defect detecting/correcting system for a tape-mounted electronic components assembly, comprising a storing section which temporarily stores a length of the tape-mounted electronic components assembly fed from a taping machine producing a tape-mounted electronic components assembly having electronic components carried at regular intervals on a tape, a defect detecting section which detects defects in the tape-mounted electronic components assembly fed from said storing section, a defect correcting section at which detected defects can be corrected, and a take-up section which winds the defect-detected/corrected tape-mounted electronic components assembly on to a reel, the storing section having at least one pair of parallel shafts movable towards and away from each other by drive means and mounting rollers about which the tape-mounted electronic components assembly is wound in several turns in advancing from the taping machine to the defect detecting section, whereby the length of the tape-mounted electronic components assembly temporarily stored in the storing section is variable by moving the shafts towards and away from one another.
2. A system according to claim 1, wherein the tape-mounted electronic components assembly comprises chip-like electronic components.
3. A system according to claim 1 or 2, wherein the tape-mounted electronic components assembly has a top film on the top surface of its tape which covers the electronic components.
4. A system according to claim 1, 2 or 3, wherein the storing section comprises a plurality of pairs of said parallel shafts movable towards and away from each other and the tape-mounted electronic components assembly is successively wound about the pairs of parallel shafts.



5. A system according to any preceding claim, wherein the tape-mounted electronic components assembly is wound about the parallel shafts of the storing section in the same direction.
6. A system according to any preceding claim, wherein means
5 which detects the input and output of the tape-mounted electronic components assembly and also which controls movement of the parallel shafts towards and away from each other by operating the drive means are provided respectively at the inlet and outlet sides of the storing section.
- 10 7. An automatic defect detecting/correcting system of a tape-mounted electronic components assembly substantially as hereinbefore described with reference to the accompanying drawings.
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