United States Patent

Yabuta

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[54] **METHOD OF AND APPARATUS FOR CUTTING A METAL WEB UTILIZING AN ELECTRO-MAGNETIC INDUCTION TYPE FEEDING APPARATUS**

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[58] **Field of Search**....83/35, 36, 219, 220, 256, 268, 83/269, 401, 402, 404, 357, 419, 255, 408, 321; 271/63 A, 18 A, DIG. 3; 198/41

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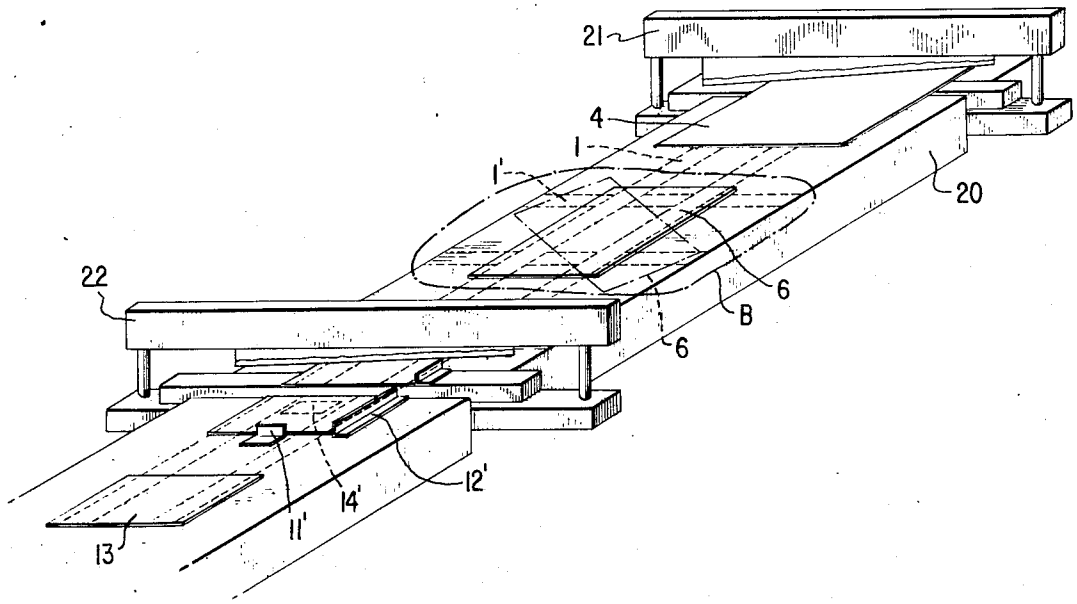
[57] **ABSTRACT**

The method and apparatus of the present invention utilize an electromagnetic induction-type feeding apparatus for advancing a metal web and pieces cut therefrom. In one embodiment, the metal web is advanced in one direction and cut into pieces of a predetermined length. The cut pieces are then advanced in a direction transverse to the one direction and are again cut to form pieces of a desired size and shape. In a second embodiment, the web and pieces cut therefrom are advanced in one direction only, and after pieces are initially cut from the web by a first cutter, the pieces are rotated in a horizontal plane through a desired angle and are then advanced to a second cutter where they are cut to a desired size and shape.

5 Claims, 2 Drawing Figures



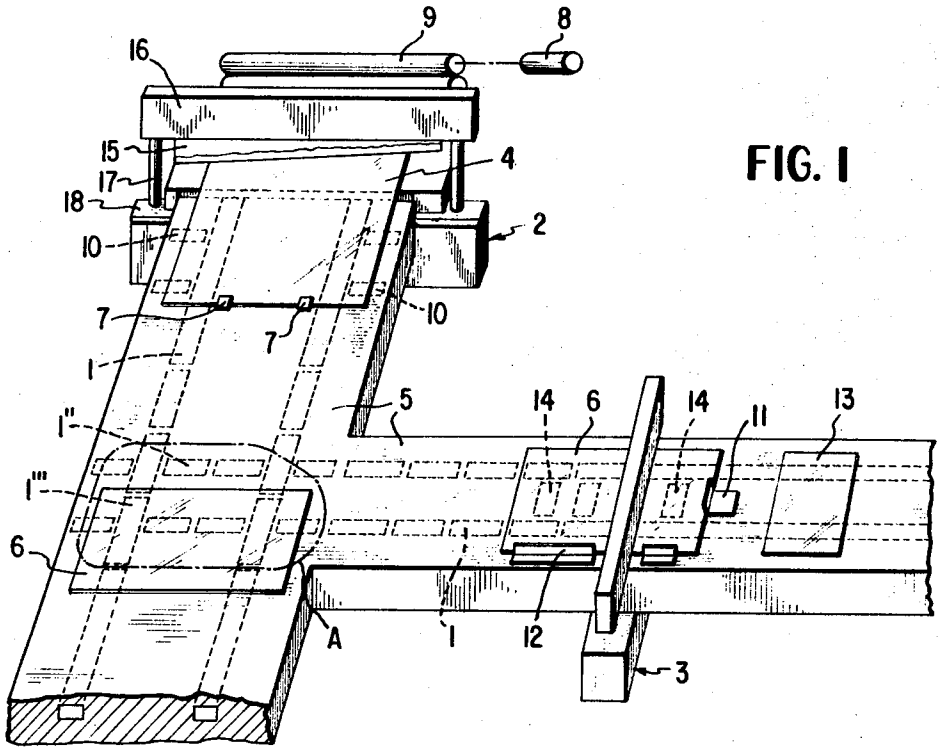
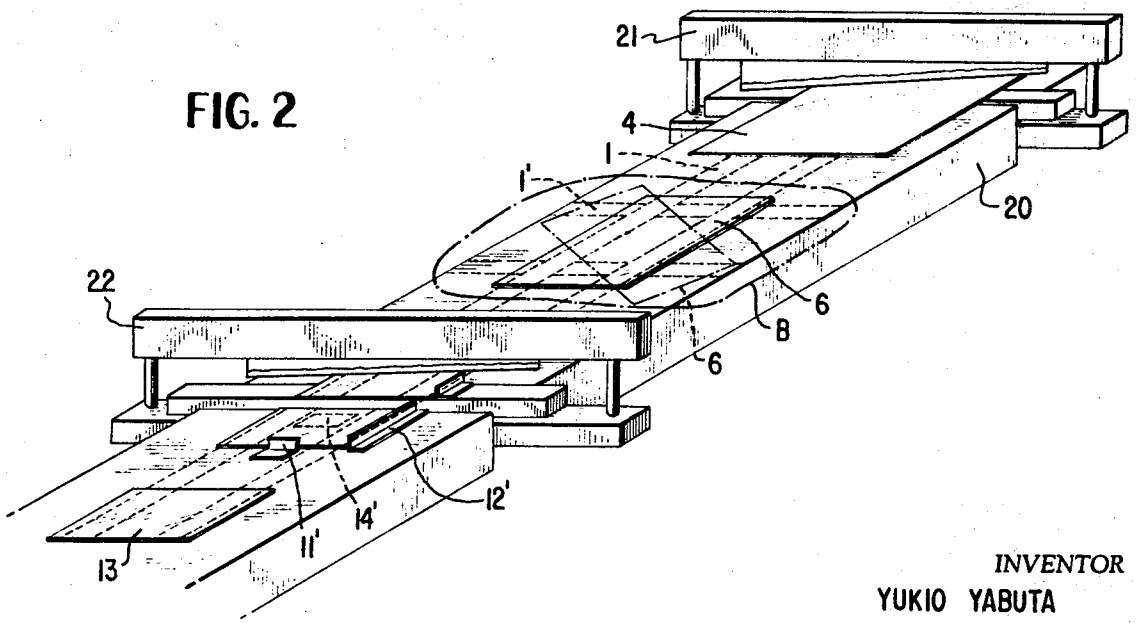


FIG. 1

FIG. 2



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METHOD OF AND APPARATUS FOR CUTTING A METAL WEB UTILIZING AN ELECTRO-MAGNETIC INDUCTION TYPE FEEDING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a method of and apparatus for cutting a metal web into desired dimensions and with high efficiency utilizing a feeding apparatus of the electro-magnetic induction type.

With respect to conventional methods for cutting metal webs, the slit-cut method and the guillotine methods are well known and have been put into practice. The former, the slit-cut method, is a method for cutting the web just after the web is slit by a slitter, wherein the slitter and the cutter are arranged in series and the web continuously supplied to the slitter is slit by the slitter having slitting blades with a predetermined spacing, and the web is cut by the cutter disposed downstream of the slitter just after the web is slit. Thus, the metal web is slit and cut into sheet type metal pieces of predetermined size. The latter, the guillotine method, is a method for first cutting the metal web and second guillotining the cut web into desired sheet type metal pieces, wherein the supplied metal web is cut transversely by a cutter and the cut sheets of the metal are stacked and guillotined into sheet type metal of desired size and shape.

In the above described conventional methods, there are inevitable disadvantages as hereinafter described.

In the slit-cut method, since the position of and the spacing between the slitting blades are fixed, it takes a fairly long time to change the positions of the slitting blades and to change the width of the slit metal. In some cases, this requires the stopping of the entire system for slitting and cutting the metal web. Further, in case one of the blades in the set of the slitting blades in the slitter becomes damaged, the entire system must be stopped before the damaged blade can be replaced with a new one. In the case of slitting a thick metal web, the blades of the slitter should be of the gang slit type. If one of the blades of the gang slit type slitting blades should require replacement with a new one, the whole set of blades must be replaced with a new set. This replacement not only takes a long time, but it is also very difficult to change the size of the slitted metal because of complexity of the size changing operation. Still further, in the slit-type method for cutting the metal web, wherein a thin metal web is to be cut, the slitter should be operated in the burst-cut type method. In such a case, the loss of the metal web in cutting operation is large, and it is difficult to change the slitting width of the metal web.

In the guillotine method, while it is comparatively easy to change the size of the sheet metal made by the apparatus utilizing the cutter and guillotine, it is very difficult to make the cutter and the guillotine operate in one operational line to cut the metal web into the desired size of sheet metal continuously in the line. In other words, it is very difficult to provide a metal cutting system for automatically cutting the metal web into the desired or controlled size of sheet metal utilizing the above-described cutter and guillotine from the viewpoint of mechanical construction. Further, in the guillotine method for cutting the metal web, there is a large loss of material resulting from guillotining the edge portions of the cut metal.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide a method for cutting a metal web utilizing an electro-magnetic induction type feeding apparatus which is easily capable of changing the size of the cut sheets of metal.

Another object of the present invention is to provide a method for cutting a metal web utilizing an electro-magnetic induction type feeding apparatus wherein the cutting blades are easily replaced.

Still another object of the present invention is to provide a method for cutting a metal web utilizing an electro-magnetic induction type feeding apparatus wherein the cutting size can be changed while operating the cutting mechanism, that is, without stopping the operation of the system.

A further object of the present invention is to provide an apparatus for carrying out the above-described method for cutting the metal web.

In order to achieve the above-described objects of the present invention, the method in accordance with the present invention utilizes an electro-magnetic induction type feeding apparatus for feeding the metal web horizontally and includes a step of feeding the metal web in one direction to cut the web transversely and another step of feeding the metal web in the direction transverse to said one direction to cut the once cut metal longitudinally. In another embodiment of the present invention, the electro-magnetic induction type feeding apparatus is arranged to feed the web in one direction only and to rotate each piece of metal through a desired angle after the first cut and prior to the second cut.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing an embodiment of the apparatus used in the method for cutting the metal web in accordance with the present invention, and

FIG. 2 is a perspective view showing another embodiment of the apparatus used in the method for cutting the metal web in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, showing an embodiment of the apparatus used in the method of the present invention, the electro-magnetic induction type feeding apparatus is shown at 1 arranged in crossed or transversely intersecting relationship. The crossed or intersecting portion of the electro-magnetic induction type feeding apparatus is shown with the reference character A. A first cutter 2, called "X-cutter" hereinafter, is disposed at the upstream end of the conveyor line 5, called "X-line" hereinafter, for cutting the supplied metal web 4 transversely to the direction of advancement. The metal web 4 is advanced longitudinally on the X-line and the X-cutter 2 cuts the web 4 transversely at predetermined intervals. The conveyor line 5 has an extending portion carrying the said electro-magnetic induction type feeding apparatus 1 therein and being located in transverse relationship with the X-line. This transversely extending portion of the conveyor line 5 is called the "Y-line" hereinafter. The Y-line is provided

with a second cutter 3, called the "Y-cutter" hereinafter. The metal web 4 is transversely cut into pieces of predetermined size by the X-cutter 2 and then is fed longitudinally up to the crossed portion A. The cut pieces shown at 6 in FIG. 1, are moved transversely to the direction of the X-line by the electro-magnetic feeding apparatus in the Y-line, when they reach the portion A, and are then advanced along the Y-line up to the position where the Y-cutter is disposed. Electro-magnetic feeding apparatus of the type shown in U.S. patents to Von Stark et al. U.S. Pat. No. 3,554,670 and Beamish U.S. Pat. No. 2,767,823, may be employed in conjunction with the method and apparatus of the present invention, such magnetic induction feeding means being themselves conventional. When the cut pieces of metal 6 reach the Y-cutter, they are cut longitudinally or parallel to the direction of the advancing web 4. The metal web 4 is thus cut into metal sheets of a desired size and shape.

The angle of the intersection between the X-line and Y-line is able to be selected according to the desired shape of the sheet metal pieces. It is also possible to connect a plurality of Y-lines branching off at different angles from the X-line to make various shapes of sheet metal pieces at the different Y-lines.

Referring again to FIG. 1, a detector 7 of any suitable construction for detecting the parallelism or the position of the advancing web or cut pieces is provided on at least one of the lines. The roll of the metal web is shown at 9 and is driven by the driving device 8 connected thereto in any suitable manner. The roll driving device 8 drives the web roll 9 at a predetermined speed to feed out the metal web 4 onto the X-line at a constant rate. The size of the cut sheets of metal are determined by the web feeding out speed as controlled by the driving device 8. The position of each cut piece 6 of metal at the Y-cutter is regulated by an abutting or stop member 11 retractably disposed of the Y-line downstream of the Y-cutter. The abutting member 11 emerges out of the conveyor line surface of the Y-line when each cut piece 6 of the metal is brought to a predetermined position to be cut by the Y-cutter, and is retracted into the conveyor line surface of the Y-line when each piece 6 is about to be advanced after cutting by the Y-cutter. Thus, the position of each piece 6 of metal on the Y-line is regulated by the abutting member 11 by being brought into abutting relation therewith. The position of the abutting member 11 is variable along the direction of the Y-line, thereby providing for the controlling or varying of the width of the finally cut sheets of metal on the Y-line.

Inclination of each cut piece 6 at the position to be cut by the Y-cutter is amended by an inclination amending device. The inclination amending device comprises an electro-magnetic induction unit 14 provided under the conveyor surface of the Y-line in the vicinity of the Y-cutter and an abutting member 12 disposed on the edge of the conveyor surface. The induction unit 14 provides for a longitudinal feed transverse to the X-line of each cut piece 6 of metal on the Y-line so as to bring each cut piece 6 into abutment with the abutting member 12. By the abutment of the edge of each cut piece 6 with the abutting member 12, the inclination of the cut piece 6 is corrected, if inclined.

In the vicinity of the X-cutter, there are provided on the both sides of the X-line some pairs of positioners 10, 10 for electro-magnetically controlling the lateral position of the advancing metal web 4. The reference character 18 denotes a stationary frame supporting a pair of guiding columns 17. An upper movable frame 16 carrying the upper blade 15 of the X-cutter is guided by the guiding columns 17 to cut the advancing metal web.

Referring to FIG. 2, showing another embodiment of a metal web cutting device used in connection with the method for cutting the metal web in accordance with the present invention, the metal feeding units of the electro-magnetic induction type feeder are arranged in intersecting relation in the portion B of the conveyor 20 between the cutters 21 and 22. The cut pieces 6 of the metal web 4 are fed along the conveyor 20 after being cut transversely by a first cutter 21. When each cut piece 6 reaches the B-portion of the conveyor 20 where the intersecting or crossed arrangement of the electro-magnetic induction units 1, 1' are disposed thereunder, the cut piece 6 of metal is subjected to the couple and is turned by some angle in the horizontal plane accordingly. By controlling the magnitude or duration of the supply of the couple, each cut piece 6 of metal can be turned at a desired angle at the conveyor portion B. The above-described couple is provided by magnetizing the pair of electro-magnetic induction units 1, 1' inversely. That is, by magnetizing one of the pair of electro-magnetic units in one direction and magnetizing the other of the pair of electro-magnetic units in the opposite direction, the couple is generated thereabout.

By being provided with the couple, each cut piece 6 of the metal web is turned at the desired angle in the horizontal plane and further fed to a second cutter 22, where the cut piece 6 is cut again. In the case where the cut pieces 6 of metal are turned by 90°, each cut piece 6 of metal is cut finally into a square or rectangular shape. The position of each cut piece 6 of metal at the second cutter 22 is regulated and amended by an abutting member 11'' corresponding to the abutting member 11 in the embodiment shown in FIG. 1, and an inclination amending device comprising the abutting member 12' and the electro-magnetic induction unit 14'. The abutting member 12' and the electro-magnetic induction unit 14' correspond to the abutting member 12 and the electro-magnetic induction unit 14, respectively, which are employed in the inclination amending device provided in the embodiment shown in FIG. 1.

Upon operation of the embodiment of the apparatus for cutting the metal web used in connection with the metal cutting method of the present invention as shown in FIG. 1, the roll of the web 9 is rotated by the driving device 8 to feed out the metal web 4 into the X-line. The metal web 4 is fed up to the X-cutter 2 and the edge position of the web 4 is controlled by the positioners 10, 10 so that the center line of the metal web 4 is brought into alignment with the center line of the X-line. After the prescribed length of the metal web is fed beyond the X-cutter and the edge position of the metal web 4 is controlled by the positioners, 10, 10, the leading end of the metal web 4 is transversely cut off by the X-cutter to form a cut piece 6. The cut piece 6 of the

metal web is tested for proper inclination or parallelism by the detector 7, and if the cut piece 6 is somewhat inclined, the inclination is amended by the electro-magnetic induction feeder 1 controlled by the signal from the detector 7.

Thereafter, the properly positioned cut piece 6 of the metal web 4 is conveyed up to the A-portion where the electro-magnetic induction units 1 are crossed, and then the cut piece 6 of the metal web 4 is conveyed along the transverse Y-line by stopping the operation of the electro-magnetic induction unit 1'' parallel to the X-line and by starting the operation of the electro-magnetic induction unit 1'' disposed in transverse relation to the X-line. When the cut piece 6 of the metal web 4 reaches the Y-cutter, the inclination of the cut piece 6, if any, is corrected by the abutting member 12 and the electro-magnetic induction unit 14, and the position of the cut piece 6 along the Y-line is controlled by the abutting member 11 retractably disposed downstream of the Y-cutter on the Y-line. After the position of the cut piece 6 is fixed and the inclination thereof is amended, the cut piece 6 is cut off by the Y-cutter in a direction parallel to the longitudinal axis of the web 4. Thus, sheet metal pieces 13 are obtained which are of a desired size and shape.

Upon operation of the second embodiment of the apparatus for carrying out the method of the present invention as shown in FIG. 2, the metal web 4 is fed up to the cutter 21 and cut into pieces 6 by the cutter 21. Each cut piece 6 of the metal web 4 is then advanced to the B-portion on the conveyor 20, where the cut piece 6 is turned by 90° or any other desired angle in a horizontal plane by the couple provided by the electro-magnetic induction units 1, 1'. Each turned cut piece 6 is further conveyed along the conveyor 20 up to the position where the second cutter 22 is disposed. AT the position where the second cutter 22 is disposed, the cut piece 6 is precisely positioned by the abutting member 11' for determining the size of the sheet metal piece to be cut and by the side abutting member 12' cooperating with the electro-magnetic induction unit 14'. After the position of each cut piece 6 is fixed and the inclination thereof is amended, the cut piece 6 is again cut off by the second cutter 22. Thus, sheet metal pieces 13 are obtained of a desired size and shape.

From the foregoing description it will be apparent that there are several advantages in utilizing the method of the present invention, some of which are as follows:

First, the size of the sheet metal pieces to be cut can be freely and easily changed. Only by changing the position of the abutting member 11 or 11' and by changing the timing of the cutting operation of the first cutter or the speed of advancement of the web 4, the size of the cut sheets of metal can be changed. This is easily accomplished.

Second, damaged blades can be simply and quickly replaced with new ones without stopping the operation of the system. This is particularly advantageous in the case wherein the thickness of the metal web is changed, which requires a change in the blades. This is particularly because the cutting of the metal web is performed without loss of material regardless of the thickness of the metal web, since the cutter is of the shear type. On changing the damaged blade, the advancement of the metal web is stopped only for the operational line where the blade is broken, and the changing of the blade can be easily accomplished.

Third, the cutting size can be changed even during the operation of the system. That is, the mechanism for changing the cutting size can be conducted without stopping the operation of the system.

Fourth, it is possible to control the feeding of the cut pieces of the metal web by simply controlling the electro-magnetic induction units electrically. For instance, the cut pieces supplied on the X-line in the embodiment shown in FIG. 1 can be prevented from being fed transversely to the Y-line while the Y-cutter is not in operation by electrically controlling the electro-magnetic induction units at the conveyor portion A. Such an operation can be performed with high speed and accuracy even during the operation of the system.

Fifth, it is comparatively easy to apply the numerical control of this system for cutting the metal web in accordance with the present invention as may be apparent from the above description as to the present invention.

I claim:

1. In a method of cutting a metal web utilizing electro-magnetic induction type feeding for feeding the severed metal pieces, the improvement comprising:
feeding a metal web through a first cutter,
cutting the metal web transversely to form a cut metal piece,
horizontally feeding said cut metal piece from said first cutter through a second cutter operating in a substantially parallel plane to that of said first cutter and spaced therefrom by electro-magnetic induction,
subjecting said cut metal piece during said movement simultaneously to two magnetic induction fields which are angularly offset to cause said piece to rotate horizontally during feeding and
cutting said rotated cut piece of metal with said second cutter.

2. A method for cutting a metal web as defined in claim 1 wherein said electro-magnetic induction means comprises a pair of electro-magnetic induction units magnetized inversely so as to provide a couple to said cut piece of metal for turning the same in the horizontal plane.

3. An apparatus for cutting a metal web comprising a web feeding means for feeding a metal web from a web roll, a web conveying means for conveying said web longitudinally, a first cutter for cutting said web transversely into cut pieces of metal, a means for turning said cut piece of metal in a horizontal plane disposed downstream said first cutter, and a second cutter for cutting said cut piece disposed downstream from said turning means and in parallel relationship with said first cutter.

4. An apparatus for cutting a metal web as defined in claim 3 wherein said means for turning said cut piece is a pair of electro-magnetic induction units magnetized inversely so as to provide a couple to said cut piece of metal for turning it in a horizontal plane.

5. An apparatus for cutting a metal web as defined in claim 4 wherein said pair of electro-magnetic units are transversely arranged in the conveyor line between said first and said second cutter.

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