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APPARATUS FOR CUTTING INCREMENTALLY CHANGING LENGTHS OF MATERIAL

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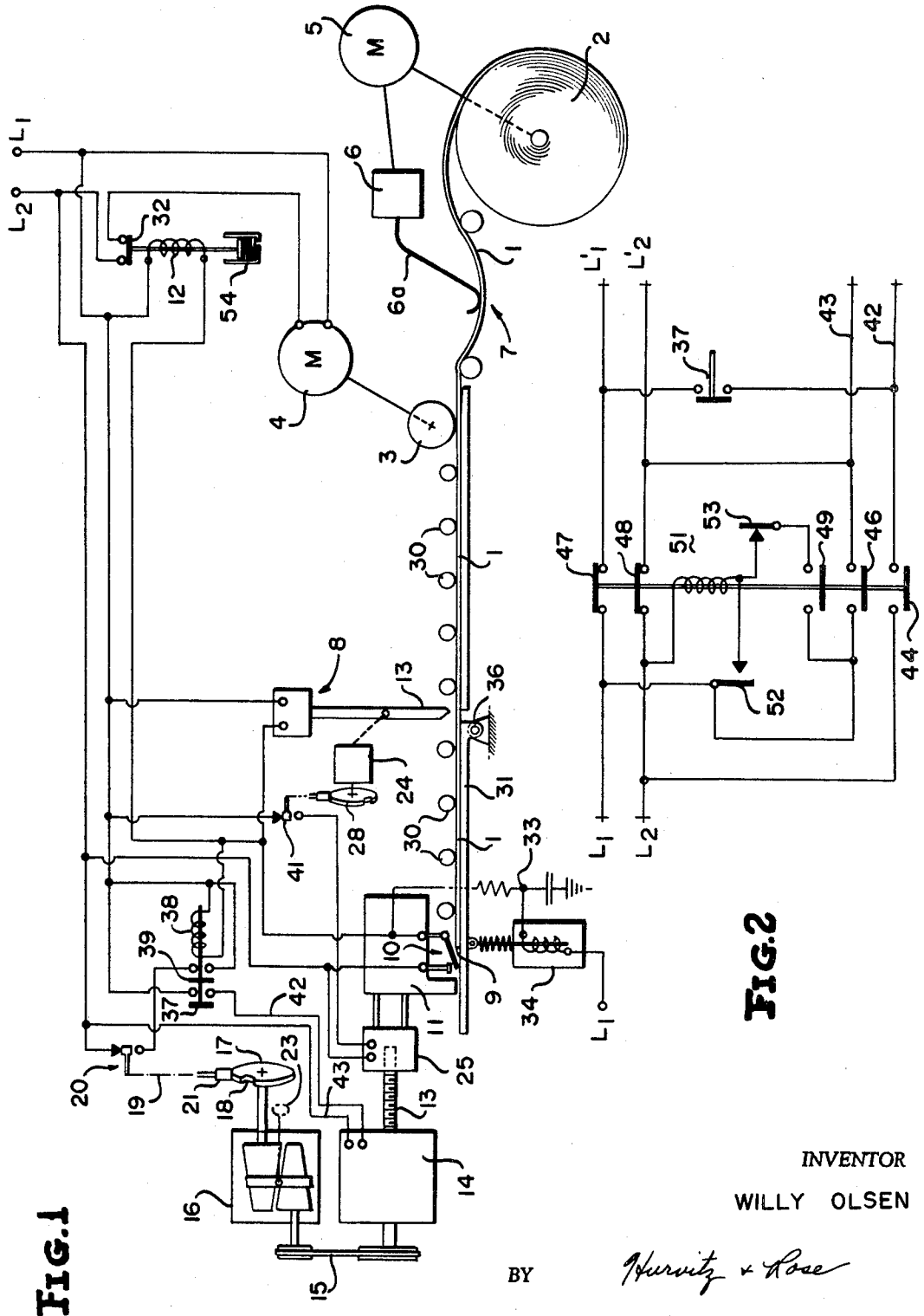


FIG. 1

FIG. 2

INVENTOR

WILLY OLSEN

BY Hurwitz & Rose

ATTORNEYS

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# APPARATUS FOR CUTTING INCREMENTALLY CHANGING LENGTHS OF MATERIAL

Willy Olsen, Mount Vernon, Ill., assignor to Olsen Magnetics, Inc., Mount Vernon, Ill., a corporation of Illinois

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## ABSTRACT OF THE DISCLOSURE

The apparatus cuts strip material into pieces of increasing length. Strip material is fed up to a stop and, upon arrival of the material at the stop, feed is terminated, a shear cuts the material and the cut strip is removed from the machine. Removal of the strip indicates feed and moves the head one increment of length relative to the shear. After a predetermined number of shear operations, the head is moved an abnormally large increment relative to the shear and the cycle then reverses itself and returns the machine to its starting condition.

The present invention relates to strip cutting apparatus for cutting various lengths of magnetic strip to be employed in laminated magnetic cores for inductive devices, especially transformers, and more particularly, to an apparatus capable of cutting various lengths of magnetic strip for use in fabricating a magnetic core of the type disclosed in my copending U.S. patent application Ser No. 443,929, filed Mar. 30, 1965.

In a standard form of transformer construction, a coil structure is provided with a coil window having a magnetic core passing therethrough and enclosing at least one leg of the coil. The core in this type of structure is normally assembled from a plurality of laminations to provide a generally rectangular or square core configuration. In discussing such a core, the term "legs" refers to the core member or members passing through the window in the coil and the member or members parallel thereto. The term "yokes" refers to the members joining the legs. The invention is concerned with the cores for use in inductive apparatus made by assembling the laminations of magnetic strip material in ring shape nested one within the other with each lamination lying in a plane surrounding the axis of the window, shaping the assembly by pressing and then heat treating it to relieve stresses. After heat treatment, the laminations can be separated into groups and each group opened at a joint for reassembly with a leg of the core passing through the coil window.

In accordance with prior art techniques of assembly of such cores, a strip of magnetic material is cut into lengths, such that all of the lengths cut differ in length from each other, to the extent that, when the lengths are each formed into a closed ring with the ends of the lengths abutting, the rings can be fitted one within the other to form a core. The manufacture of the core is completed by the known step of pressing the whole assembly to a required shape and heat treating the assembly to relieve strain and set the core.

In one novel pattern of joints contemplated by my aforesaid application, at least one lamination in each group of laminations is overlapped; the overlapped joints, owing to the overall arrangement of the laminations, being staggered relative to all other overlapped joints. Thus, the usual objection to overlapped joints, that the width of the core is greatly increased, is obviated. On the other hand, a continuous magnetic path about the core is provided for each group of laminations.

It is an object of the present invention to provide apparatus for cutting magnetic core laminations suitable for fabrication of cores as described in my aforesaid patent application.



It is another object of the present invention to provide a mechanism for automatically cutting varying lengths of magnetic strip to provide laminations for magnetic cores some of which provide butt joints and some of which provide overlapping joints in the final core assembly.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a diagrammatical representation of the apparatus used for advancing a strip of magnetic material and cutting it into lamination lengths; and

FIGURE 2 is a circuit diagram of an additional feature of the invention.

Referring to FIGURE 1, a strip **1** of oriented magnetic material is advanced from a supply reel **2** by a driving roller **3** rotated by a drive motor **4**. The strip reel **2** is itself rotated by a strip feed motor **5**, the speed of rotation of which is controlled by a motor control circuit **6**, the sensing element for which is a feeler device **6***a*. The control circuit **6** controls the speed of the motor such as to maintain a stable catenary **7** of the strip **1** between the supply reel **2** and the drive roller **3**. The control circuit **6** is completely conventional and forms no part of the present invention.

The strip **1** is advanced longitudinally by the drive roller, through an electromagnetic shear device **8** and through guide means comprising rollers **30** and flat beds **30** and **31** appropriate to maintain the strip **1** straight and level, until the leading end **9** of the strip **1** makes contact with a sensing switch **10** mounted on an adjustable stop **11**. Closure of the switch **10** by the end **9** energizes a cutout relay **12** to open contacts **32** in the supply to the motor and de-energize the motor. Thus, when the leading end **9** of the strip bears against the stop **11**, the drive to the strip **1** ceases. The closure of the switch **9** also initiates downward movement of a blade **13** of the shear **8** so that, after the strip **1** is stationary with its leading end **9** in contact with the stop **11**, a predetermined length of the strip is cut from the strip supply. After the appropriate time which is determined by an RC timing network **33**, the signal generated by the closing of switch **10** actuates a solenoid **34**. The solenoid pulls down on the guide **31**. The cut length of strip is released from between the guide **31** and rollers **30** and allowed to fall away on to a suitable receptacle (not shown).

As a consequence, the switch **10** opens and the drive by which the strip is advanced is reinstated, i.e., contacts **32** are closed, the motor **4** is energized and the operation so far described repeated, but with the following modification. After a suitable time interval, the initial closure of the switch **10** by the end **9** of the strip, starts an indexing motor **14** to rotate an indexing screw **15** which indirectly governs the position of the stop **11**. In a manner that will hereinafter be explained, the indexing motor rotates in an appropriate direction to retract the stop **11**, that is to say, it moves it in a direction away from the shear blade **13**.

Specifically, the indexing motor **14** is energized through contacts **37** of a relay **38**. The motor **14** also drives, through a belt **15** and a variable speed drive **16**, a cam **17** having a notch **18** found in the surface thereof.

An actuating arm **19** of a holding switch **20** carries a cam follower **21** which normally rests in the notch **18** in the cam **17**. Immediately upon initiation of rotation of the

indexing motor **14** due to closure of switch **10**, the arm **19** is raised to close the switch **20** in series with holding contacts **39** and relay **38**. Thus, the power supply to the motor **14** is maintained until the cam **17** has completed one revolution and the cam follower **21** again falls into the notch **18**. The gear ratio of the variable speed device **16** which is provided with a fine adjustment device **23**, is such that the stop **11** takes up a new position appropriate to the production of a further length of the magnetic strip **1** longer than the previously cut length by a calculated increment, which increment is determined by the pitch of the screw **13** and the ratio of the belt drive **15** and the ratio set into the drive **16**.

The apparatus shown is appropriate for producing groups of laminae of progressively increasing length in which the increment of length between successive laminations of the groups is equal in all cases and also for producing groups of laminae in which the increment for one or more laminae is greater than for the remainder, to the extent that at least one lamination in the group subsequently forms an overlapping instead of a butting joint. This latter function of the apparatus is controlled by a counter **24**, operated by the blade **13** of the shear **8**. The counter which can be in the form of a Veeder-Root counter with a crank drive, rotates a cam **28** one rotation for each predetermined number, e.g., ten, down strokes of the shear. On each revolution of the cam **28**, a switch **41** is closed and energizes a magnetic set-back device **25** (solenoid) by which the stop **11** is supported relative to the indexing screw **13**. The magnetic set back device **25** retracts the stop **11** (moves it toward the left in FIGURE 1) through a distance supplementing that by which it is retracted by the indexing screw **13**.

The arrangement is such that this extra retraction of the stop **11** is maintained only until the next lamination has been cut since cutting the extra length strip operates counter **24**, opens the switch **41** and de-energizes the solenoid **25** and, before the leading end **9** of the strip **1** again reaches the stop **11**, the stop **11** returns to its normal position relative to the set-back device **25**. In other words, it returns to the position it would have occupied had the last distance of retraction been equal to the preceding distance of retraction.

With little modification, the apparatus can be arranged to cut the longest lamination first and the shortest lamination last, by advancing rather than retracting the stop. In this case, however, the counter is preferably set to make the first lamination of each group longer (by temporarily retracting the stop **11**) instead of the last of each group.

If a core having butt laminations only is required, the counter is put out of operation and the apparatus produces a stack of laminations of progressively increasing or decreasing length, the relative increments of adjacent laminations being equal. If it is known that the strip is not of uniform thickness and it is known at least roughly how the thickness changes, with experience it is possible to adjust the ratio of the gear box **16** by hand through the fine adjustment **23**, during the operation of the apparatus, to make allowance for this known variation of thickness.

After a complete set of laminations has been cut, an operator may return the stop **11** to its starting position by manual operation of a reversing switch. However, the motor may be automatically controlled by employing limit steps.

Referring to FIGURE 2, leads **42** and **43** to the motor **14** are connected to supply line $L_1'$ and $L_2'$ respectively. The supply leads $L_1'$ and $L_2'$ of FIGURE 2 correspond to leads $L_1$ and $L_2$ of FIGURE 1 of the accompanying drawings to insure that, when motor **14** is reversed, all apparatus of FIGURE 1 is de-energized except the motor **14**. Leads **42** and **43** are connected to leads $L_2$ and $L_1$, respectively, through normally open switch contacts **44** and **46**. Leads $L_1'$ and $L_2'$ are connected to leads $L_1$ and $L_2$ through normally closed contacts **47** and **48**. Contacts **44** and **46** (normally open) and **47** and **48** (normally closed) and a set of holding contacts **49** (normally open) are elements of a relay **51**.

Relay **51** is connected across leads $L_1$ and $L_2$ through a normally open limit switch **52**. The switch **52** detects end of travel of the stop **11** to the left as viewed in FIGURE 1. When contact **52** is closed, signifying that all of the laminae for a core have been cut, relay **51** is energized and a holding circuit for the relay is established through holding contacts **49** and a normally closed limit switch **53**, connected in series. It is noted that, when relay **51** is energized, the supply motor **14** is reversed. Relay **51** remains energized until stop **11** contacts limit switch **53** and opens it, breaking the holding circuit on the relay.

A dash pot **54** is connected to relay **12** so that the contacts **32** cannot reclose until the reset cycle of the apparatus of FIGURE 2 is complete. This function can be performed electrically by adding another set of contacts to the relay **51** to switch a delay circuit into parallel with the solenoid **12** only when relay **51** is energized.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What I claim is:

**1.** An apparatus for cutting sheet material comprising a movable stop, a cutting device located at least a predetermined distance from said movable stop, means for advancing a strip of sheet material through said cutting device to said movable stop, means for sensing arrival of the sheet material at said movable stop, first and second means responsive to said means for sensing for, respectively, discontinuing advance of the sheet material and for actuating said cutting device to cut a length of material from the sheet of material, and further means responsive to said sensing means for moving said movable stop a predetermined distance relative to said cutting device.

**2.** The combination according to claim **1** further comprising means for removing the cut length of material from against said stop and means responsive thereto for re-energizing said means for advancing.

**3.** The combination according to claim **1** further comprising means for manually changing the distance said movable stop is moved by said further means.

**4.** The combination according to claim **1** further comprising means for establishing an initial position for said movable stop and means responsive to said stop acquiring a predetermined position for returning said movable stop to its initial position.

**5.** The combination according to claim **1** further comprising means responsive to a specified number of actuations of said cutting device for moving said movable stop a distance greater than said predetermined distance.

**6.** The combination according to claim **1** wherein said movable stop comprises a stop member, an electromagnet, means for mounting said stop member for movement relative to said electromagnet upon energization thereof, and wherein said means for moving said movable stop constitutes means for moving said electromagnet.

**7.** The combination according to claim **6** further comprising means responsive to a specified number of actuations of said cutting device for energizing said electromagnet.

**8.** The combination according to claim **6** wherein said means for moving said movable stop comprises a rotary electric motor, said motor being energized by said means for sensing a holding circuit for maintaining said motor energized after the cut length of material is removed from said means for sensing and means for opening said hold-

ing circuit upon said motor having rotated through a predetermined number of degrees.

**9.** The combination according to claim **2** wherein said means for removing comprises a base member extending under said stop, said base member supporting the strip material and means for moving one end of said base member downwardly away from said stop.

**10.** The combination according to claim **1** wherein said movable stop comprises a stop member, a motive means, means for mounting said stop member on said motive means for movement relative to said motive means upon actuation of said motive means, and wherein said means for moving said movable stop constitutes means for moving said motive means.



**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,369,617 | 2/1945 | Sommerville | 83—393 |
| 2,749,981 | 6/1956 | MacKinnon | 83—238 X |
| 3,078,053 | 2/1963 | Duenke | 83—238 X |
| 3,093,183 | 6/1963 | Eldred | 83—238 X |
| 3,137,190 | 6/1964 | Mosher | 83—210 |
| 3,163,065 | 12/1964 | Kolodgy | 83—419 X |

FOREIGN PATENTS

| | | |
|---|---|---|
| 1,178,022 | 5/1959 | France. |

WILLIAM S. LAWSON, *Primary Examiner.*