

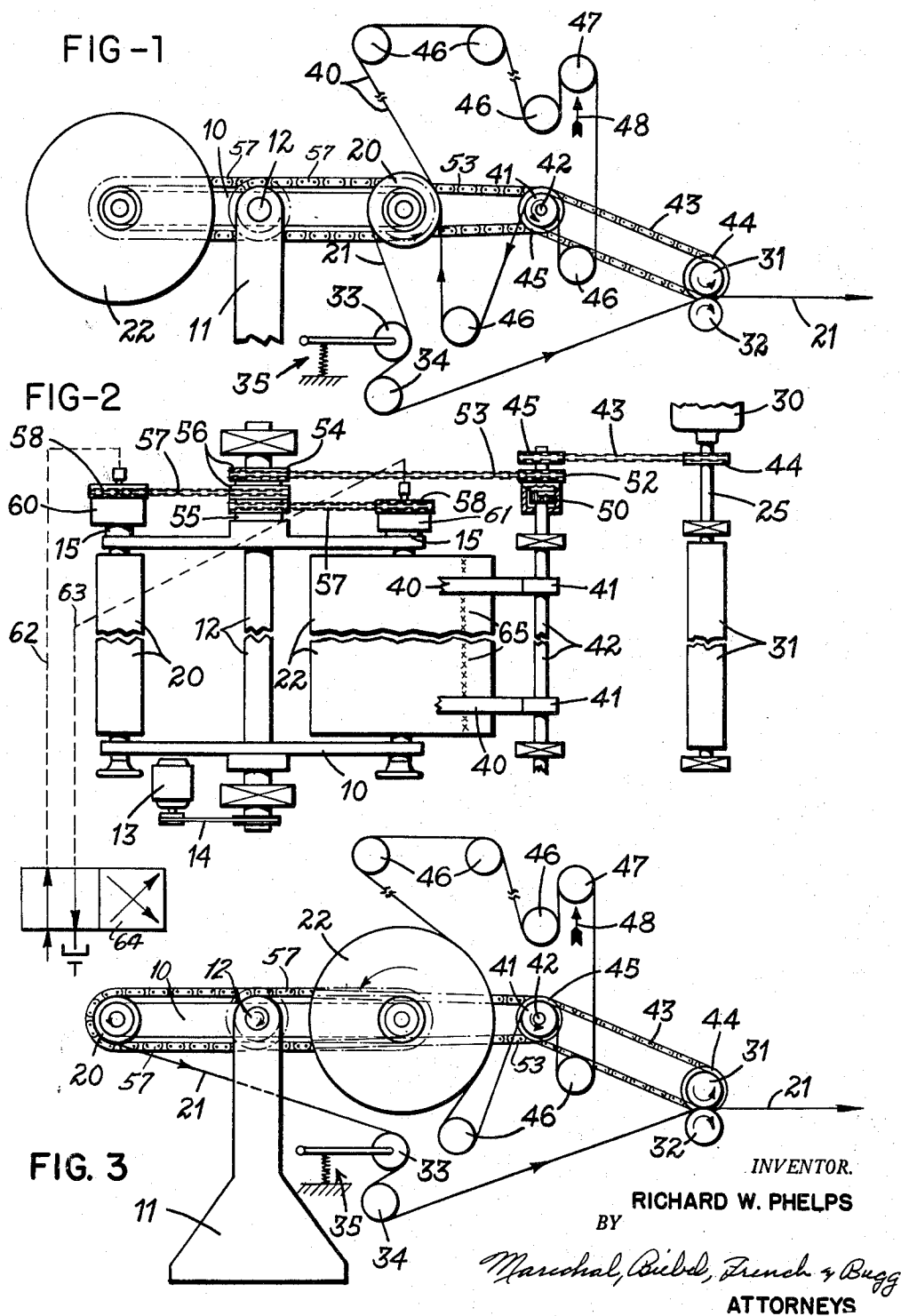
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R. W. PHELPS

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Richard W. Phelps, Fulton, N. Y., assignor to The Black-Clawson Company, Hamilton, Ohio, a corporation of Ohio

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This invention relates to apparatus for continuously unwinding web rolls.

The invention has particular relation to apparatus for continuously unwinding and changing web rolls wherein special provision is made for accurately controlling the tension in the web during splicing and changing from an unwinding roll to a full roll.

It is a particular object of the present invention to provide continuous unwinding, changing and tensioning apparatus for web rolls wherein the tension of the unwinding web is maintained during the major portion of the unwinding of each successive roll by a tension control member which engages the unwinding roll and is continuously driven at a slightly lesser speed than the web speed to restrain free rotation of the roll, wherein the unwinding roll is moved out of engagement with the tension control member prior to changing to the next full roll in order to bring the full roll into engagement with the tension control member for acceleration to unwinding speed, and wherein tension is maintained in the unwinding roll while out of engagement with the tension control member by a driving connection to the spindle of the unwinding roll which is so correlated with the drive for the tension control member that essentially the same peripheral speed relation is maintained between the unwinding roll and the tension control member throughout the roll changing operation.

It is another object of the invention to provide continuous web roll unwinding, changing and tensioning apparatus as outlined above wherein the driving connection to the spindle of the unwinding roll becomes effective automatically in response to reduction in the diameter of the unwinding roll to a point such that the changing operation to the next full roll should commence.

An additional object of the invention is to provide web roll unwinding, changing and tensioning apparatus as outlined above wherein the drive to the spindle of the unwinding roll is connected to the continuous drive for the main tension control member.

A further object of the invention is to provide web roll unwinding, changing and tensioning apparatus as outlined above wherein tension control of the unwinding roll during roll changing is effected and maintained by a simple and novel arrangement of friction members operating through an overrunning clutch which forms a part of the driving connection between the spindle of the unwinding roll and the drive for the main tension control member and which is arranged to effect automatic transfer of the tension control of the unwinding roll from the periphery thereof by the main tension control member to the spindle thereof in response to predetermined reduction in the diameter of the unwinding roll.

It is also an object of the invention to provide continuous web roll unwinding, changing and tensioning apparatus wherein the main tension control member is constituted by one or more continuously driven belts and wherein the driving connection between the main tension control member and the spindle of the unwinding roll is

established through an overrunning clutch having the overrunning member thereof mounted on or otherwise connected with the drive shaft for the tension control belt or belts.

Additional objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

Fig. 1 is a diagrammatic side view of continuous web roll unwinding, changing and tensioning apparatus constructed in accordance with the invention and showing the apparatus in the position just prior to a roll change;

Fig. 2 is a diagrammatic top view looking downward in Fig. 3; and

Fig. 3 is a view similar to Fig. 1 showing the apparatus in an intermediate position during the roll change.

Referring to the drawing, which illustrates a preferred embodiment of the invention, the apparatus is shown as including a double armed reel 10 mounted for rotation on a base 11 by means of its shaft 12 provided with a suitable indexing drive indicated diagrammatically as a motor 13 having a driving connection 14 to the shaft 12. Spindle means 15 of any suitable type are provided at opposite ends of the reel arms 10 for mounting the successive web rolls to be unwound from the reel. Such web rolls are designated as an unwinding roll 20, from which the web 21 is being unwound, and a full roll 22 from which the web is to be spliced to the end of the web 21 to maintain the continuous unwinding operation.

Means are provided for drawing the web 21 from the roll 20 at a predetermined speed causing the roll 20 to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as its diameter decreases. A main drive shaft 25 is shown as driven by a motor 30 and carries a pull roll 31 cooperating with a complementary pull roll 32, this drive means being advantageously a part of or otherwise correlated with the printing or coating apparatus or other station where the web is to be treated or used. The web 21 travels to the pull rolls 31—32 over a paster roll 33 and a fixed guide roll 34, the paster roll 33 having a yieldable mounting as indicated at 35.

The main tension control means for the unwinding rolls comprises a plurality of belts 40 mounted for engagement with each successive unwinding roll. The belts 40 are continuously driven by drive pulleys 41 on a drive shaft 42 which is positively driven in fixed angular speed relation with the main drive shaft 25 such that the peripheral speed of the belts is slightly less than the web speed established by the peripheral speed of pull roll 31. The drive for the belts is shown as a chain 43 and sprockets 44 and 45 on shafts 25 and 42 respectively. In addition to the drive pulleys 41, the belts 40 run over a series of idler pulleys 46 and a set of tension control pulleys 47 having a yieldable mounting as indicated by the arrow 48.

An auxiliary drive is provided for selectively driving the spindles 15 to control the rotation of an unwinding roll 20 while out of engagement with the belts 40. This drive includes an overrunning clutch or conventional construction having its overrunning member 50, shown as the inner clutch member, directly mounted on the belt drive shaft 42 for continuous driving thereby. The other member 51 of the overrunning clutch carries a sprocket 52 connected by chain 53 with a sprocket 54 fixed on a sleeve 55 which is rotatable on the reel shaft 12. This sleeve 55 also has fixed thereon a pair of additional sprockets 56 each connected by a chain 57 with a sprocket 58 carried by the outer member of a friction clutch 60, 61 having its inner member secured to the associated spindle 15. Means are provided, such as the fluid pressure system indicated diagrammatically by the line 62

and 63 and the valve 64, for causing selective engagement and disengagement of the clutches 60 and 61.

In the operation of this apparatus, the normal positions of the parts during unwinding from a roll 20 are shown in Fig. 1. The reel 10 is positioned to hold the roll 20 in engagement with the belts so that it is frictionally restrained against free rotation by the belts running at a speed slightly less than the web speed through the nip of pull rolls 31—32. At the same time, since the unwinding roll will continuously attempt to overrun the belts 40, this action will be transferred back to the sprocket chain 43 in such manner that the upper side of the chain as viewed in Fig. 1 will be the tight side.

During this portion of the unwinding sequence, the overrunning clutch member 50 will be continuously driven by shaft 12 in fixed angular speed relation with the peripheral speed of the belts. The friction clutch 60 on the spindle 15 carrying roll 20 will be engaged, and it will therefore act through its chain 57, the sleeve 55 and the chain 53 to drive the outer member 51 of the overrunning clutch at an angular speed which is less than that of the overrunning clutch member 50, but which will steadily increase as the diameter of the unwinding roll decreases with resulting increase in its angular speed. The other friction clutch 61, on the spindle 15 carrying the next full roll 22, will be held disengaged, and these conditions will obtain until the speed of the outer clutch member 51 has increased to such extent that it substantially matches the constant speed of the overrunning clutch member 50, thus causing these two clutch members to engage.

As soon as the overrunning clutch members engage, a driving torque will be applied from the unwinding roll 20 back through its associated spindle 15 and the several sprockets and chains to the main drive shaft 25 independently of the belts 40, but since this torque will be in the same direction as the torque applied to the drive shaft 25 through the belt system, the load changes presented to the drive motor 30 will be held to a minimum during roll changing. Following engagement of the overrunning clutch, the speed of the two clutch members in the engaged friction clutch 60 will initially be equal, and then as the diameter of the roll continues to decrease following engagement of overrunning clutch 50—51, slippage will occur in clutch 60 by reason of the fact that the speed of its outer member and its sprocket 58 are being held constant.

As soon as this tensioning drive connection has been established, the reel 10 is indexed in clockwise direction from the position shown in Fig. 1 to the position shown in Fig. 3, thus swinging the unwinding roll 20 out of engagement with the belts 40 and bringing the full roll 22 into engagement with the belts for acceleration to the peripheral speed of the belts. The full roll will ordinarily previously have pressure sensitive adhesive applied thereto adjacent the end of the web thereon as indicated at 65 in Fig. 2. Then after roll 22 has been adequately accelerated, the reel is indexed further in clockwise direction sufficiently to bring the full roll into pressure engagement with the web 21 against the pasteur roll 33 to form the desired splice to the web.

After the splice and roll change have thus been completed, the web 21 from the roll 20 is either severed or allowed to run out, and the associated friction clutch 60 is disengaged. The core from this expired roll is then replaced by a new full roll, and the other friction clutch 61 should be engaged in preparation for the next roll change. The control system for these clutches may be such that engagement of either clutch causes simultaneous disengagement of the other, since the normal unwinding operation is not affected by the special tension control system of the invention until the diameter of the unwinding roll has substantially decreased as described above. It will thus be apparent that the apparatus of

the invention provides simple and effective controls for the web tension during continuous unwinding operations, with the same main control being effective even after the unwinding roll has moved out of engagement with the continuously driven tension control belts or other members.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a continuously movable tension control member mounted for engagement with said unwinding roll, means for driving said tension control member at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said driving means for continuous driving thereby in fixed angular speed relation therewith, means for connecting the other member of said clutch with said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speeds of said clutch members are substantially equal, and means for indexing said reel to shift said unwinding roll out of engagement with said tension control member and to bring said full roll into driven relation with said tension control member for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members.

2. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a continuously movable tension control member mounted for engagement with said unwinding roll, means for driving said tension control member at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said driving means for continuous driving in fixed angular speed relation with said driving means, frictional means for connecting the other member of said clutch with said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speed of said unwinding roll tends to exceed the angular speed of said tension control member, means for indexing said reel to shift said unwinding roll out of engagement with said tension control member and to bring said full roll into driven relation with said tension control member for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members and said frictional means, and means for disconnecting said fric-

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tional means from said unwinding roll following splicing of the web and for connecting said frictional means with said full roll in preparation for the next roll change.

3. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a belt mounted for engagement with said unwinding roll, means for driving said belt at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said driving means for continuous driving in fixed angular speed relation with said driving means, means for connecting the other member of said clutch with said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speed of said unwinding roll tends to exceed the angular speed of said belt driving means, and means for indexing said reel to shift said unwinding roll out of engagement with said belt and to bring said full roll into driven relation with said belt for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members.

4. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, main drive means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a belt mounted for engagement with said unwinding roll, means including a pulley driven by said main drive for driving said belt at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said belt driving means for continuous driving in fixed angular speed relation therewith, means for connecting the other member of said clutch to said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speed of said unwinding roll tends to exceed the angular speed of said belt driving means, and means for indexing said reel to shift said unwinding roll out of engagement with said belt and to bring said full roll into driven relation with said belt for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said belt driving means acting through said engaged clutch members.

5. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a belt mounted for engagement with said unwinding roll, means including a drive shaft for driving said belt at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an

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overrunning clutch having the overrunning member thereof mounted on said drive shaft for continuous driving thereby in fixed angular speed relation with said belt, means for connecting the other member of said clutch to said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speeds of said clutch members are substantially equal, means for indexing said reel to shift said unwinding roll out of engagement with said belt and to bring said full roll into driven relation with said belt for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members, and means for disconnecting said other clutch member from said unwinding roll following splicing of the web and for connecting said other clutch member with said full roll in preparation for the next roll change.

6. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, main drive means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a belt mounted for engagement with said unwinding roll, means including a pulley shaft having a positive driving connection with said main drive means for driving said belt at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof mounted on said pulley shaft for continuous driving thereby in fixed angular speed relation therewith, frictional means for connecting the other member of said clutch with said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members upon decrease in the diameter of said unwinding roll to such extent that the angular speeds of said clutch members are substantially equal, and means for indexing said reel to shift said unwinding roll out of engagement with said belt and to bring said full roll into driven relation with said belt for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said belt driving means acting through said engaged clutch members.

7. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, first and second spindle means on said reel for connection with said unwinding and full rolls respectively, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a tension control member mounted for engagement with said unwinding roll, means for driving said tension control member at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said driving means for continuous driving in fixed angular speed relation with said driving means, means forming a driving connection between the other member of said clutch and said first spindle means for effecting rotation of said other clutch member at a continuously increasing angular speed corresponding with said unwinding roll to cause driving engagement of said clutch members upon decrease in the diameter of said unwinding roll such that the angular speeds of said

clutch members are substantially equal, and means for indexing said reel to shift said unwinding roll out of engagement with said tension control member and to bring said full roll into driven relation with said tension control member for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members.

8. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, first and second spindle means on said reel for connection with said unwinding and full rolls respectively, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a belt mounted for engagement with said unwinding roll, means for driving said belt at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said belt driving means for continuous driving in fixed angular speed relation with said driving means, means forming a driving connection between the other member of said clutch and said first spindle means for effecting rotation of said other clutch member at a continuously increasing angular speed corresponding with said unwinding roll to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speed of said first spindle means tends to exceed the angular speed of said belt driving means, means for indexing said reel to shift said unwinding roll out of engagement with said belt and to bring said full roll into driven relation with said belt for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members, and means for shifting said driving connection from said first spindle means to said second spindle means following splicing of the web to prepare for the next roll change.

9. Continuous web roll unwinding, changing and tensioning apparatus as defined in claim 8 comprising first and second friction clutches carried by said first and second spindle means respectively, a driving member mounted coaxially with said reel for rotation relative thereto, means forming separate driving connections between said driving member and each of said friction clutches, means forming a driving connection between

said driving member and said other member of said overrunning clutch, and selective control means for causing engagement of said first friction clutch with said first spindle means while effecting disengagement of said second friction clutch to complete the driving connection between said first spindle means and said belt driving means and to provide for transfer of said driving connection to said second friction clutch and said second spindle means following a roll change and in preparation for the next roll change.

10. Continuous web roll unwinding, changing and tensioning apparatus comprising a rotatable reel for carrying an unwinding web roll and a full web roll for splicing to the end of the web from said unwinding roll, means for drawing the web from said unwinding roll at a predetermined speed causing said unwinding roll to rotate at a substantially constant peripheral speed and a constantly increasing angular speed as the diameter thereof decreases, a continuously movable tension control member mounted for engagement with said unwinding roll, means for driving said tension control member at a controlled speed slightly less than said web speed to maintain tension in the web by frictionally restraining rotation of said unwinding roll, an overrunning clutch having the overrunning member thereof connected with said driving means for continuous driving thereby in fixed angular speed relation therewith, first and second friction clutches carried by said reel in driving relation with said unwinding and full rolls respectively, means forming a driving connection between the other member of said clutch and both of said friction clutches, selective control means for effecting disengagement of said second friction clutch while effecting engagement of said first friction clutch with said unwinding roll for rotation at a corresponding continuously increasing angular speed to cause driving engagement of said clutch members when the diameter of said unwinding roll decreases to such extent that the angular speeds of said clutch members are substantially equal, said control means being shiftable to provide for transfer of said driving connection to said full roll following a roll change and in preparation for the next roll change, and means for indexing said reel to shift said unwinding roll out of engagement with said tension control member and to bring said full roll into driven relation with said tension control member for acceleration and splicing to the web from said unwinding roll while said unwinding roll is restrained against free rotation by said driving means acting through said engaged clutch members.

No references cited.