

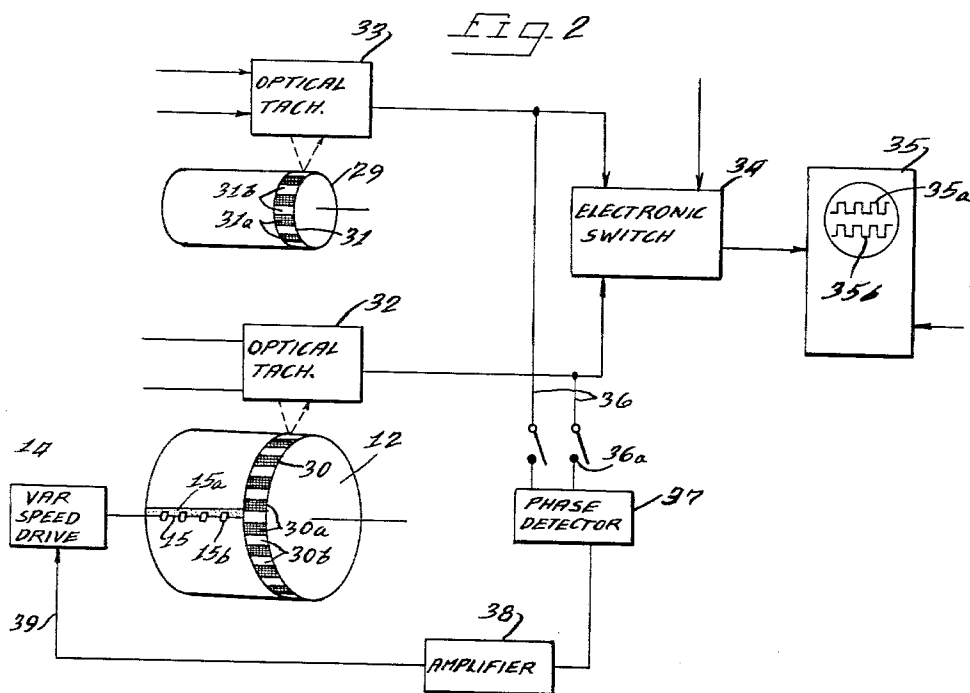
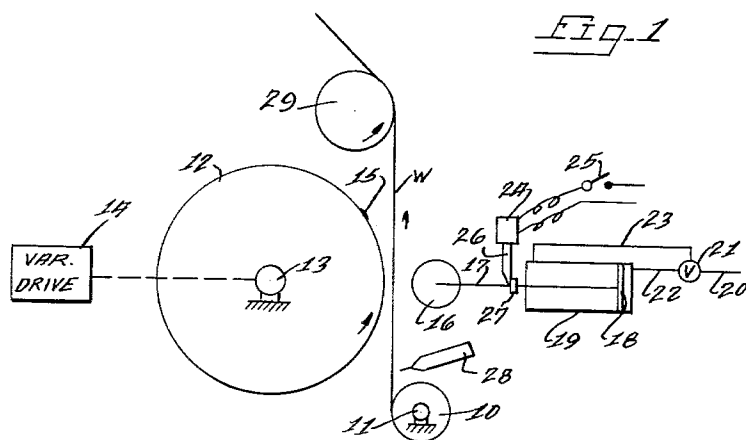
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FLYING SPLICE SYNCHRONIZER

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3,223,339

FLYING SPLICE SYNCHRONIZER

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1 Claim. (Cl. 242—58.3)

The present invention relates to improvements in machines for unwinding rolls of paper or like web material and more particularly to an unwinding machine which forms a flying splice for continuous unwinding by splicing the lead end of a fresh roll to the web from an expiring unwinding roll without stopping the unwinding operation.

More specifically, the invention pertains to a speed synchronizing mechanism which obtains equal surface speed between the surface of the fresh roll and the moving unwinding web so that a reliable splice can be formed. In a paper unwinding machine, very high speeds of travel of the unwinding web are utilized and an unwinding web is paid off of a roll until the roll is nearly empty. The lead end of a fresh roll is then spliced to the moving web for continuous, uninterrupted unwinding operation. The flying splice is accomplished by providing an adhesive lead end on the web on the fresh roll and when the moving unwinding web is pressed against the surface of the fresh roll, the adhesive lead end automatically forms a splice to break from the fresh roll and follow the traveling web.

It is essential that the flying splice is reliably made and if the lead end of the web from the fresh roll becomes detached at the high speeds of web travel, the machine will become jammed and disastrous results often occur which can damage the machine and prove dangerous to operating personnel.

An essential factor to forming a reliable flying splice is the obtaining of accurately equal surface speeds between the traveling web surface and the surface of the fresh roll.

Accordingly, it is an object of the present invention to provide an improved device for obtaining accurate equal speeds of movement between the traveling web and the surface of the fresh roll.

A further object of the invention is to provide an improved device whereby the speed of a traveling unwinding web can be easily measured and whereby the speed of a fresh roll to be unwound can be easily measured and the two measured speeds compared.

A still further object of the invention is to provide an improved mechanism for forming a flying splice in an unwinding machine wherein linear strain between the spliced lead end of a fresh web and the surface of the traveling web are substantially eliminated and equal traveling speeds can readily be obtained.

Other objects, advantages and features will become more apparent with the teachings of the principles of the invention in connection with the disclosure of the preferred embodiments in the specification, claim and drawings, in which:

FIGURE 1 is a schematic illustration of an unwinding machine providing with a flying splice mechanism operating in accordance with the principles of the present invention; and

FIGURE 2 is a schematic illustration of the unwinding machine with the apparatus for comparing the moving surface speeds being shown in schematic detail.

As shown on the drawings:

FIGURE 1 illustrates schematically unwinding mechanism provided with a device for forming a flying splice.

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It will be understood that, while the features of the present invention are particularly well adapted for use in machines for unwinding paper rolls, they may be embodied and utilized in other mechanism. For convenience, the invention is here shown and described as used in paper machinery.

A moving unwinding traveling web W is drawn from an unwinding roll 10 having a core which is suitably supported on bearings 11. The roll 10 is shown as nearly exhausted and transfer is to be made to start a fresh roll 12. The parent roll 12 is carried on a core suitably supported on bearings 13.

To make the transfer and to begin unwinding the web from the fresh roll 12, the roll 12 is driven in rotation until its peripheral speed is the same as the surface speed of the web W. Suitable driving mechanism, such as a motor, driving the roll 12 through a variable speed drive 14 is employed. A variable speed electric motor or a variable gear drive are among the forms of drives that may be employed and braking means may also be employed to accurately obtain a peripheral speed of the parent roll, which is the same as the surface speed of the web W.

When the traveling speeds are equal, the lead end 15 of the web wound on the parent roll 12 is spliced to the surface of the traveling web. For this purpose, the lead end 15, FIGURE 2, is provided with adhesive attaching means such as a pressure-sensitive strip 15a which will adhere to the web W when it is pressed against the surface of the roll. Holding tabs 15b are provided which break or release the lead end 15 from the roll when the end is attached to the web W.

For forming the splice, a splicing roll 16 moves laterally to the left, as shown in FIGURE 1, to press the moving web W against the surface of the roll 12. The roll is carried on a piston rod 17 connected to a piston 18 within a cylinder 19.

For moving the splicing roll 16 rapidly and firmly against the roll 12, the cylinder 19 is continually pressurized behind the piston and the piston rod is latched so that the splicing roll 16 is maintained in a poised position. Pressurized air is supplied through a line 20 and a valve 21 is normally set to pressurize a line 22 leading to the space in the cylinder in back of the piston 18. The valve 21 has a line 23 leading to the front end of the cylinder for returning the piston rod and the splicing roll 16 to the latched poised position, as shown in FIGURE 1.

The piston rod is held latched in the position shown by a latching pin 26 which latches behind a collar 27 on the piston rod. The latching pin is lifted by a solenoid 24 energized through leads when a switch 25 is closed. It will, of course, be recognized that various other types of release and latching mechanism may be employed.

The splicing roll 16 is preferably released when the lead end 15 of the web is just past its location of proximity to the web W which is in the position shown in FIGURE 1. Thus, the web W will be pressed against the outer surface of the new roll 12 for substantially a full revolution before the splice is formed and this will aid in further insuring the same surface speed between the web W and the outer surface of the roll 12 and will help insure that the splicing roll 16 is steadily engaging the roll 12, pushing the web W thereagainst.

As will be observed, unless the outer surface of the roll 12 has the identical surface speed of the traveling web W, linear stresses will be placed at the splice between the web end 15 and the surface of the web W. If the two webs have the identical speed, this linear stress at the splice

will be avoided. It is essential that the stresses be reduced to a minimum to avoid any possibility of the splice failing, since disastrous results can occur at the speeds of travel employed.

As soon as the splice is formed, a knife 28 operated by suitable means (not shown) severs the web W and the expired roll 10 is stopped by a suitable brake. Thereafter, unwinding operation continues with the web being paid off the new roll 12 until it is substantially expired and then a new fresh roll is provided and a new splice formed.

For obtaining the same surface speeds, a plurality of first indicator elements having a predetermined linear spacing are placed on the periphery of the fresh main roll 12, and a plurality of second similar indicator elements are positioned to travel with the web by being placed on a guide roll 29 over which the web travels, and which has the same peripheral speed as the speed of travel of the web W. The roll 29 may be a guide roll, as shown in FIGURE 2, driven by contact with the web.

The indicator elements are shown for the main roll as including spaced black marks 30a with intermediate white spaces 30b. These are conveniently carried on an adhesive backed tape 30 which is placed around the circumference at the end of the main roll 12.

The roll 29 has similar black indicator marks 31a with intermediate white spaces 31b on a strip 31 extending around the circumference at the end of the roll. The marks are conveniently in the form of spaced black rectangles, and the linear spacing of the marks 30a is the same as the linear spacing of the marks 31a so that when the linear speed of travel of the marks of the rolls 12 and 29 is equal, the surfaces of the web on the roll 12 and the unwinding web W are the same.

Means are provided for detecting the speed of movement of each of the indicator elements and a first stationary optical tachometer 32 is positioned adjacent the strip 30. A second optical tachometer 33 is positioned adjacent the marking strip 31. The optical tachometers are of the type known to those skilled in the art and need not be described in detail, incorporating a light source and a photoelectric cell for detecting the speed of linear movement of the black marks. The outputs of the optical tachometers 32 and 33 are fed into an electronic switch 34 and its output is fed to an oscilloscope 35. The electronic switch separates the square wave forms 35a and 35b on the oscilloscope so that they can be visibly compared.

The oscilloscope is then adjusted so that one of the wave forms remains horizontally stationary, preferably the upper wave form generated by the movement of the markings on the roll 29, and the speed of the roll 12 is then adjusted by changing the variable speed drive 14 until the wave form 35b becomes stationary. This indicates that the speeds of the surfaces of the rolls 12 and 29 are the same and at this time the flying splice can be formed by closing the switch 25 of FIGURE 1 so that the splicing roll 16 will force the web W against the surface of the roll 12.

The method of the invention contemplates incorporation in a mechanism for automatic speed control, and leads 36 may be connected to the outputs of the tachometers 32 and 33, and a switch 36a, when closed, will connect the outputs to a phase detector 37. The output of the phase detector will be fed into an amplifier 38 and its output signal will be fed through leads 39 to the variable speed drive to vary the drive until the outputs of the optical tachometers 32 and 33 are in phase, thus obtaining the same surface speeds of the web W and the roll 12. The electrical construction of the phase detector and amplifier will be well known to those skilled in the art and need not be described in detail. Also, suitable electrical supply lines will be provided for the electrical mechanism above described, as indicated schematically by leads.

In non-automatic speed control operation, the switch 36a will be open.

While the preferred form of arrangement is illustrated and described, it is contemplated that other indicator elements may be employed on the surfaces of the rolls for obtaining the proper speeds for splicing, such as by providing metallic marks having a magnetic field with a magnetic head for detecting the passage of the marks.

In operation, the fresh roll 12 is supported in the bearings when the unwinding roll is almost empty, and the fresh roll is brought up to speed by the variable speed drive 14. When a speed close to splicing speed is reached, the wave patterns 35a and 35b on the oscilloscope 35 are compared, such as by adjusting the scope until wave form 35a is stationary and the variable speed drive is regulated to bring the speed of the surface of the roll 12 equal to the speed of the traveling web W, as will be indicated when wave form 35b is also stationary. When the speeds are equal, the solenoid 24 is energized to release the splicing roll 16. This may be done manually or automatically. Automatic release may be accomplished such as by providing a marker on the end of the roll 12 with a detecting mechanism which will automatically release the splicing roll so that it will press the web W against the roll 12 just as the lead end 15 has passed the splicing roll 16 to press the web against the roll 12 for the major portion of the revolution of the roll.

Thus, it will be seen that there has been provided an improved paper web splicing mechanism which meets the objectives and advantages above set forth. The mechanism and method insure the formation of a high speed flying splice at uniform surface speeds and insure the elimination of strains on the splice due to unequal speeds. The formation of a reliable splice is thus insured.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

We claim as our invention:

- A mechanism for synchronizing the speed of a main roll carrying a web to be unwound with the speed of a traveling unwinding web for connecting the unwinding web to the web on the main roll comprising,
 - a cylindrical main roll having an outer cylindrical web supporting surface,
 - a guide roll having an outer cylindrical web supporting surface,
 - a first annular band mounted on the outer surface of a roll of paper on the main roll,
 - a second annular band mounted on the outer surface of said guide roll,
 - each of said bands having spaced indicator marks facing radially outwardly with the indicator marks being uniformly spaced a predetermined distance apart with the same spacing on each band,
 - a first photoelectric detector for detecting the speed of movement of the marks on the first band providing a first output signal,
 - a second photoelectric detector for detecting the speed of movement of marks on the second band providing a second output signal,
 - means electrically connected to receive said first and second signals converting the signals to first and second visible signals having wave forms each providing an indication as a function of frequency of the movement of the marks past said detectors,
 - and means for controlling the speed of the main roll until the wave forms are correlated to obtain an equal surface speed between an unwinding web running over the guide roll and a web wound in the roll.

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