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METHOD FOR RESTRICTING AN EXCESSIVE TENSION DEVELOPING
IN NARROW METALLIC BAND IN CUTTING SYSTEM FOR SLITTING
A METALLIC STRIP INTO THE METALLIC BANDS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a method for restricting an excessive tension developing in a narrow metallic band when a metallic strip comes to a sudden stop in a cutting system for slitting the metallic strip into a plurality of the metallic bands, and more particularly to a method for restricting, at low cost, an excessive tension developing in a metallic band when the metallic strip comes to a sudden stop in a cutting system thereof, wherein: the metallic strip is unwound from an unwinding roll and slitted into a plurality of narrow metallic bands through a slit; and, each of the narrow metallic bands is wound on each of a plurality of winding rolls not provided with a brake mechanism.

DESCRIPTION OF RELATED ART

Fig. 11 shows a conventional cutting system 50 for a metallic strip 51. The cutting system 50 is for slitting, under tension, the strip 51 of metal such as copper, copper alloys, SUS (including those plated with tin) and like metals at high speed to traverse-wind the thus slitted strip 51, i.e., to wind the slitted strip 51 in the same manner as that of the line wound on a bobbin. In general, the system 50 comprises: an unwinding roll 52 of the metallic strip 51 with a predetermined width; a slit 54 for slitting, under tension, the metallic strip 51 thus unwound from the unwinding roll 52 into a plurality of narrow metallic bands

53; and, a plurality of winding rolls 56 with no brake mechanism, each for traverse-winding the metallic band 53 thereon.

In front of the slitter 54, there is provided an inspection unit 58 for detecting a fault such as scratches, stains and the like in a surface of the metallic strip 51 to issue a detection signal 61, which brings the metallic strip 51 to a sudden stop before the fault of the metallic strip 51 reaches the slitter 54. Some of the fault may be readily removed by an operator of the system 50. In this case, the operator stops the metallic strip 51 to remove such fault, which enables the metallic strip 51 to become a fine product.

The fault in the surface of the metallic strip 51 is detected in the inspection unit 58 which in turn issues the detection signal 61 to a control panel 60. Upon receipt of such detection signal 61, the control panel 60 issues a stop signal 62 to both the unwinding roll 52 and the slitter 54, which brings the metallic strip 51 to a sudden stop before the fault in the surface of the metallic strip 51 reaches the slitter 54, so that the fault of the metallic strip 51 comes to a stop at the operator's position 64.

The metallic bands 53 thus slitted by the slitter 54 are directed by a separator 66 to their corresponding winding rolls 56 and traverse-wound thereon at the positions of from Nos. 1 to 5.

Fig. 13 is a graph showing the relationship between: elapsed time (in seconds) after the stop signal 62 is issued from the control panel 60 to both the unwinding roll 52 and the slitter 54; and, the speed (m/min) of the metallic strip 51 in operation. As shown in Fig. 13, operation of the sudden stop is performed along the graph passing a plurality of points A, B, C and D. At the point A, the operation of the sudden stop starts after the fault of the

metallic strip 51 is detected by the inspection unit 58. In a part of the graph between the points A and B, a considerable deceleration of the metallic strip 51 occurs so that the speed of the metallic strip 51 decreases from 150 m/min to 0 m/min in only 2 seconds. On the other hand, in another part of the graph between the points B and C, the metallic strip 51 is moved at a low speed of 5 m/min. At the point C, the substantially same magnitude of deceleration as that of deceleration in the part of the graph between the points A and B occurs again in the metallic strip 51, so that the metallic strip 51 comes to a stop at the point D.

The reason why the part of the graph between the points B and C in which the metallic strip 51 is moved at the low speed is as follows: namely, if the stop of the metallic strip 51 is completed at the point B shown in Fig. 13, the metallic strip 51 moves reverse by the amount of approximately 20 mm reacting to its inertia progress. In other words, when such reverse motion of the metallic strip 51 occurs at the slit 54 (see Fig. 14), the metallic strip 51 has its same portion cut twice, which produces burrs. In order to avoid such production of burrs, the metallic strip 51 is moved at the low speed in the part of the graph between the points B and C to offset the reverse motion of the metallic strip 51 reacting to the inertia progress thereof.

In the conventional cutting system 50 having the above construction, a distance between: the inspection unit 58 in which the fault in the metallic strip 51 is detected; and, the operator's position 64 is set at approximately 4 m. In this condition, it is possible for the control signal issued from the control panel 60 to bring the metallic strip 51 to a stop at the

operator's position 64 immediately before the slit 54, without fail.

The metallic strip 51 and the metallic bands 53 described above will be hereinafter referred to also as the workpiece. When the workpiece is brought into a sudden stop in the conventional cutting system 50 described above, a tension imposed on the workpiece varies as shown in the graph of Fig. 15, which shows the graph obtained in the winding roll 56 at a position No. 1 shown in Fig. 12, wherein: a tension of the workpiece 51 in its winding operation is set at 5 Kg; and, the speed of the workpiece 51 is set at 150 m/min.

As shown in Fig. 15, when the sudden stop of the workpiece starts at a point a, the tension imposed on the workpiece increases immediately thereafter, and reaches approximately 60 Kg at a point b to become an excessive tension. Under such excessive tension, the workpiece fluctuates or hunts as shown in a part of the graph of Fig. 15 between a point b and a point c. Then, at a point d, the workpiece is released from its tension. After that, the tension imposed on the workpiece increases to an excessive level again at a point f just before the complete stop of the workpiece. Then, in a part of the graph of Fig. 15 between the point f and a point g, the workpiece hunts again. After such hunting, the workpiece comes to a stop, thereby stabilizing its tension. The substantially same graph as that described above in Fig. 15 may be obtained as to the workpiece in each of winding rolls 56 disposed in the remaining positions Nos. 2 to 5.

On the other hand, in the conventional cutting system 50 described above, as shown in Fig. 12, the workpiece travels along a straight line between the unwinding roll 52 and the separator

66. However, after passing the separator 66, since the reference positions of the winding rolls 56 are arranged on the substantially same line as is clear from Fig. 12, the workpiece traveling between the separator 66 and each of the winding rolls 56 has its edge portion brought into contact with both a flange (not shown) of the separator 66 and a flange 68a of the tension detecting roll 68, as shown in Fig. 16. As described above, when the workpiece, i.e., each of the metallic bands 53 has its traveling direction aligned with a pass line of the corresponding winding roll 56, the workpiece is brought into contact with both the flange (not shown) of the separator 66 and the flange 68a of the tension detecting roll 68 as shown in Fig. 17(a). Consequently, there is a fear that the workpiece has its edge portion bent or broken widthwise as shown in Fig. 17(b) when the workpiece of thin thickness and largely tilted widthwise relative to the rotation axis of the tension detecting roll 68 comes to sudden stop. From experiments, it is known that the workpiece is bent or broken when a tension of approximately 60 Kg is developing in the workpiece having a thickness of 0.15 mm.

Thus, it is apparent that the need exists for a method for restricting an excessive tension developing in a metallic band or workpiece in a cutting system, wherein there is no fear that the workpiece is subjected to an excessive tension of more than 60 Kg even when the workpiece comes to a sudden stop.

In view of the above need in the prior art, it is an object of the present invention to provide at low cost a method for restricting an excessive tension developing in a narrow metallic band in a cutting system thereof, wherein: the metallic strip is slitted into a plurality of the metallic bands; and, each of the

metallic bands is then wound on each of a plurality of winding rolls provided with no brake mechanism.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, the above object of the present invention is accomplished by providing:

In a method for restricting an excessive tension developing in a narrow metallic band or workpiece having a predetermined width in a cutting system for slitting a metallic strip into a plurality of the narrow metallic bands through a slitter, wherein the metallic strip is unwound from an unwinding roll; each of the narrow metallic bands is wound on each of a plurality of winding rolls not provided with a brake mechanism; and, an inspection unit is provided in front of the slitter to detect a fault in the metallic strip, so that the metallic strip is brought to a sudden stop before the fault reaches the slitter, whereby the fault is removed from the metallic strip, the improvement comprises:

reducing an excessive tension, which develops in each of the metallic bands under action of the sudden stop, to a moderate value by the utilization of a mechanical loss which is caused in a drive motor of the winding roll when the drive motor is de-energized upon occurrence of a sudden-stop signal.

Such mechanical loss caused in the drive motor serves as a braking force on the drive motor to effect a stop of the winding roll in operation, which reduces the magnitude of the tension developing in the metallic band or workpiece, so that the workpiece is released from the excessive tension developing therein.

According to a second aspect of the present invention, the above object of the present invention is accomplished by providing:

In a method for restricting an excessive tension developing in a narrow metallic band or workpiece having a predetermined width in a cutting system for slitting a metallic strip into a plurality of the narrow metallic bands through a slitter, wherein the metallic strip is unwound from an unwinding roll; each of the narrow metallic bands is wound on each of a plurality of winding rolls not provided with a brake mechanism; and, an inspection unit is provided in front of the slitter to detect a fault in the metallic strip, so that the metallic strip is brought to a sudden stop before the fault reaches the slitter, whereby the fault is removed from the metallic strip, the improvement comprises:

reducing an excessive tension, which develops in each of the metallic bands under action of the sudden stop, to a moderate value by decreasing the magnitude of deceleration of the metallic strip by increasing a stopping distance of the metallic strip defined between the inspection unit and a stop position of the fault of the metallic strip.

When an initial speed and a final speed (stop) of the workpiece are the same in respective stoppage, it is possible to decrease the magnitude of deceleration of the workpiece by increasing a distance between: a position in which a fault in the workpiece is detected; and, a stop position of the fault along the production line of the workpiece. When the magnitude of deceleration of the workpiece is decreased in a manner described above, the workpiece or metallic band is released from the

excessive tension, which is developing in the metallic band when the metallic strip comes to a sudden stop.

According to a third aspect of the present invention, the above object of the present invention is accomplished by providing:

The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in the first or the second aspect of the present invention, wherein:

when the metallic strip comes to the sudden stop, in order to compensate for a reverse motion of the workpiece reacting to its inertia progress, the workpiece is moved at a low speed for a predetermined period of time before the workpiece comes to a stop; and

after the drive motor slows down, and at a time when the workpiece travels at a speed of from 25 to 35 m/min before the workpiece is moved at the low speed, the drive motor is energized again.

By energizing the drive motor again before the workpiece is moved at the low speed, it is possible for the winding roll to slightly wind the metallic band, which prevents the metallic band from slacking in a condition in which the metallic band is released from any tension. Consequently, it is possible to prevent the metallic band from being subjected to an excessive tension, which is developing when the metallic band having slacked is subjected to an impulsive drive.

According to a fourth aspect of the present invention, there is provided:

The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in the third aspect of the present invention, wherein:

the sudden-stop signal and/or a low-speed operation signal of the metallic strip are/is sequentially controlled so that a speed graph of the workpiece forms a smooth curve.

Since the tension developing in the metallic strip depends on acceleration or deceleration of the same strip, it is possible to decrease the magnitude of acceleration or deceleration of the workpiece by sequentially controlling the sudden-stop signal and/or the low-speed operation signal so as to have the speed graph of the workpiece form a smooth curve.

According to a fifth aspect of the present invention, the above object of the present invention is accomplished by providing:

The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in the third and the fourth aspect of the present invention, wherein:

the low speed is in a range of from 10 to 30 m/min.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of the cutting system for the metallic strip, in which system the method of the present invention for restricting the excessive tension is carried out according to the first aspect of the present invention.

Figs. 2(a), (b) and (c) are graphs illustrating the relationship between the current supplied to the drive motor (not shown) of the winding roll and torque applied to the winding roll, wherein (a) shows the characteristics of the ideal motor with no mechanical loss in operation, (b) shows the characteristics of the

existing motor with a mechanical loss in starting operation thereof, and (c) shows the characteristics of the existing motor with a mechanical loss in winding operation thereof.

Fig. 3 is a graph illustrating the relationship between: each of the tension (Kg) developing in the metallic band when the drive motor (not shown) of the winding roll is de-energized at the same time when the sudden-stop signal is issued and the speed (m/min) of the metallic strip; and, lapsed time (second).

Fig. 4 is a graph showing variation of the tension when the sudden-stop signal and/or the low-speed operation signal of the metallic strip is sequentially controlled to realize the smooth curve of 0.5 second.

Fig. 5 is a graph showing variation of the tension when the sudden-stop signal and/or the low-speed operation signal of the metallic strip is sequentially controlled to realize the smooth curve of 1.0 second.

Fig. 6 is a graph showing variation of the tension when the low speed is set at 15 m/min.

Fig. 7 is a graph showing variation of the tension when the low speed is set at 20 m/min.

Fig. 8 is a graph showing variation of the tension when the deceleration between the points C and D is set at 20 m/min/sec.

Fig. 9 is a graph showing variation of the tension when the deceleration between the points C and D is set at 10 m/min/sec.

Fig. 10 is a cross-sectional view of the inspection unit for carrying out the second embodiment of the method of the present invention for restricting the excessive tension.

Fig. 11 is a schematic diagram of the conventional cutting system for the metallic strip.

Fig. 12 is a plan view of the cutting system shown in Fig. 11.

Fig. 13 is a graph illustrating the relationship between the speed (m/min) of the metallic strip and elapsed time (second) when the metallic strip comes to a sudden stop.

Fig. 14(a) and (b) are schematic diagrams of the slitter to explain how the workpiece moves reverse by approximately 20 mm as reaction against the inertia progress of the workpiece.

Fig. 15 is a graph illustrating the relationship between: the current supplied to the drive motor (not shown) of the winding roll, the speed (m/min) of the metallic strip and the tension of the workpiece; and, time (second) when the metallic strip comes to a sudden stop in the conventional cutting system.

Fig. 16(a) and (b) are a sectional view taken along the line X-X of Fig. 12 and a longitudinal sectional view of the metallic strip in an area of the winding roll, respectively.

Fig. 17(a) and (b) are schematic diagrams of the workpiece brought into contact with the tension detecting roll, illustrating the principle of breakage of the workpiece on the tension detecting roll.

THE BEST MODE FOR EMBODYING THE INVENTION

Hereinbelow, a method of the present invention for restricting an excessive tension developing in a narrow metallic band 21 in a cutting system 10 for slitting a metallic strip 11 into a plurality of the metallic bands 21 will be described in detail with reference to its preferred embodiments shown in the accompanying drawings.

Fig. 1 is a schematic diagram of the cutting system 10 for the metallic strip 11, in which a method of the present invention

for restricting an excessive tension developing in the metallic band 21 is carried out.

In general, the cutting system 10 shown in Fig. 1 comprises: a coil car 14 for carrying an unwinding roll 12 of the metallic strip 11 having a predetermined width; an inspection unit 16; a drier 18; a welder 20; a cutter stand 24 for carrying a slitter 22 which slits the metallic strip 11 into a plurality of the narrow metallic bands 21; a separator 26; and, a bobbin car 30 for carrying a winding roll 28 on which each of the metallic bands 21 is wound.

Provided adjacent to the coil car 14 are a paper winder 13a, a return-workpiece winder 13b, and a snubber roll 13c. On the other hand, provided in the cutter stand 24 are: a scrap winder 24a on which a scrap is wound; and, a plurality of director rolls 24b for directing the plurality of the metallic bands 21 to the separator 26. The tension developing in each of the metallic bands 21 is detected by a tension detecting roll 27, which is disposed between the separator 26 and the winding roll 28. When a fault in a surface of the metallic strip 11 is detected by the inspection unit 16, the unit 16 issues a detection signal 33 to a control panel 34. Upon receipt of such detection signal 33, the control panel 34 issues a sequence-control signal 36 to both the unwinding roll 12 and the slitter 22, and also issues a control signal 40 to the winding roll 28, so that the metallic strip 11 is controlled to have its fault come to a stop at the operator's position 32 in which the operator checks the fault of the metallic strip 11 and takes a necessary remedy for the fault.

The method of the present invention for restricting the excessive tension developing in the workpiece (11, 21) is characterized in that: an excessive tension developing in the

metallic band 21 when the metallic strip 11 comes to a sudden stop is reduced to a normal value by the utilization of a mechanical loss, which is caused in a drive motor (not shown) of the winding roll 28 after the drive motor is de-energized upon occurrence of a sudden-stop signal. Fig. 2 is a graph illustrating the relationship between: the current supplied to the drive motor (not shown) of the winding roll 28; and, torque applied to the winding roll 28 in its winding operation. In Fig. 2: (a) is a graph showing the characteristics of an ideal motor free from any mechanical loss in operation; (b) is a graph showing the characteristics of an existing motor with a mechanical loss in its starting operation; and, (c) is a graph showing the characteristics of the existing motor with the mechanical loss in its winding operation. Since any one of the existing motors can't be free from a mechanical loss caused therein in operation, it is not possible to realize the characteristics of the ideal motor shown in Fig. 2(a). In the present invention, the mechanical loss caused in the existing motor shown in Figs. 2(b) and 2(c) is considered as a hint to the method of the present invention. Namely, the method of the present invention is characterized in that: in a cutting system for the metallic strip, which system is provided with a low-cost winding roll with no braking function, the drive motor (not shown) of the winding roll 28 is de-energized upon occurrence of the sudden-stop signal, and a mechanical loss caused in the drive motor thus de-energized is used as a braking force in operation.

Fig. 3 shows variation of both tension (Kg) developing in the workpiece and its speed (m/min) with elapsed time (second) when the drive motor (not shown) of the winding roll 28 is de-energized upon occurrence of the sudden-stop signal. In

comparison with the graph shown in Fig. 15 as to the conventional cutting system, it is clear that: in the method of the present invention, an initial value of the excessive tension developing in the metallic band 21 at the point A immediately after a starting point of deceleration of the metallic strip 11 is reduced from 60 Kg to 50 Kg which is of a safe tension as to the metallic band 21. Further, the second occurrence of excessive tension developing in the metallic band 21 at the point f of Fig. 15 in the conventional cutting system disappears from the graph of Fig. 3 obtained according to the method of the present invention.

As described above, in the method of the present invention according to the second aspect thereof, the excessive tension, which develops in each of the metallic bands 21 under action of the sudden-stop operation, is reduced to a moderate value by decreasing the magnitude of deceleration of the metallic strip 11 by increasing a stopping distance of the metallic strip 11, which distance is defined between the inspection unit and a stop position of the fault of the metallic strip 11. More particularly, as shown in Fig. 10, a by-pass idle roller 16a is provided inside the inspection unit 16 in a position under the pass line of the metallic strip 11 to form a by-pass line having a length of approximately 1500 mm, which makes it possible to increase the stopping distance of the metallic strip 11 described above. As a result, the magnitude of deceleration of the metallic strip 11 decreases, so that a tension developing in the metallic strip 11 (i.e., workpiece) also decreases in proportion thereto.

Incidentally, in the method of the present invention according to the first aspect thereof, as described above, since the metallic band 21 is released from any tension during its low-speed

operation, the metallic band 21 often slacks in operation. When the thus slacked metallic band 21 is subjected to a tension again, it is known that an impulsive or excessive tension is imposed in such metallic band 21 (see the point f of Fig. 15). In the preferred embodiment of the method of the present invention for restricting the excessive tension, in order to avoid such impulsive tension, after the drive motor (not shown) of the winding roll 28 slows down in operation, and at a time when the workpiece (11, 21) travels at a speed of from 25 to 35 m/min before the workpiece is moved a low speed, the drive motor (not shown) of the winding roll 28 is energized again. By energizing such drive motor of the winding roll 28 before the workpiece is moved at the low speed, it is possible for the winding roll 28 to slightly wind the metallic band 21 thereon, which makes it possible to prevent the metallic band 21 from slacking even when the tension developing in the metallic band 21 disappears.

Further, in another preferred embodiment of the method of the present invention for restricting the excessive tension, the sudden-stop signal and/or the low-speed operation signal 36 are/is sequentially controlled so that the speed graph of the workpiece smoothly curves. Since the magnitude of tension developing in the metallic strip 11 depends on variation of speed of the same metallic strip 11, it is possible to decrease the magnitude of deceleration of the metallic strip 11 by sequentially controlling the sudden-stop operation signal 36 so as to have the speed graph of the workpiece form a smooth curve. This substantially eliminates the initial excessive tension which appears at the point b immediately after the point A at which the metallic strip 11 slows down in speed. Figs. 4 and 5 show

variation of the tension of the metallic strip 11 when the sudden-stop signal and/or the low-speed operation signal 36 are/is sequentially controlled so that the speed graph of the workpiece smoothly curves, wherein: the graph of Fig. 4 is of a smooth curve of 0.5 second; and, the graph of Fig. 5 is of a smooth curve of 1.0 second. In any one of the graphs shown in Figs. 4 and 5, the magnitude of tension developing in the metallic band 21 is limited to approximately 40 Kg at maximum, which is of a safe tension for the metallic band 21, and, therefore there is no fear that the metallic band 21 is broken.

Further, since slacking is caused in the metallic band 21 due to its reaction against a sudden-release from an intensive tension after completion of the low-speed operation, it is possible to prevent the tension of the workpiece from completely disappearing by sequentially controlling the low-speed signal 36 so as to have the speed graph of the workpiece assumes a smooth shape so that the tension of the workpiece is gradually decreased. As is clear from Figs. 4 and 5, in case of the sequence control for having the speed graph of the workpiece form the smooth curve of 0.5 second, it is clear that some reaction of the workpiece against such sudden-release from the intensive tension is still observed. However, in case of the sequence control for having the speed graph of the workpiece form the smooth curve of 1.0 second, it is clear that no reaction of the workpiece against such sudden-release from the intensive tension is observed. In other words, in case of the sequence control for having the speed graph of the workpiece form a smooth curve of at least 1.0 second, it is clear that such slacking problem of the metallic band 21 resulted from the release of tension after completion of the low-speed

operation is solved. Consequently, in the method of the present invention, there is no fear that the metallic band 21 is subjected to an impulsive or excessive tension, which is imposed on the metallic band 21 when the band 21 is driven again in its slacked condition. In this respect, the method of the present invention is advantageous.

Further another preferred embodiment of the method of the present invention for restricting the excessive tension is characterized in that: the low speed at which the workpiece is moved is in a range of from 10 to 30 m/min. In the embodiment shown in Fig. 4, the low speed of the workpiece is approximately 5 m/min. Under such circumstances, the second occurrence of the excessive tension appears in the last stage of the low-speed operation, which stage corresponds to the point f shown in Fig. 15. Now, referring to the graphs shown in Figs. 6 and 7, a tension developing in the workpiece at a low speed of 15 m/min is approximately 45 Kg, and a tension developing in the workpiece at a low speed of 20 m/min is up to approximately 30 Kg. In either case, the tension is in a safety range in which the metallic band 21 is not bent or damaged. In the graph shown in Fig. 7, the control signal 40 for de-energizing the drive motor (not shown) of the winding roll 28 is issued together with the sudden-stop signal 36. Further, the sudden-stop signal and/or the low-speed operation signal 36 for the metallic strip 11 is subjected to the sequence control so as to have the speed graph of the workpiece form the smooth curve of 0.5 second. Further, the drive motor (not shown) of the winding roll 28 is energized again when the workpiece is driven at a speed of 30 m/min.

Still further another preferred embodiment of the method of the present invention for restricting the excessive tension is characterized in that: the low speed of the workpiece is set at 20 m/min; and, then the deceleration of the workpiece is set at 20 m/min/sec and at 10 m/min/sec in the section between the points C and D. In either case, any excessive tension is not observed in the last stage of the low-speed operation, which stage corresponds to the point f shown in Fig. 15. The tension developing in the workpiece in this case reaches up to 30 Kg.

In the method of the present invention for restricting the excessive tension of the metallic band 21 in the cutting system 10 for slitting the metallic strip 11, when the drive motor (not shown) of the winding roll 28 is de-energized, the magnitude of the excessive tension developing in the metallic band 21 upon sudden stop of the metallic strip 11 is reduced to a normal value by the utilization of a mechanical loss caused in the thus de-energized drive motor. Consequently, it is possible to carry out the method of the present invention at low cost in an easy manner only by changing the operation mode of the winding roll 28 through an appropriate control system. In this respect, the method of the present invention is advantageous.

In the method of the present invention for restricting the excessive tension developing in the metallic band 21 in the cutting system 10 for slitting the metallic strip 11, the magnitude of the excessive tension developing in the metallic band 21 upon sudden stop of the metallic strip 11 is reduced to a normal value by increasing the stopping distance defined between the inspection unit and a stop position in which the fault of the workpiece stops, thereby decreasing the magnitude of deceleration of the

workpiece. Consequently, it is possible to carry out the method of the present invention in an easy manner at low cost by forming the by-pass line having a predetermined length with the use of, for example such as the idle roller 16a, which is provided under the conventional pass line of the workpiece to increase the stopping distance described above. In this respect, the method of the present invention is advantageous.



WHAT IS CLAIMED IS:

1. In a method for restricting an excessive tension developing in a narrow metallic band or workpiece having a predetermined width in a cutting system for slitting a metallic strip into a plurality of said narrow metallic bands through a slit, wherein said metallic strip is unwound from an unwinding roll; each of said narrow metallic bands is wound on each of a plurality of winding rolls not provided with a brake mechanism; and, an inspection unit is provided in front of said slit to detect a fault in said metallic strip so that said metallic strip is brought to a sudden stop before said fault reaches said slit, whereby said fault is removed from said metallic strip, the improvement comprises:

reducing an excessive tension, which develops in each of said metallic bands under action of said sudden stop, to a moderate value by the utilization of a mechanical loss which is caused in a drive motor of said winding roll when said drive motor is de-energized upon occurrence of a sudden-stop signal.

2. In a method for restricting an excessive tension developing in a narrow metallic band or workpiece having a predetermined width in a cutting system for slitting a metallic strip into a



plurality of said narrow metallic bands through a slit, wherein said metallic strip is unwound from an unwinding roll; each of said narrow metallic bands is wound on each of a plurality of winding rolls not provided with a brake mechanism; and, an inspection unit is provided in front of said slit to detect a fault in said metallic strip, so that said metallic strip is brought to a sudden stop before said fault reaches said slit, whereby said fault is removed from said metallic strip, the improvement comprises:

reducing an excessive tension, which develops in each of said metallic bands under action of said sudden stop, to a moderate value by decreasing the magnitude of deceleration of said metallic strip by increasing a stopping distance of said

metallic strip defined between said inspection unit and a stop position of said fault of said metallic strip.

3. The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in claim 1 or 2, wherein:

when said metallic strip comes to the sudden stop, in order to compensate for a reverse motion of said workpiece reacting to its inertia progress, said workpiece is moved at a low speed for a predetermined period of time before said workpiece comes to a stop; and

after the drive motor slows down, and at a time when said workpiece travels at a speed of from 25 to 35 m/min before said workpiece is moved at the low speed, said drive motor is energized again.



4. The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in claim 3, wherein:

said sudden-stop signal and/or a low-speed operation signal of said metallic strip are/is sequentially controlled so that a speed graph of said workpiece forms a smooth curve.

5. The method for restricting the excessive tension developing in the metallic band in the cutting system, as set forth in claim 3 or 4, wherein:

said low speed is in a range of from 10 to 30 m/min.

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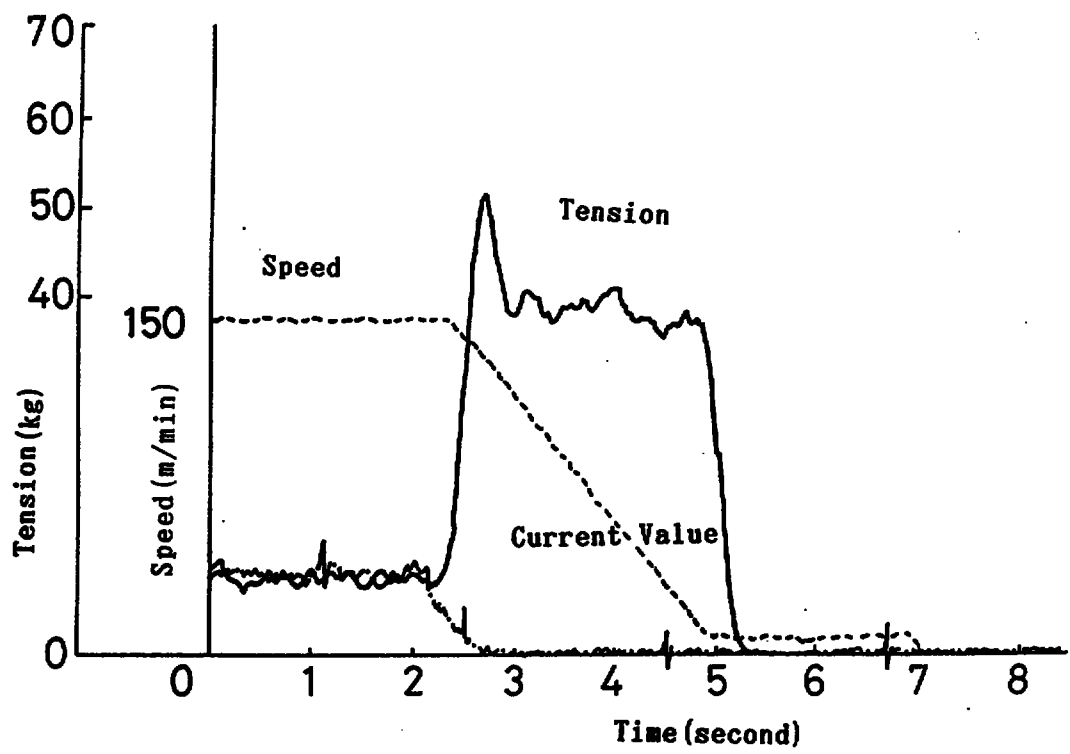
ABSTRACT

In a method for restricting an excessive tension developing in a narrow metallic band or workpiece having a predetermined width in a cutting system for slitting a metallic strip into a plurality of said metallic bands through a slitter, wherein a metallic strip 11 having a predetermined width is unwound from an unwinding roll 12; the metallic strip 11 thus unwound is then slitted into a plurality of narrow metallic bands 21 by means of a slitter 22; the metallic bands 21 are wound on a plurality of corresponding winding rolls 28 provided with no brake mechanism; an inspection unit 16 is disposed in front of the slitter 22 to detect a fault in a surface of the metallic strip 11; and, the fault of the metallic strip 11 is then removed by bringing the metallic strip 11 to a sudden stop before the fault reaches the slitter 22 in the cutting system 10 for the metallic strip 11, wherein an excessive tension developing in the metallic band 21 upon sudden stop of the metallic strip 11 is reduced in magnitude to a safe value by de-energizing the drive motor (not shown) of the winding roll 28 upon occurrence of a sudden-stop signal to utilize a mechanical loss of the drive motor (not shown) of the winding roll 28 as a braking force.

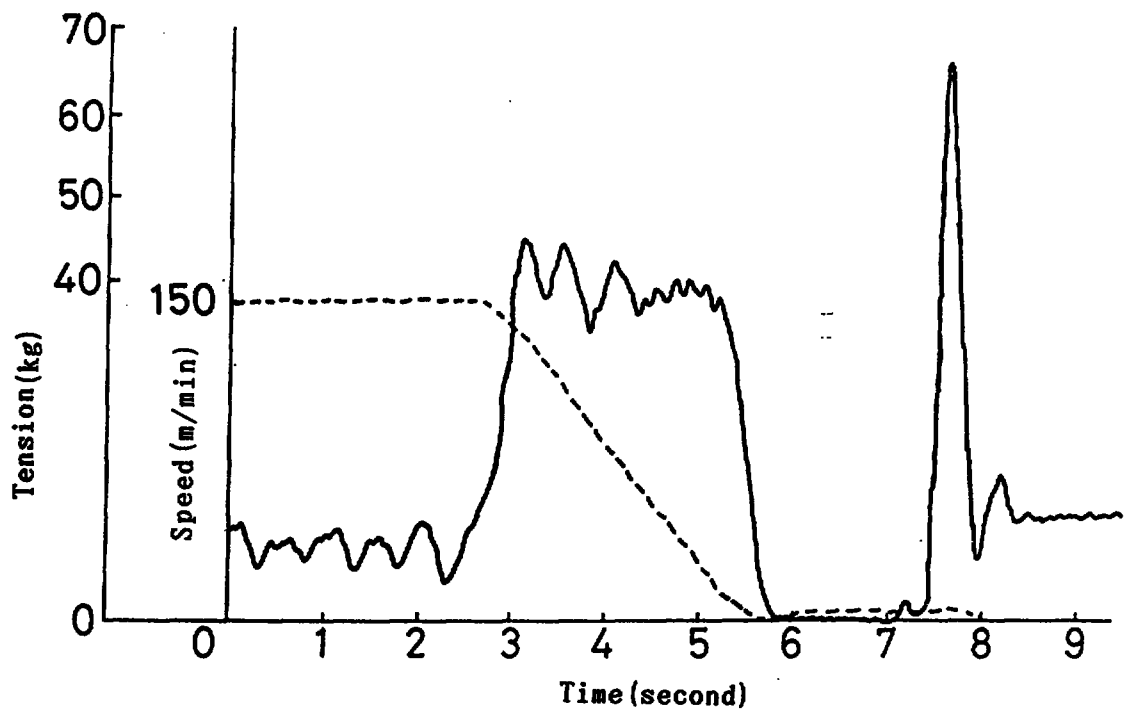
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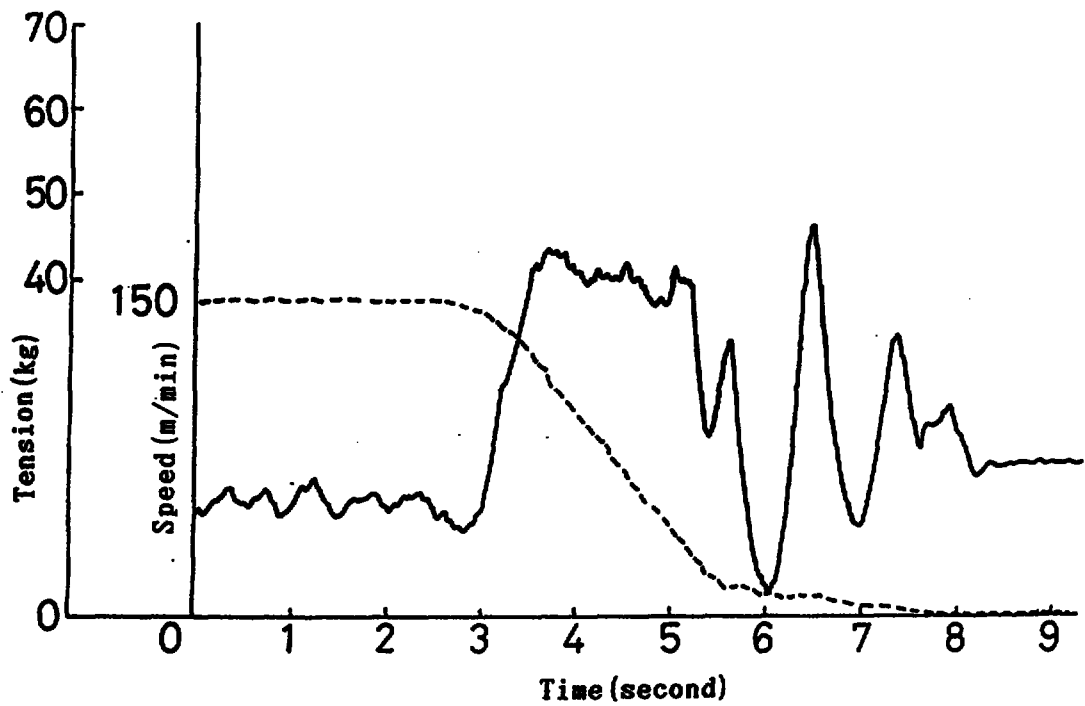
F i g . 3



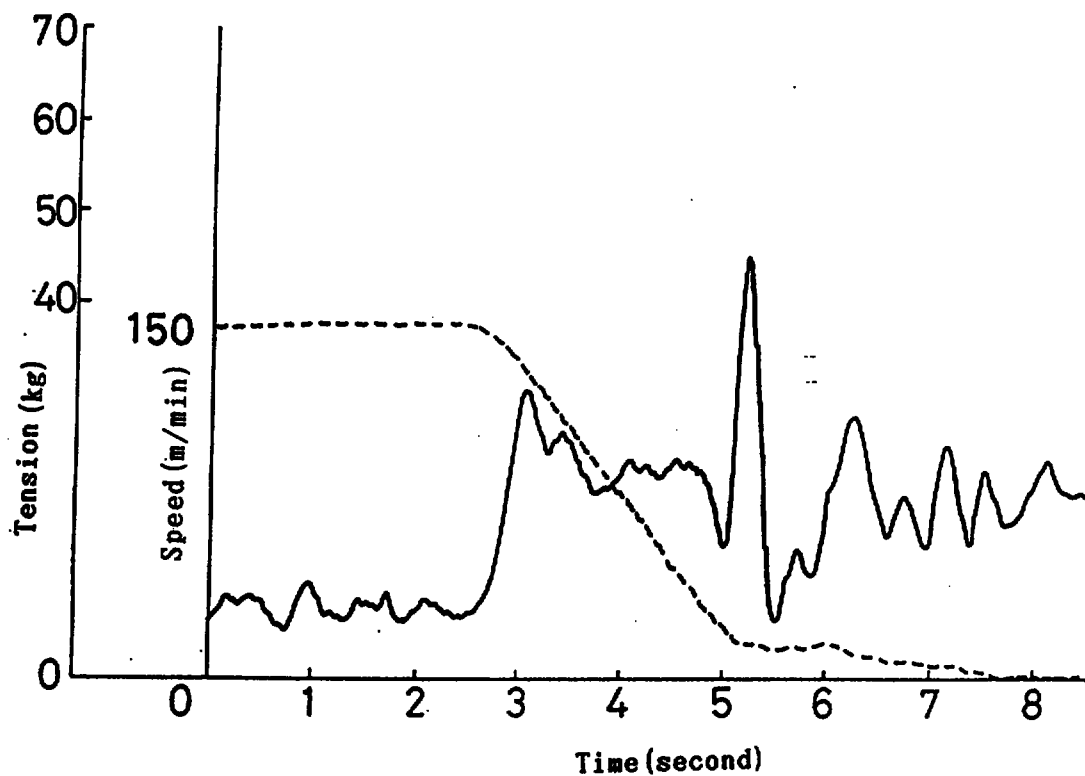
F i g . 4



F i g . 5



F i g . 6



F i g . 7

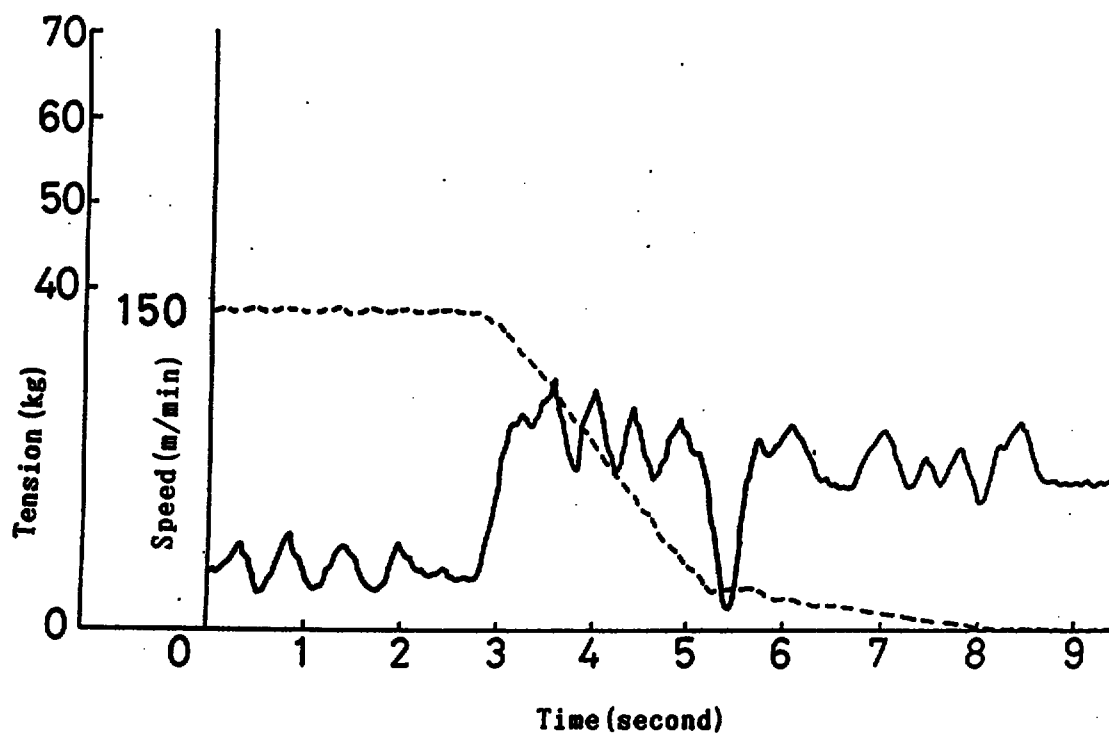


Fig. 8

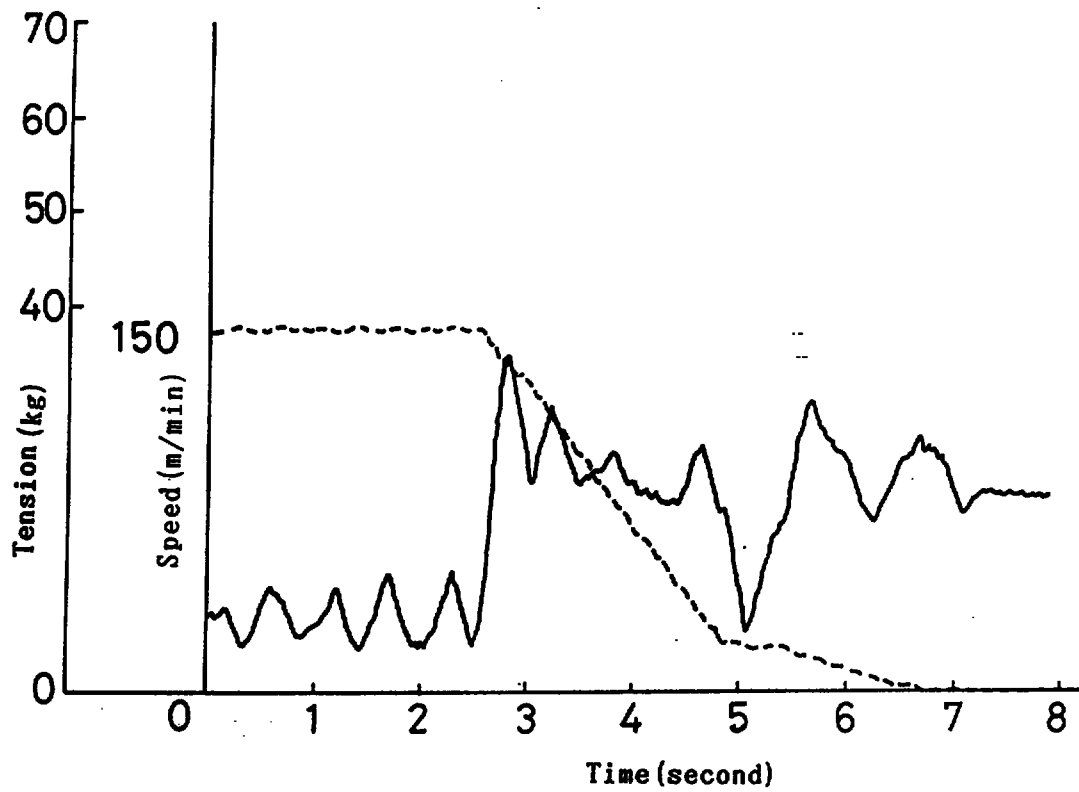


Fig. 9

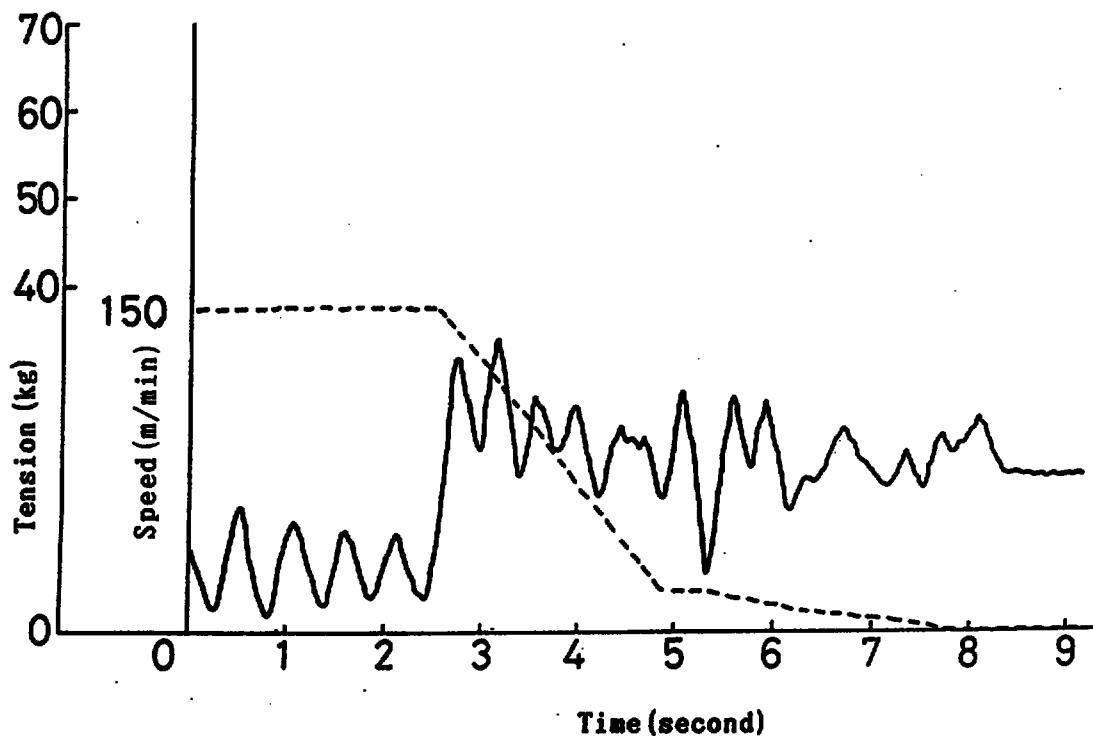


Fig. 10

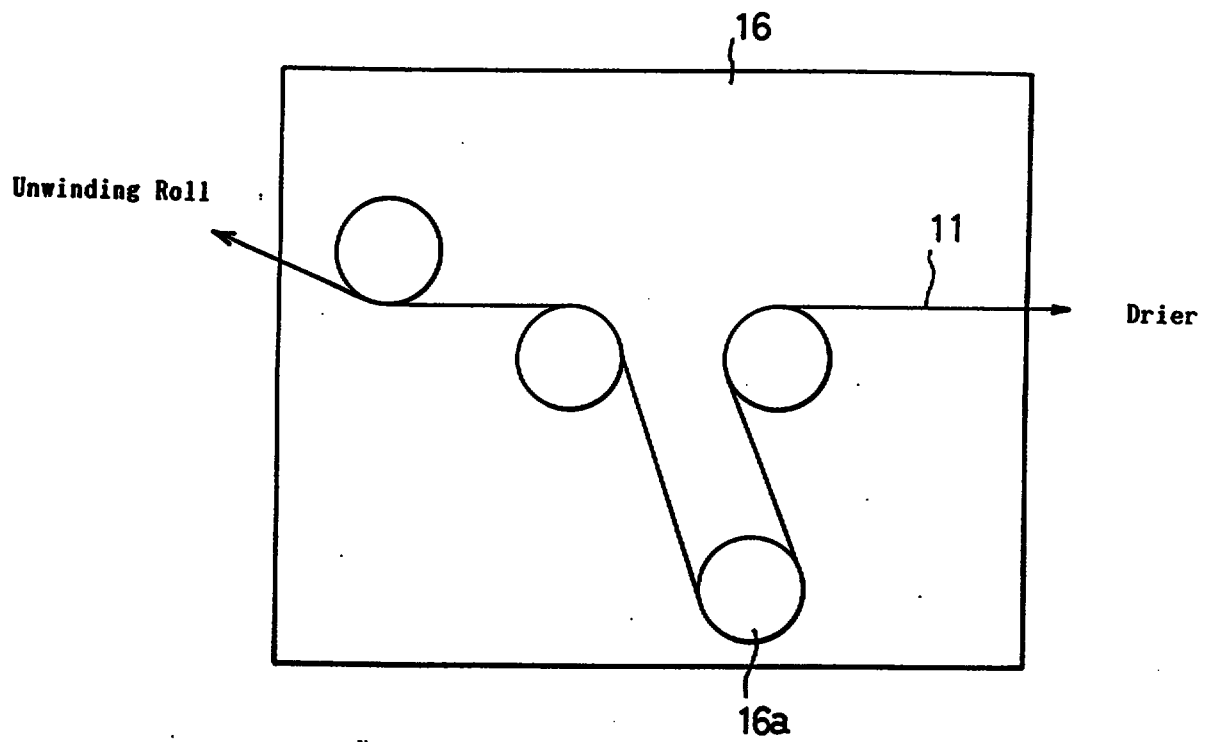


Fig. 11

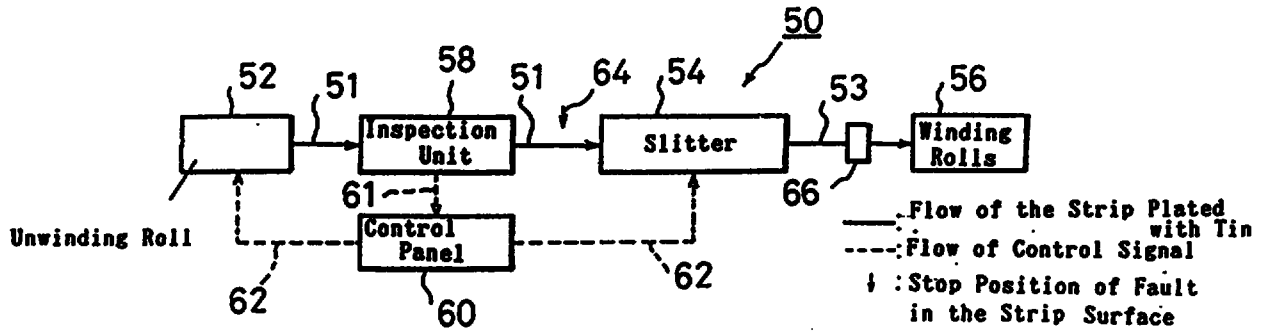


Fig. 12

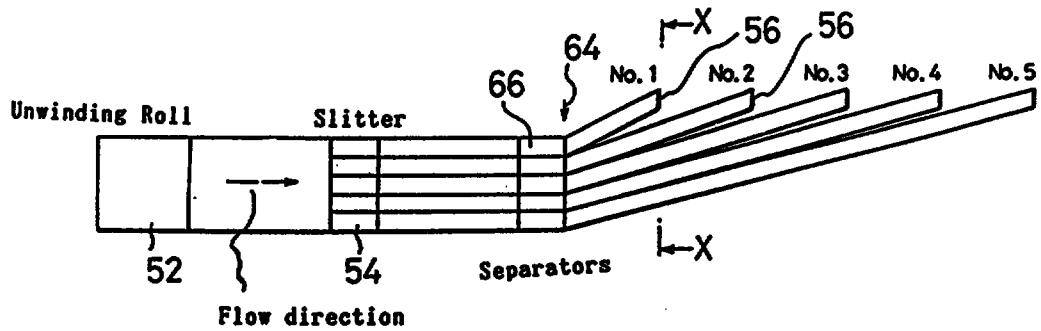
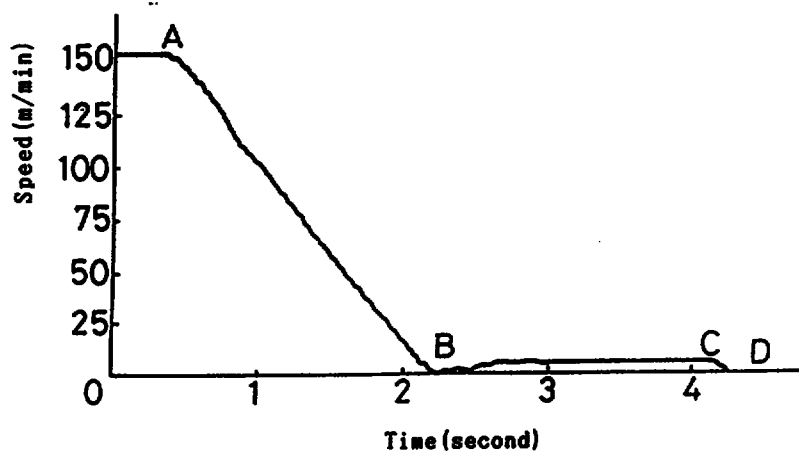
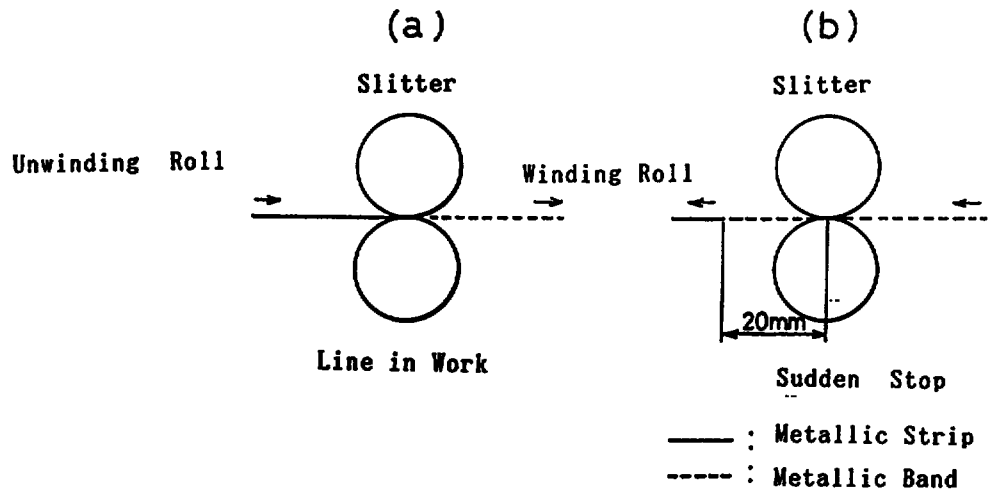


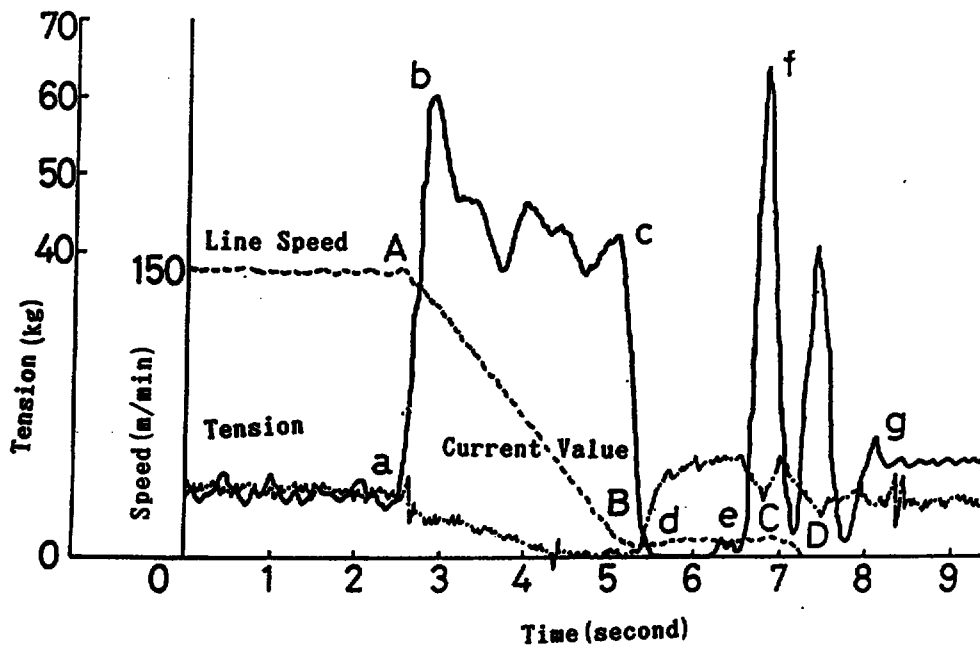
Fig. 13



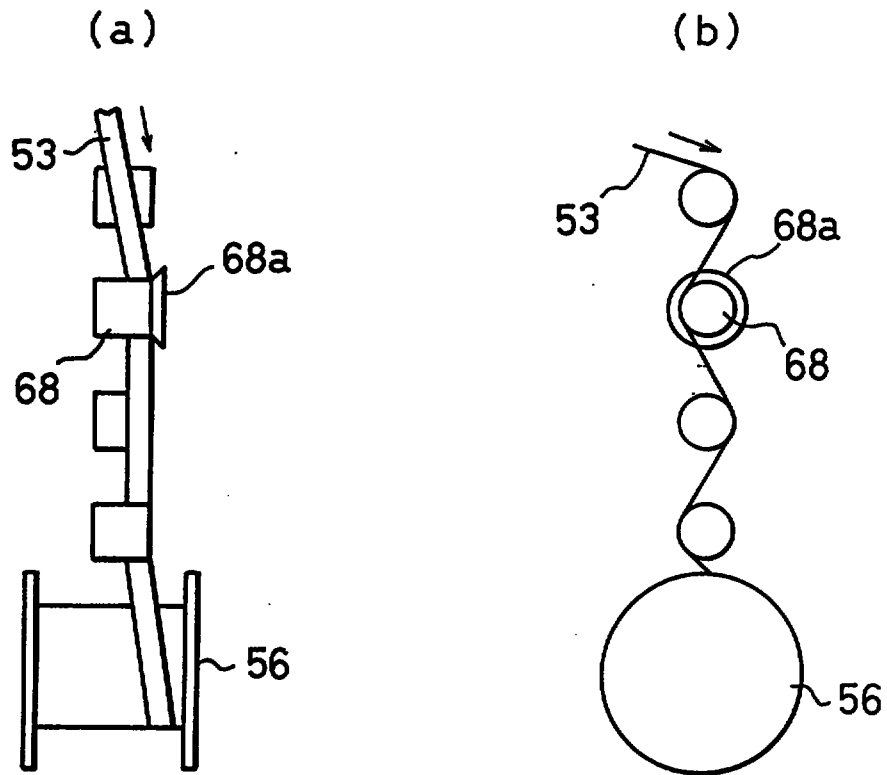
F i g . 1 4



F i g . 1 5



F i g . 1 6



F i g . 1 7

