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APPARATUS FOR SPLICING WEBS OF CIGARETTE PAPER

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Fig. 1

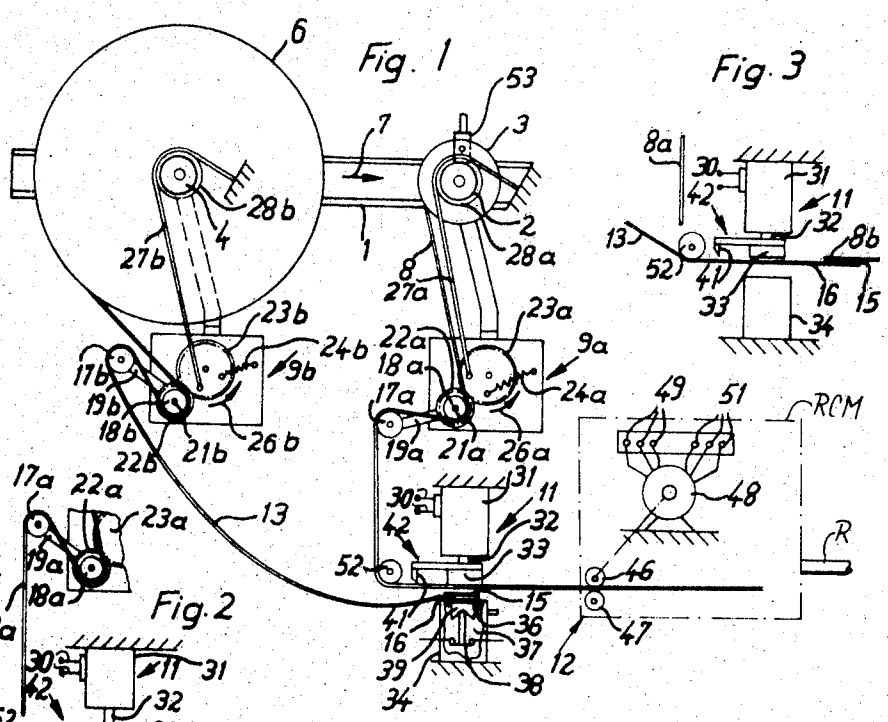
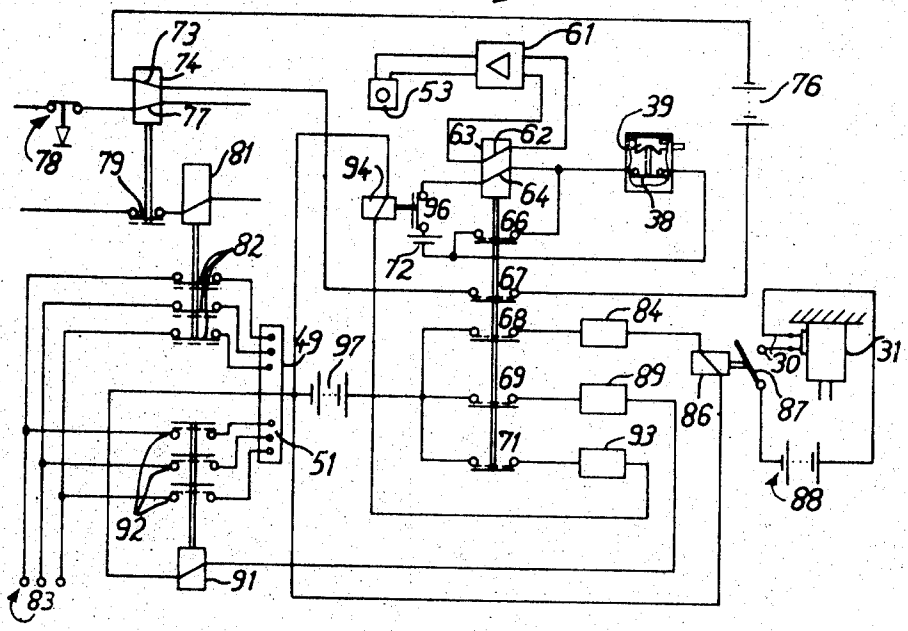


Fig. 3

Fig. 2

Fig. 4



Inventor:
GERD-JOACHIM WENDT
BY
ATTORNEY

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APPARATUS FOR SPLICING WEBS OF CIGARETTE PAPER

Gerd-Joachim Wendt, Hamburg-Bergedorf, Germany, assignor to Hauni-Werke Korber & Co. KG, Hamburg-Bergedorf, Germany

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Claims priority, application Germany, Aug. 31, 1967, P 16 32 206.8
Int. Cl. B31f 5/06; B32b 31/18
U.S. Cl. 156—367 9 Claims

ABSTRACT OF THE DISCLOSURE

The leading end of a fresh web which is stored on a reel is automatically spliced to an expiring web when the machine which consumes the expiring web and draws such expiring web from a source of supply is arrested in response to a signal from a detector which scans the supply of expiring web and produces the signal when the supply of expiring web is depleted to a predetermined minimum value. The consuming machine is started with a predetermined delay following completion of the splicing operation and is accelerated to normal operating speed in several stages at such a rate that the united webs which are accelerated in response to acceleration of the consuming machine are not subjected to excessive tensile stresses.

CROSS-REFERENCE TO RELATED APPLICATION

This is a division of my copending application Ser. No. 755,255 filed Aug. 25, 1968, now Pat. No. 3,586,006 granted June 22, 1971.

BACKGROUND OF THE INVENTION

The present invention relates to web splicing apparatus, particularly to apparatus which are adapted to form a splice between a fresh web of convoluted cigarette paper or mouthpiece paper and an expiring web which is being drawn into the rod forming mechanism of a continuous rod cigarette machine or into the wrapping station of a filter machine or filter cigarette machine. The invention also relates to a method of uniting an expiring web with the leading end of a fresh web.

Splices between an expiring web and the leading end of a fresh web can be formed while the expiring web is running or while the expiring web is at a standstill. The splicing operation is more complicated when the expiring web is running because the leading end of the fresh web must be accelerated to the speed of the expiring web and the splice must be formed between a travelling portion of the expiring web and a travelling portion of the fresh web. Such splices are often unreliable and the number of parts necessary to insure fully automatic acceleration of the fresh web, fully automatic splicing of the two webs, and automatic severing of the remainder of the expiring web in excessive. In accordance with presently prevailing practice, a splice between a stationary part of the expiring web and a stationary fresh web is formed by accumulating a supply of expiring web in a reservoir located downstream of the splicing station, arresting the trailing end of the thus accumulated supply while the consuming machine which receives the web continues to draw web material from the reservoir, and forming a splice between the arrested trailing end of the stored expiring web and the leading end of the fresh web. Such splicing, too, is quite complicated and involves the use of expensive apparatus, particularly because the leading end of the

spliced fresh web must be suddenly accelerated to full operating speed of the consuming machine when the supply of expiring web in the reservoir is exhausted. This often leads to breakage of the web and causes considerable losses in output of the consuming machine. Furthermore, the reservoir occupies a substantial amount of spaces and the apparatus must be provided with two drives.

SUMMARY OF THE INVENTION

One of the objects of my present invention is to provide a novel and improved apparatus for uniting the leading end of a stationary fresh web with an expiring web which is being fed to a consuming station in a consuming machine, particularly in a continuous rod cigarette machine, in such a way that the splice between the two webs can be formed while the webs are stationary but without materially affecting the output of the consuming machine and/or the quality of products which are being produced or treated at the consuming station.

Another object of the invention is to provide an apparatus for uniting a stationary fresh web with an arrested expiring web in such a way that the formation of the splice is completed within a short interval of time and that the completion of such splice automatically triggers a series of operations which lead to acceleration of the fresh web to the full operating speed of the consuming machine.

An additional object of the invention is to provide an apparatus of the just outlined character wherein the splicing operation is triggered automatically when the supply of expiring web is depleted, and wherein the remainder of the expiring web is automatically severed from the splice and is moved out of the way in response to completion of the splicing operation.

A concomitant object of the invention is to provide a relatively inexpensive, compact, and reliable web splicing apparatus which can complete the splice rapidly and with a minimal delay following substantial depletion of the expiring web, and which allows for proper placing of the fresh web into requisite position for splicing of its leading end prior to exhaustion of the expiring web.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved web splicing apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic side elevational view of a splicing apparatus which embodies the invention;

FIG. 2 is a view similar to FIG. 1 illustrating the splicer of the apparatus in operative position;

FIG. 3 illustrates the splicer in a position it assumes upon completion of the splicing operation; and

FIG. 4 is a schematic diagram of the electric circuit of the splicing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The splicing apparatus which is illustrated in FIG. 1 comprises a main support 1 for a source of supply 3, here shown as a reel which pays out the expiring web 8, for example, a web of cigarette paper which is being fed to the wrapping mechanism of a continuous cigarette rod making machine. The reel 3 is mounted on a shaft 2. The support 1 also carries a second shaft 4 for a reel 6 which contains a supply of convoluted fresh web 13. The expiring web 8 travels through a braking device 9a,

through an automatic splicer **11**, and between the advancing rolls **46**, **47** of a drive **12**. The cigarette rod making machine which embraces the drive **12** is shown schematically at RCM. A cigarette rod, with a web of cigarette paper convoluted around a tobacco filler rod, is shown at R.

The fresh web **13** is threaded through a second braking device **9***b*, thereupon through the aforementioned splicer **11** and has a leading end **16** provided with a layer **15** of adhesive which can bond the web **13** to the web **8**. The layer **15** of adhesive can be applied to one side of a uniting band whose other side is also coated with adhesive and adheres to the leading end **16**. Such a band would be placed manually in the position shown in FIG. 3.

The braking device **9***a* comprises rollers **17***a*, **18***a* and the expiring web **8** is trained over these rollers in a manner as shown in FIG. 1. The rollers **17***a*, **18***a* are rotatable on a web-removing lever **19***a* which is pivotable on a pin **21***a* and serves the additional purpose of removing the remainder **8***a* of the expiring web **8** from the splicing station subsequent to severing of such remainder **8***a* from the main part of the web **8**. A gear **22***a* which is secured to the removing lever **19***a* coaxially with the pivot pin **21***a* meshes with a second gear **23***a*. The latter is biased by a spring **24***a* which tends to rotate it in a counterclockwise direction (arrow **26***a*). This gear **23***a* is further connected with one end of a brake band **27***a* which is trained over a friction disk **28***a* on the shaft **2**. The other end of the brake band **27***a* is fixedly anchored in a stationary part of the frame. The parts **17***a* to **24***a* together constitute an actuating unit which initiates the operation of the brake band **27***a*.

The second braking device **9***b* is identical or substantially identical with the braking device **9***a*. It comprises rollers **17***b*, **18***b*, a removing lever **19***b*, a pivot pin **21***b*, gears **22***b*, **23***b*, a spring **24***b* which biases the gear **23***b* in the direction indicated by arrow **26***b*, and a brake band **27***b*. The latter is trained over a friction disk **28***b* mounted on the shaft **4**. One end of the band **27***b* is secured to a stationary frame member.

The automatic splicer **11** includes an electromagnet **31** having terminals **30** and comprising a reciprocable armature **32** carrying a movable splicing member or ram **33**. A stationary splicing member or anvil **34** has a splicing surface which is adjacent to the expiring web and is provided with suction ports **36** in communication with a suction chamber **37** provided in the interior of the anvil **34**. The suction chamber **37** accommodates a vacuum switch **39** having a movable contact **38** which engages stationary contacts and closes the vacuum switch when the ports **36** are sealed by the leading end **16** of the fresh web **13**. The armature **32** of the electromagnet **31** is further connected with a movable cutter or knife **42** which includes a blade **41**.

The drive **12** for the expiring web **8** comprises the aforementioned advancing rollers **46**, **47** the former of which is rotated by the motor **48** of the machine RCM. The motor **48** is a reversible-polarity polyphase induction motor and can be operated at two speeds. The conductors which supply current to that winding which causes the motor **48** to operate at a higher (normal) speed are shown at **49**. The conductors **51** supply current to that winding which causes the motor **48** to operate at a lower speed. The numeral **52** denotes a guide roll which is installed upstream of the splicer **11**.

The splicing apparatus further comprises a detector which serves to scan the quantity of expiring web **8** on the reel **3**. This detector comprises a photoelectric receiver **53** and a light source (not shown). The receiver **53** produces a signal when the diameter of the reel **3** is reduced to a predetermined minimum value.

FIG. 4 illustrates the electric circuit of the web splicing apparatus. The photoelectric receiver **53** of the detector is connected with an amplifier **61** whose output is connected with the winding **62** of a relay **63** including a second winding **64** and relay contacts **66**, **67**, **68**, **69**, **71**. The contacts **66–69** and **71** assume the broken-line closed positions only when the winding **62** is energized simultaneously with the winding **64**. The latter winding is connected in a circuit which is controlled by the movable contact **38** of the vacuum switch **39**. This circuit further includes an energy source **72**. Due to the fact that the vacuum switch **39** is in circuit with the winding **64** of the relay **63**, the anvil **34** can perform the additional function of detecting whether or not the leading end **16** of the fresh web **13** is in requisite position for splicing to the expiring web **8**, i.e., the anvil can prevent splicing if the leading end **16** does not seal the ports **36**.

The contact **66** of the relay **63** is a holding contact and the contact **67** controls the winding **73** of a disconnecting relay **74** for the motor **48**. This second relay contact **67** is in series with a second energy source **76**. The disconnecting relay **74** has a second winding **77** which is energized as long as the master switch **78** of the machine RCM remains closed. The design of the relay **74** is such that its contact **79** opens when the winding **73** is energized simultaneously with the winding **77**. The contact **79** controls a motor relay **81** which can establish or terminate a connection between the conductors **49** of the motor **48** and a source **83** of polyphase current. The contacts **82** of the relay **81** are closed when the winding **77** of the relay **74** is energized and when the winding **73** is deenergized.

The contact **68** of the relay **63** is in circuit with a time-lag device **84** and with the winding of a relay **86** which closes its contact **87** for a short interval of time in response to energization of its winding and automatically opens the contact **87** irrespective of the condition of such winding. The contact **87** can connect one terminal **30** of the electromagnet **31** with an energy source **88**. Relays which can perform the function of the relay **86** are produced, for example, by Schiele Industriewerke K.G., 7746 Hornberg, Germany, and are known as "EW" relays. The parts **84**, **86** and **31** control the operation of the splicer **11**.

The contact **69** of the relay **63** is in circuit with a (second) time-lag device **89** and with the winding of a further motor relay **91** having contacts **92** which can connect the conductors **51** of the motor **48** with the source **83**. The contact **71** of the relay **63** is in circuit with a third time-lag device **93** and with the winding of a relay **94** having a contact **96** which is in the holding circuit of the relay **63** and can complete the circuit of the winding **64** when the winding of the relay **94** is energized. The energy source **72** is in series with the winding **64** and contact **96**. A further energy source **97** is in circuit with the time-lag devices **84**, **89**, **93**. The delays furnished by the devices **84**, **89**, **93** are selected in such a way that the delay furnished by the device **89** exceeds that furnished by the device **84** but is less than that furnished by the device **93**. Each of these time-lag devices may comprise a conventional R–C unit and they may form part of the relays **86**, **94** or of the motor relay **91**. As can be seen in FIG. 4, the devices **84**, **93** respectively delay energization of the relays **86**, **94** and the device **89** delays energization of the relay **91**.

The relays **91**, **94** together constitute a starter for accelerating the motor **48** and hence the drive **12** from zero speed to normal operating speed in automatic response to completion of the splicing operation. The time-lag device **84** initiates automatic operation of the splicer **11** with a predetermined delay following inactivation of the drive **12** by relays **63**, **74**, **81**. The time-lag device **89** initiates the operation of the aforemetioned starter with a predetermined delay following operation of the splicer **11** and the time-lag device **93** initiates the second stage of acceleration of the motor **48** and drive **12** with a predetermined delay following completed acceleration to the first speed.

The operation is as follows:

Prior to splicing, a reel **6** containing a full supply of fresh web **13** is mounted on the support **1** in the position shown in FIG. 1. The fresh web **13** is then trained over the rollers **18***b*, **17***b* of the braking device **9***b* and its leading end **16** is placed onto the top surface of the anvil **34**. As stated before, the leading end **16** carries a layer **15** of adhesive which is preferably applied to one side of a customary uniting band whose other side is also coated with adhesive and is adjacent to the underside of the travelling expiring web **8**. The leading end **16** of the fresh web **13** then seals the ducts **36** in the anvil **34**. Thus, suction builds up in the chamber **37** to attract the leading end **16** to the top surface of the anvil **34**, and such suction also causes closing of the vacuum switch **39**. However, the relay **63** remains inactive because its winding **62** is deenergized until the supply of expiring web **8**, i.e., the diameter of the reel **3**, is reduced to a predetermined minimum value at which the photoelectric receiver **53** responds. The fresh reel **6** is now ready and its web **13** can be spliced to the web **8** in response to a signal from the amplifier **61**. This is shown in FIGS. 1 and 4.

The expiring web **8** travels around the rollers **18***a*, **17***a* of the braking device **9***a*, around the guide roll **52**, below the blade **41** of the cutter **42** and along the underside of the ram **33** which is spaced from the top surface of the anvil **34**. This expiring web is drawn by the advancing rolls **46**, **47** and is fed into the wrapping mechanism of the machine RCM. The expiring web **8** is sufficiently taut to maintain the lever **19***a* in the position shown in FIG. 1 in which the lever **19***a* is turned in a counterclockwise direction and causes the spring **24***a* to store energy. The brake band **27***a* is loose, i.e., it has a certain amount of slack so that it does not oppose rotation of the friction disk **28***a* with the shaft **2**. If the expiring web **8** breaks, the spring **24***a* is free to contract and rotates the gear **23***a* in a counterclockwise direction indicated by arrow **26***a* whereby the band **27***a* tightens around the peripheral surface of the disk **28***a* to brake the shaft **2** and the expiring reel **3**. Thus, the reel **3** is arrested in automatic response to breakage of the expiring web **8**.

The master switch **78** of the machine RCM is closed so that the winding **77** of the relay **74** is energized. Thus, the relay contact **79** is closed and the relay **81** is energized so that the motor **48** drives the advancing roller **46** at the normal (higher) operating speed. In other words, the conductors **49** are connected with the energy source **83** by way of contacts **82** which then assume the solid-line positions shown in FIG. 4.

When the diameter of the reel **3** decreases to a predetermined value, the receiver **53** produces a signal which causes the amplifier **61** to energize the winding **62** of the relay **63**. The winding **64** is already energized because the vacuum switch **39** is closed due to sealing of ducts **36** by the leading end **16** of the fresh web **13**. Thus, the relay **63** moves its contacts **66–69** and **71** to the broken-line positions shown in FIG. 4 whereby the contact **66** completes the holding circuit and the contact **67** energizes the winding **73** of the relay **74** whereby the relay **74** opens its contact **79** (broken-line position of FIG. 4) to deenergize the relay **81**. The contacts **82** move to the broken-line (open) positions and disconnect the conductors **49** from the energy source **83**. Consequently, the drive of the machine RCM is arrested and the moving parts of this machine are allowed to come gradually to a full stop.

The delay furnished by the time-lag device **84** is long enough to insure that the machine RCM is at a standstill when the electromagnet **31** is energized. This device **84** then causes energization of the relay **86** which closes the contact **87** and thus completes the circuit of the electromagnet **31**. The latter moves its armature **32** downwardly whereby the ram **33** causes the expiring web **8** to move against the adhesive-coated upper side of the aforementioned uniting band on the leading end **16** of the fresh web **13**, i.e., the web **8** is spliced to the web **13**. It will be seen that the splicing operation is carried out while the webs **8** and **13** are idle. Energization of the electromagnet **31** is of short duration (due to the aforedescribed nature of the relay **86**) so that the ram **33** immediately returns from the extended position shown in FIG. 2 back to the retracted position shown in FIG. 1. During movement of the armature **32** toward the position shown in FIG. 2, the blade **41** of the cutter **42** automatically severs the expiring web **8** upstream of the splicing station. As shown in FIG. 1, the spring **24***a* causes the lever **19***a* to turn in a clockwise direction in response to severing of the expiring web **8** whereby the remainder **8***a* of this web is automatically moved away from the splicing station. The spring **24***a* also causes the brake band **27***a* to hold the shaft **2** and reel **3** against rotation by way of the friction disk **28***a*.

When the splicing and severing steps are completed, the ram **33** returns to the position of FIG. 1 in response to the action of a suitable spring (not shown) which tends to maintain the armature **32** in retracted position. Energization of the electromagnet **31** is of short duration because the splicing and severing steps take up a relatively short interval of time. Thus, the seam between the overlapping edges of the tube formed in the wrapping mechanism around the tobacco rod does not open up during the interval when the machine is idle. The delay determined by the time-lag device **89** expires in the meantime so that the relay **91** because energized and its contacts **92** move to the broken-line positions of FIG. 4 to connect the conductors **51** with the energy source **83** and to thus start the motor **48** of the machine RCM at the lower speed. The rate of acceleration of the motor **48** to such lower speed is selected with a view to avoid tearing of the web **13**. The splice between the trailing ends **8***b* of the expired web and the leading end **16** of the web **13** then advances beyond the splicing station as shown in FIG. 3. The webs **8** and **13** are taut and advance at the slower speed.

Upon elapse of a further delay which is determined by the time-lag device **93** and which is selected with a view to insure that the motor **48** is accelerated to the lesser or lower speed as well as to insure that the splice between the webs **8**, **13** has already reached the wrapping mechanism of the machine RCM and forms part of a tube which is provided around the travelling tobacco rod, the relay **94** is energized and causes its contact **96** to open the holding circuit for the relay **63**. Such position of the contact **96** is shown in FIG. 4 by broken lines. The contacts **66–69** and **71** of the relay **63** return to the solid-line positions of FIG. 4 and the relay **63** thereupon remains deenergized despite renewed closing of the contact **96** because the web **13** is taut and moves away from the top surface of the anvil **34** so that the suction chamber **37** is connected with the atmosphere by way of the ducts **36**. In other words, the vacuum switch **39** opens and causes deenergization of the winding **64** in the relay **63**. Consequently, the relay **91** is disconnected from the energy source **97**.

The relay **63** also causes deenergization of the relay winding **73** whereby the relay **74** closes the switch **79** (because the winding **77** is energized due to the fact that the master switch **78** is closed). The switch **79** energizes the relay **81** which closes the contacts **82** and thus connects the conductors **49** with the energy source **83**. The motor **48** is then accelerated to its higher operating speed and the advancing rollers **46**, **47** accelerate the fresh web **13** (which is now the expiring web). This completes the splicing operation.

The shaft **2** with the expired reel **3** and with the braking device **9***a* is then removed from the support **1** and the expiring reel **6** (with the braking device **9***b*) is moved in the direction of arrow **7** (FIG. 1) to take the place of the removed reel **3**. A fresh reel is mounted on the shaft **2** and this shaft is thereupon mounted in the support **1**

to take the place of the shaft **4**. The web of the fresh reel is threaded around the rollers **17***a*, **18***a* and its leading end is placed onto the top surface of the anvil **34** so that it seals the ports **36** and causes closing of the vacuum switch **39**. However, and as described hereinabove, closing of the vacuum switch **39** cannot initiate a fresh splicing operation until and unless the receiver **53** produces a signal which indicates that the supply of expiring web **13** is reduced to a predetermined minimum. Thus, and since the reel **6** is shifted to the right, as viewed in FIG. 1, before the leading end of the fresh reel is placed onto the anvil **34**. No premature splicing action can take place prior to a predetermined reduction in the diameter of the reel **6** in the new position on the support **1**.

It is clear that the splicer **11** can be designed to roll a pressure splice instead of providing an adhesive bond between the expiring and fresh webs or that the splicer can establish an adhesive bond in addition to providing a pressure splice. In such instances, the top surface of the anvil **34** and/or the underside of the ram **33** is provided with teeth, needles or analogous protuberances which can cause the formation of a pressure splice similar to that provided by apparatus disclosed in the patent to Phillips, Jr., et al., No. 3,089,661.

A very important advantage of the improved apparatus is that the splicing of an expiring web to a fresh web consumes very little time so that, even though the webs are spliced to each other while they are at a standstill, the seam between the overlapping edges of the tube formed by the web around the tobacco rod in in the wrapping mechanism is not destroyed even though the drive of the machine is temporarily disconnected. Splicing of webs which are at a standstill is desirable because it is much safer than splicing of travelling webs. Furthermore, the splicing operation is initiated and carried out in a fully automatic way so that the persons in charge need not supervise the expiring reel, as long as a fresh reel is properly mounted on the support **1** and the leading end of its web overlies the anvil **34**. Temporary stoppage of the machine RCM for a short period of time which is required to complete the splicing operation has very little effect on the output and/or quality of cigarettes. The apparatus of the present invention can operate properly without resorting to a magazine for an expiring reel which is necessary in presently known web splicing apparatus wherein the splice is formed between two stationary webs. The expenses involved in connection with the provision of afore-discussed controls for the motor of the consuming machine are considerably less than those involved in insuring that the magazine of a conventional web splicing apparatus invariably contains a requisite amount of reserve material so that the splice can be rolled or otherwise formed between a stationary portion of the expiring web and a stationary portion of the fresh web.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. Apparatus for uniting the leading end of a fresh web which is stored on a fresh reel with an expiring web which is being drawn from a source of supply, comprising variable-speed drive means operative to advance the expiring web at a predetermined speed to a consuming station in a tobacco processing machine and to operate the machine at a variable speed; detector means arranged to scan the supply of expiring web and to produce a signal in response to depletion of said supply to a predetermined minimum value; means for reducing the speed of said drive means in response to said signal to thus reduce the speed of the entire expiring web and of the tobacco processing machine; splicer means operative to splice the leading end of the fresh web to the expiring web upon completed reduction of the speed of said drive means; and means for automatically increasing the speed of said drive means to said predetermined speed upon completion of the operation of said splicer means.

2. Apparatus as defined in claim **1**, further comprising means for supporting the leading end of the fresh web in a predetermined position and for blocking the operation of said splicer means when the leading end of the fresh web is out of said predetermined position.

3. Apparatus as defined in claim **1**, wherein said supply consists of a reel of convoluted expiring web and said detector means comprises means for determining the diameter of said last mentioned reel and operative to produce said signal when the diameter of said last mentioned reel decreases to predetermined minimum value.

4. Apparatus as defined in claim **1**, further comprising time-lag means for initiating the operation of said splicer means with a predetermined delay following the inactivation of said drive means by said speed reducing means.

5. Apparatus as defined in claim **1**, wherein said speed increasing means comprises means for accelerating said drive means to said predetermined speed in a plurality of stages.

6. Apparatus as defined in claim **1**, further comprising time-lag means for initiating the operation of said speed increasing means with a predetermined delay following the operation of said splicer means.

7. Apparatus as defined in claim **1**, wherein said speed increasing means comprises means for accelerating said drive means to said predetermined speed in at least two successive stages, and further comprising means for initiating the second stage of acceleration of said drive means with a predetermined delay following the completion of the first stage.

8. Apparatus as defined in claim **1**, further comprising cutter means for severing the expiring web upstream of said splicer means and means for removing the remainder of the thus severed expiring web.

9. Apparatus as defined in claim **8**, wherein said severing means is arranged to sever the expiring web substantially simultaneously with the operation of said splicer means.

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PHILIP DIER, Primary Examiner

U.S. Cl. X.R.

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