Nov. 7, 1967 H. VITS 3,351,297

WEB SPLICING DEVICE

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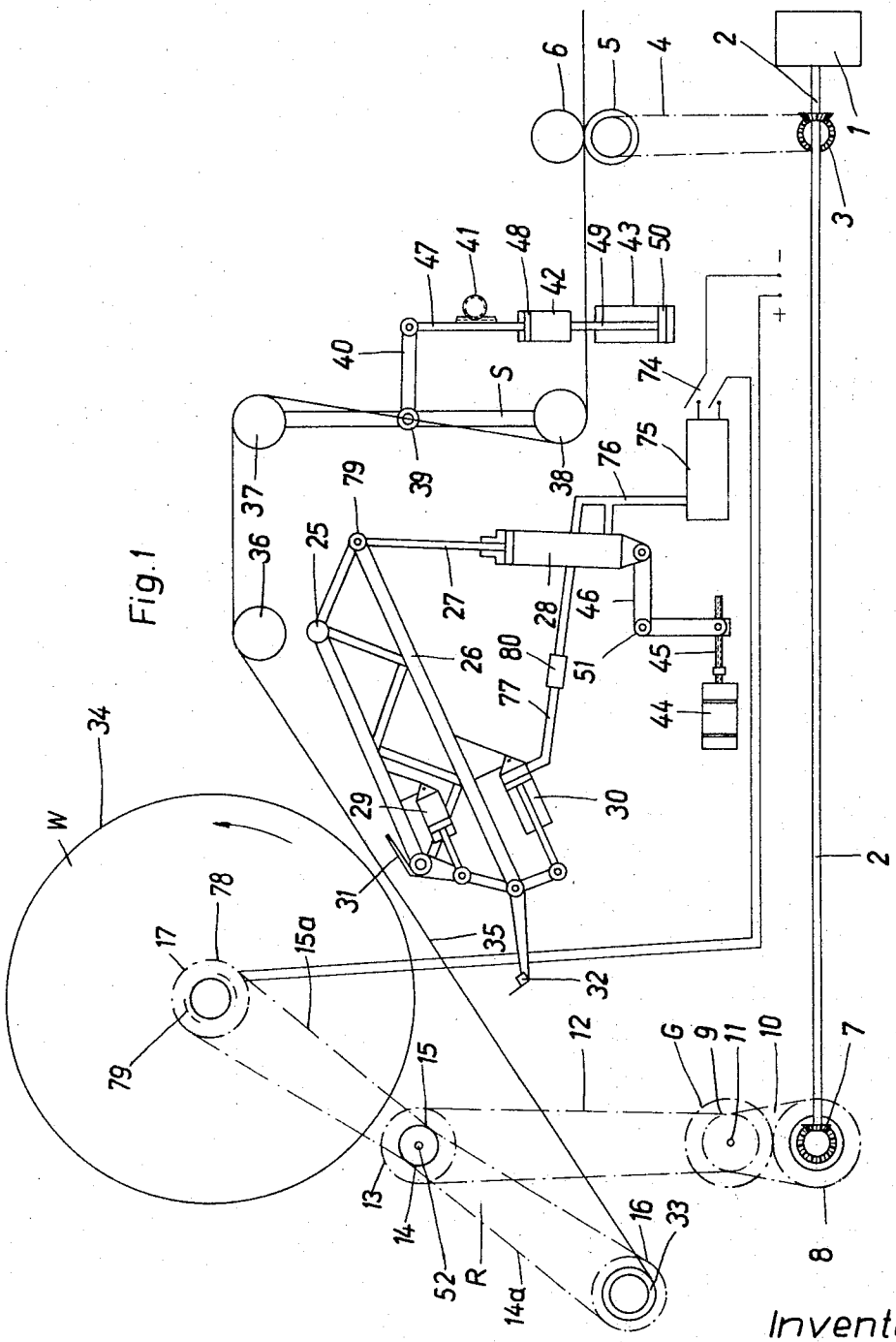


Fig. 1

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WEB SPLICING DEVICE

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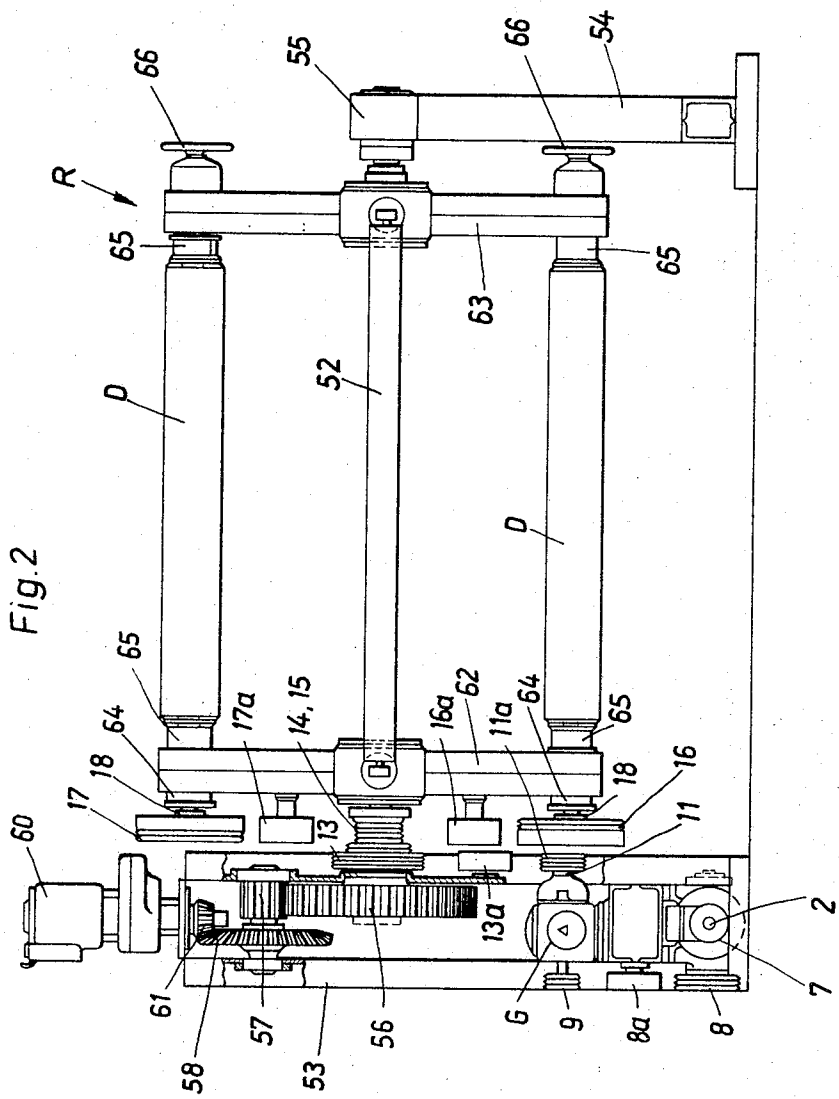


Fig.2

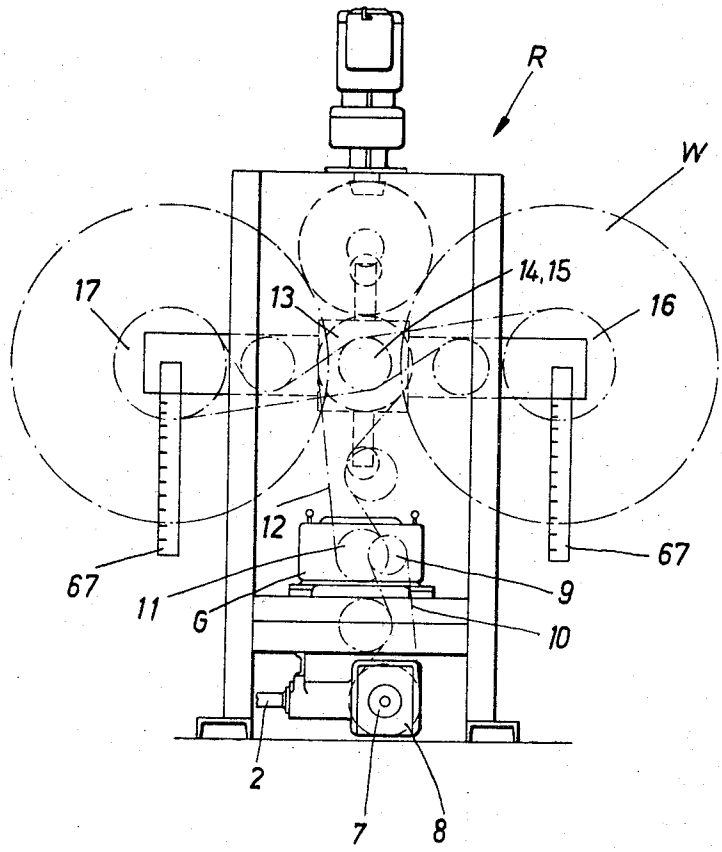
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WEB SPLICING DEVICE

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Fig. 3



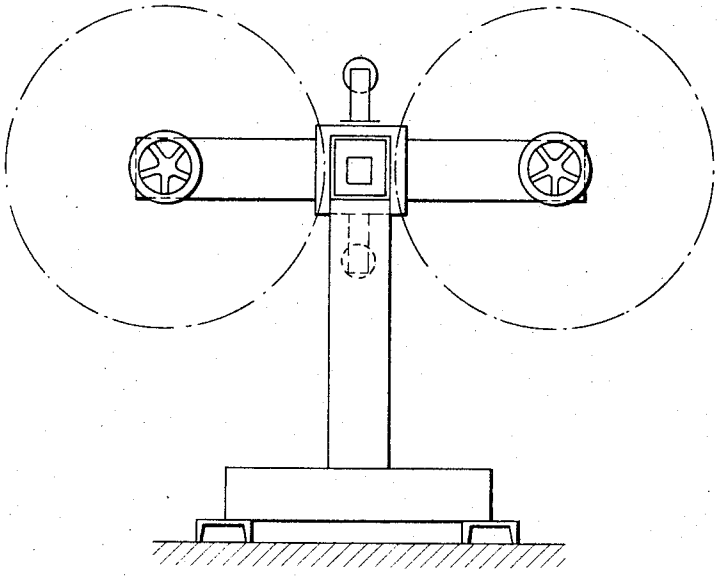
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WEB SPLICING DEVICE

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Fig. 4



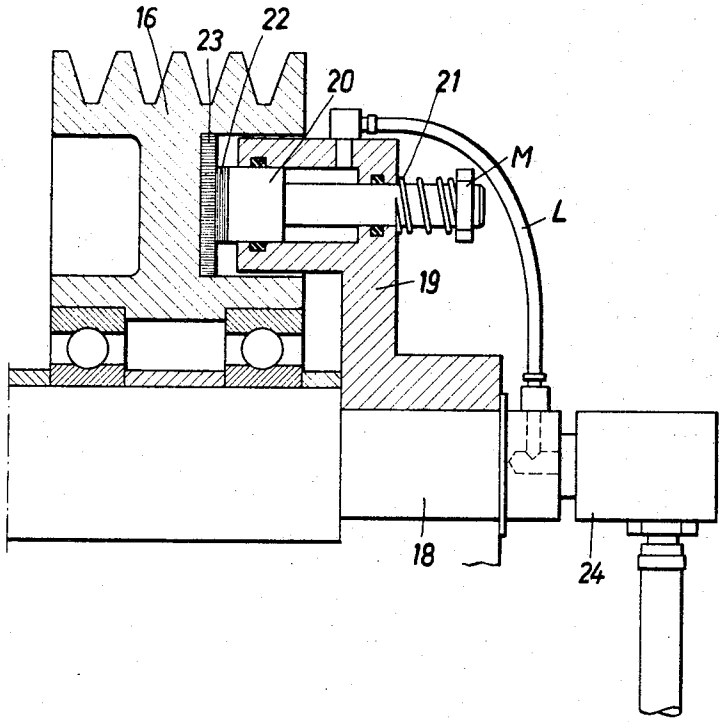
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Fig.5

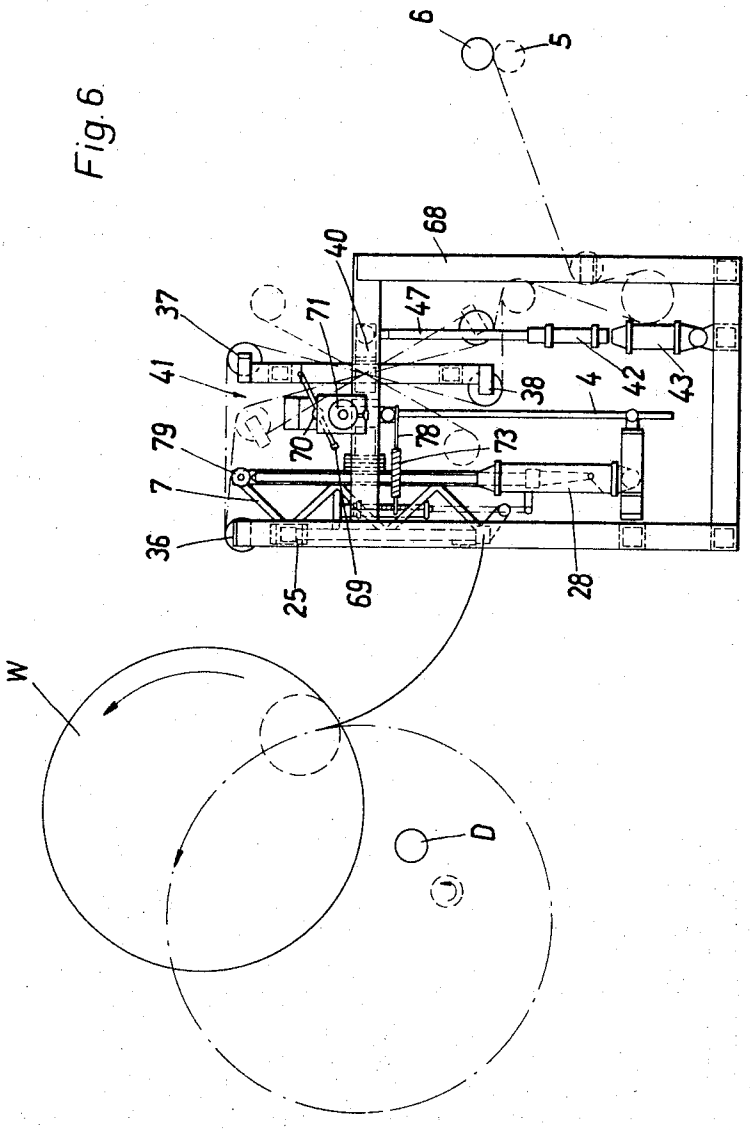


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Fig. 6



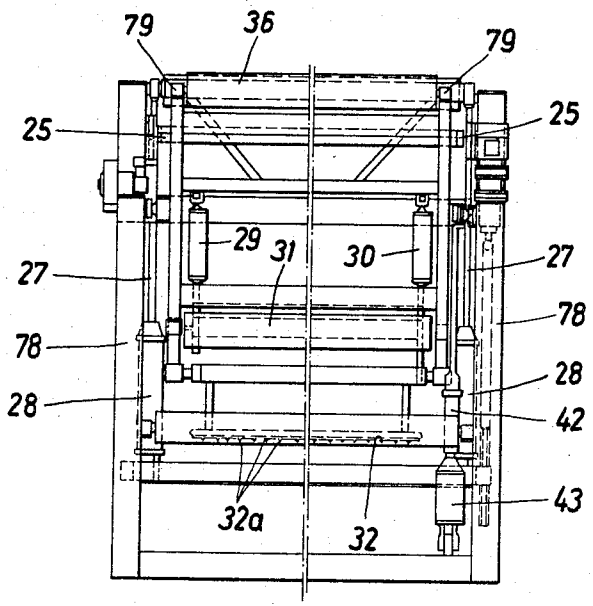
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Fig. 7



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United States Patent Office

3,351,297
Patented Nov. 7, 1967

3,351,297

WEB SPLICING DEVICE

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Filed Mar. 29, 1966, Ser. No. 538,356
Claims priority, application Germany, Mar. 30, 1965, M 64,707
12 Claims. (Cl. 242—58.2)

This invention relates to an apparatus for connecting the beginning of a new roll of strip material to the end of an old roll of strip material, the connection being made while the strip material is moving at a relatively high speed.

In prior-art devices for handling strip material (such as paper, newsprint and so on) at hight speeds, difficulties have been encountered with regard to the drive for the new roll, which is to supply further strip material. Prior-art drive means which engaged the periphery of the new roll with a friction wheel or a belt entailed the disadvantage that the adhesive necessary for attaching the new roll to the strip material coming from the old roll had to be omitted in the area where the wheel or belt contacted the strip; otherwise the strip would adhere to the wheel or belt and the new strip would tend to wind around the drive wheel or belt. However, in coating and impregnating machines where the strip material is completely immersed in an impregnating tank, a connection which does not have a complete layer of adhesive causes the impregnating fluid to accumulate in the area not covered with adhesive, and this leads to breaking or ruining the connection when it is passed through the slot of a roller.

Therefore, the adhesive area must extend transversely across the entire width of the strip. When, because of this requirement, drive means of the type which engaged the periphery of the roll was used, the roll had to be brought very quickly to a peripheral speed corresponding to the speed of the strip, and it had to attain the required speed during completion of less than one full revolution. In order to achieve this acceleration extraordinarily great drive and pressure forces were required, which at times adversely affected the beginning portion of sensitive or delicate strip material, so that it became impossible to achieve secure adhesion to the end of the preceding strip.

Unwinding devices have been built for coating machines in which the new roll was driven on a shaft and a tachometer was mounted at the outermost edge of the roll for enabling adjustment of the circumferential speed required for the connection, so that the adhesive application could be uninterrupted from edge to edge. The drive means for the new roll was then adjusted so that the circumferential speed coincided with the speed of advance of the old strip. However, devices of this type required considerable technical complications, for it was necessary to separate the drive from the new roll at the moment of cohesion; since slight speed deviations between the strips were unavoidable, the new strip thereby tended to be advanced either too loosely or too tautly. If the strip were too taut, the strips were pulled apart or else the strip tore at another point; a strip that was too loose tended to cause trouble in the further processing. Attempts to utilize the electrical drive of the new roll simultaneously as a brake for the new strip to be wound off, have not yielded satisfactory results.

An object of the present invention is to provide apparatus wherein the hitherto-encountered disadvantages are eliminated. To solve the problems, the invention provides that the drive apparatus for the new roll be connected to the main drive of the engine through (1) a transmission gear arrangement which is smoothly adjustable, without stages, to a desired fixed transmission ratio and

(2) a coupling having infinitely adjustable slip disposed in series with the transmission. The concept is based on the realization that the angular velocity of the new roll which is needed in order to make the connection depends on the diameter of the new roll. Each change in roll diameter therefore requires a specific appropriate adjustment of the transmission ratio. This transmission ratio can be determined from a scale on the unwinding device either directly or in characteristic values for the relative drive adjustment, so that, after having inserted the new roll into the apparatus, the operator can read the scale and set the drive adjustment necessary for achieving the desired identical speed.

If, as is usually the case, the apparatus is provided with a swivel frame which receives the rolls from exchangeable mandrels, the invention, as a further advantageous feature, provides on the shaft of each mandrel a selectively engaged coupling of adjustable slip. The tension of the strip may be adjusted by the braking force applied on these couplings. It has been found that when adjusting the couplings to the normally occurring strip tensions, braking forces are obtained which are entirely sufficient for putting the new roll slowly into motion after closing the coupling. Since the mass inertia of the roll is relatively great, several revolutions are necessary before the new roll reaches a circumferential speed corresponding to the speed of the strip where the slip in the coupling ceases. However, the time required to achieve this is no disadvantage when the other advantages of the invention are taken into consideration. After the adhesive connection has been made, the coupling generates the desired braking force, since the speed of the mandrel increases as the roll diamter decreases, while the linear speed remains unchanged.

In order to obtain the desired braking effect from the very start, it is recommended that at the beginning the transmission gear be set for a driven roll speed slightly lower than the speed of the strip. To compensate for the difference in speed between the old and the new strip, which is particularly pronounced at the moment when the adhesive connection is made, the strip material is led, between its wind-off and a following processing machine, through a tensioning device having movably supported rollers whose resistance to displacement (in the sense of a shortening of the path in the strip) corresponds to the highest admissible tension in the strip, and whose restoring force (in the sense of a lengthening of the path) is attuned to the lowest required strip tension. Such a tensioning or compensating device temporarily compensates for the slightly decreased speed of the strip. Devices of this type generally maintain a uniform tension in the strip, when the adjusting power for overcoming friction in both directions is disregarded. To prevent vibration during operation of the tensioning device, it is advisable to install a damping device.

Adjustment of the tensioning device may be effected by an overriding clutch, which actuates a brake pulley only during movements in one direction while adjustment into the other direction is not subject to additional braking. In this way, the adjusting power of the rollers on the tensioning device in one direction may be made to correspond to the maximum admissible tension of the strip, and the restoring force made to correspond to a minimum required tension of the strip. The differences in speed are thus prevented from becoming effective.

When adhering the old strip to the beginning of a new roll, a compressive force must be exerted in order for the adhesive film to become effective. Hitherto, it has been common to use for this purpose a roller with a resilient surface. If such a roller is not driven, it exerts significant braking force on the strip material when it comes into contact with it, at least until the roller is

accelerated to the speed of the strip. If, on the other hand, the roller is driven, it may come into contact with the strip at a circumferential speed different from that of the speed of the strip, and again result in tearing the strip material, particularly in the area of adhesion.

With apparatus in accordance with the invention, adjustment of the coupling provided on the shaft of the mandrel of the roll which is in the process of being unwound, may afford enough flexibility for the new strip to adjust itself to the linear speed of the old strip at the moment when the adhesive connection is produced. Since friction occurs when the old strip is pressed against the circumference of the new roll, the end of the old strip as well as that of the new roll is slightly braked, so that an increase in tension occurs in the forward running strip. However, as already mentioned, this is intercepted and damped by the tensioning device.

A further improvement of the apparatus relates to pressing the old strip against the new roll by means of a brush whose bristles have a smaller coefficient of friction (relative to the strip which is to be pressed against the roll) than the strips have with each other. In this manner, immediately after compression of the old strip against the new roll, complete synchronism is obtained, and the original error in synchronization in the tensioning device is compensated for while the adhesion process lasts.

Other objects and advantages of the invention will appear from the following description of a preferred embodiment.

In the drawings:

FIG. 1 is a schematic side view of apparatus in accordance with the invention;

FIG. 2 is a front view of the swivel frame;

FIG. 3 is a side view of the swivel frame showing the drive means;

FIG. 4 is a view which shows the opposite side of the arrangement of FIG. 3;

FIG. 5 is a partial vertical section through a coupling with adjustable slip, as used in the invention;

FIG. 6 is a side view of the tension means; and

FIG. 7 is an elevation which shows the front view of the arrangement according to FIG. 6.

FIG. 1 shows a main drive which drives a pair of compression rollers **5** and **6** via a shaft **2**, bevel gearing **3**, and a chain drive **4**. The rollers **5** and **6** represent a processing machine which is performing some operation upon a strip **35** and also is pulling it along, imparting to the strip **35** a predetermined velocity.

The shaft **2** also drives, via a further pair of bevel gears **7** and a transmission G comprising two pulleys **8** and **9** and the belt **10**, an infinitely variable speed transmission. From an output shaft **11** of the gearing G, a transmission **12** (which may be a belt) leads to a pulley **13**, which is supported coaxially with and rotatably on the axis **52** of rotation of a swivel frame R which receives alternatively the two rolls **34** of the strip material. Two coaxial drive pulleys **14** and **15** are rigidly connected to the pulley **13**, belt drives **14***a* and **15***a* leading from each of the pulleys **14** and **15** to each of two pulleys **16** and **17** for the exchangeable mandrels D at the ends of a swivel frame R.

The swivel frame R according to FIGS. 2–4 comprises two uprights **53**, **54**, one of which (in FIG. 2 at the left-hand side) supports the driving means for the mandrels D and for rotating the frame R. The opposite upright **54** comprises only a bearing **55** for the axis **52** of the frame R. As shown in FIG. 2, fixed upon the axis **52** is a pinion **56** which is in engagement with a second pinion **57** supported in the upright **53**. Mounted upon the same axis with the pinion **57** is a bevel gear **58** bearing in engagement with a corresponding gear **61** fixed upon the shaft **59** of the motor **60**. The arrangement consisting of motor **60** and gears **61**, **58**, **57** and **56** serves for rotating the swivel frame R when the strip material is changed from a first mandrel D to the second mandrel.

FIG 2 shows also the driving means for the mandrel D. The pulley **8** is mounted upon the output shaft of the pair of bevel gears **7**. From the pulley **8** a belt **10** (shown in FIG. 1) is led over a tension roll **8***a* to a pulley **9** as fixed upon the input shaft of the infinitely variable speed transmission G. The output shaft **11** of the transmission G supports a pulley **11***a*. From the pulley **11***a* (shown only in FIG. 2), the belt **12** runs via a tension roll **12***a* to a pulley **13**, the latter being rotatably borne on the axis **52** of the frame R. Non-rotatably connected with the pulley **13** are two side-by-side arranged pulleys **14** and **15** which again are rotatable on the shaft **52**. A belt **14***a* (FIG. 1) runs from pulley **14** to the pulley **16** which is non-rotatably connected with the (in FIG. 2) lower mandrel D. A further belt **15***a* accordingly is led from the pulley **15** to the pulley **17**, the latter being non-rotatably connected with the (in FIG. 2) upper mandrel D. The pulleys **16** and **17** are arranged in a lateral offset position with respect to each other. The arrangement is completed by tension rollers **13***a*, **16***a* and **17***a* which provide for the required tension and for quiet operation of the belts **12**, **14***a* and **15***a*.

The pulleys **16** and **17** are rotatably supported by shafts **18**. The shafts **18** are rotatably borne by a lateral arm **62** of the frame R. The bearings are shown at **64**. Both shafts **18** project inwardly over the arm **62**, the projecting end **65** comprising dogs in engagement with corresponding dogs on the end of the mandrel D. Instead of dogs a conical projection can be provided which is in engagement with a conical hole in the opposite side wall of the mandrel D. It is of importance that the mandrels are non-rotatably connected with the shafts **18** when the mandrels D are pressed against a projecting end of the shaft **18**.

In order to provide for the necessary pressure force and in order to change the mandels D, the bearings **64** at the opposite arm **62** of the frame R can be shifted in axial direction by means of handwheels **66**. When the bearing **64** is drawn back by turning the handwheel **66**, the mandrel D can be taken off from its supporting means between the shaft end **65** and the bearing **64**.

The insertion of a new mandrel is similarly done. On the drive side of the frame R a scale **67** is provided on both mandrel receiving arrangements. The scale is mounted such that the operator can easily observe it. On the scale **67**, the diameter of the new inserted strip roll or a characteristic value appears such that the operator can adjust the speed transmission G to the correct ratio in order to connect the trailing end of the exhausted strip roll with the leading end of the new strip roll.

FIG. 3 shows the swivel frame **3** of FIG. 2 in a side view seen from the left-hand side of FIG. 2, whereby the frame in relation to FIG. 2 has been turned about 90°. The position of the different belts is clearly illustrated.

The opposite upright **54** which supports only the non-driven bearings is shown in FIG. 4 in a side view and in a position of the arms **63** and **64** according to FIG. 3.

Between each of the pulleys **16** and **17** and the shaft **18** which supports the adjacent winding mandrel there is a coupling with adjustable slip. In accordance with FIG. 5, the pulleys **16** and **17**, respectively, are rotatably supported on an axle **18** on which hub **19** is secured. In the hub **19**, a plurality of fluid-pressure-actuated pistons **20** is provided in corresponding hydraulic or (preferably) pneumatic cylinders, to which fluid-pressure conduits L are connected. On their surface facing the pulley **16** (and the pulley **17**) the pistons **20** are equipped with a coupling lining **22** which, when the coupling is closed, as in FIG. 5, presses against a driven pulley **23** rigidly connected to the pulley **16** (a similar one being connected to the pulley **17**). The pressure fluid is supplied with the aid of a head **24** embracing the end of the rotating shaft **18**, which is provided with a channel. The pistons **20** are urged

toward an uncoupled position by springs **21**, which are located on the outside of the boss **19** and are secured by a nut M.

Occurrence of slip between the coupling portions **22** and **23** is dependent on the pressure of the fluid fed through the conduit L and can be accurately adjusted to a desired value. The coupling may also be adjustable by mechanical means. It is also possible to provide an electromagnetic coupling, so long as it is possible to adjust it infinitely and with sufficient accuracy and to the desired slip.

In the frame of the apparatus (which is not shown in full detail) a swivel arm **26** of truss-like construction is movable about a transverse axle **25**. For generating the swivel movement, a hydraulic or pneumatic cylinder **28** is used, having its piston act on the frame **26** via a piston rod **27**. On the swivel arm **26**, further fluid-actuated cylinders **29** and **30** are provided, of which the cylinder **29** causes movements of a rotatable brush **31**, and the cylinder **30** actuates a knife **32**.

During operation of the apparatus, the swivel frame R, one end of which supports the old roll **33** supplying the still running strip **35** and the other end of which supports the roll **34** which is to be processed after exhaustion of the roll **33**, is preparatorily turned so that the running strip **35** passes close by the outer circumference of the new roll **34**. The outwardly disposed beginning of the strip forming the roll **34** is manually provided with an adhesive film over an area extending transversely across the strip. When, with the aid of the previously described drive, the roll **34** is brought to a circumferential speed which substantially corresponds to the speed of the strip **35**, and when the old roll is about to run out, the strip **35** is urged against the roll **34** with the aid of the brush **31**, shortly before the adhesive-coated area reaches the point of contact. The already recited cylinder **29** serves to move the brush **31** to this operative position.

In order that the beginning of the roll **34** be held on the roll during acceleration to the required speed, and that it become loosened from the layer below it after adhesion with the strip **35**, the beginning of the roll **34** is secured to the roll only over an area about $\frac{1}{100}$ to $\frac{1}{1000}$ of the adhesion surface effective between the strip and mandrel with an adhesive whose adhesive force is less than that of the adhesive which serves for making the connection with the strip **35**. For this purpose small pieces of an ordinary adhesive tape can be used which are distributed over the width of the strip.

When the area of adhesion formed by contact of the strip **35** with the outer circumference of the roll **34** has passed the brush **31**, the knife **32**, whose cutting edge may be in the form of triangular teeth, is actuated by the cylinder **30**, and the old strip is thereby cut off.

The strip **35** is guided by a guide roller **36** to a tensioning device comprising two rollers **37** and **38** rotatably supported on a swivel arm S. The swivel arm S is rotatable in a joint **39** and is fixedly connected to a lever **40**. A piston rod **47** of a piston **48** which moves in a cylinder **42** is pivotally mounted to the lever **40**.

A damping device **41** is mounted on the piston rod **47**. As it is schematically shown in the drawings, it may comprise a transmission (not shown), an overriding clutch and a brake plate. The swivel movements of the arm S are transformed into rapid movements by a pair of spur wheels, the overriding clutch retransmitting the movement in one direction only to the brake plate.

The cylinder **42** in turn is connected to a piston rod **49** of a piston **50** in a further cylinder **43**. The cylinder **42** is smaller in diameter than the cylinder **43**.

The pressure of the pressure medium supplying the smaller cylinder **42** is attuned to a desired tension in the strip material **35**, so that the force transmitted by the piston **48** is insufficient to turn the swivel arm S with its rollers **37** and **38** into the direction of a longer path. The larger cylinder, on the other hand, is subjected to pressure of the pressure medium such that it moves into the direction of a shorter path only when the tension in the strip material has reached the highest admissible degree. The tension device is shown in detail in FIG. 6. The device is mounted together with the swivel arm **26** in a frame **68**, in contrast to the schematical showing of FIG. 1, and the damping and braking means **41** is provided between the tiltable arm S and the frame **68**. A toothed rack **69** is in engagement with a pinion **70**. The pinion **70** is connected by means of a transmission with a grooved roller **71**, a cord or cable **72** being wound on that roller. The opposite end of the cord or cable **72** is connected with a spring **73** fixed on the frame **68**. The spring **73** damps the movement of the swivel arm **26** in one direction. The damping action of the movements in the opposite direction is provided by an overrunning clutch acting upon a brake disc.

The tensioning device can be replaced by other elements, for example a dandy roll with hydraulic shock absorption and resilient compression. The important point, however, is that the said device should be in a position to compensate changes in the length of paths resulting from speed variations in the strip material, which occur due to deviations in the synchronism of the two strips during the process of being adhered together.

The cylinder **28** acting to turn the arm **26** is articulated at its lower end to one end of a bell crank **46** which rotates in a joint **51** fixed in the frame, and whose other end is secured by a nut to a spindle **45** which is driven by a servomotor **44**. This arrangement serves the purpose of adapting the starting position of the swivel arm **26** to different diameters of new rolls **34**; the arrangement of the servomotor **44** and spindle **45** enables precise adjustment of the distance between the brush **31** and knife **32**, respectively, and the strip material **35**. From FIG. 6 it can be seen that the arm **26** together with the tension means is mounted in the frame **68**.

The swivel arm **26** in FIG. 7 is shown in a front view. Between the lateral uprights **78** of the frame **68**, the arm formed by a framework is tiltable with relation to a horizontal transverse axis **25**. The strip material is held out of contact with parts of the arm **26** by means of a rotatably mounted guide roll **36** mounted a short distance in front of the axis **25**. The swivel arm **26** is operated by pressure medium operated cylinders **28**, the piston rods **27** whereof are connected with joints **79** localized laterally of the axis of rotation. On the frame **68** is mounted the cylinder **29** which actuates the tilting brush **31**. Furthermore, a cylinder **30** operating the cutting knife **32** is provided. The knife blade forms triangular edges **32***a*.

When a paper strip is being processed, preparation of the connection of the new roll with the still-running strip of the previous roll comprises cutting the beginning of the paper strip transversely to the direction of travel at an angle of about 60°–70°. An adhesive strip with a covering foil may be adhered along the transverse edge. Underneath the thus-prepared beginning of the strip, limited applications of adhesive are juxtaposed on small surfaces spaced from each other, so that the beginning of the strip will not become detached from the roll when the latter is accelerated. Prior to starting acceleration of the thus-prepared roll to the desired circumferential speed, the covering foil is removed from the adhesive strip.

In order that the roll be brought to the desired speed via the main drive, the coupling mounted in the pulley **17** is closed. This may be accomplished in the apparatus in accordance with the present embodiment by admitting compressed air to the cylinders in the hub **19** (see FIG. 5). Since, as already explained, a circumferential speed for the new roll **34** has been adjusted on the infinitely variable drive G which speed is somewhat less than the speed of the strip **35** when adhesion is effected as well as during the further run of the new strip, the coupling on the plate **23** acts as a brake after the adhesion

has been accomplished. In order to prevent the braking effect from increasing too much as the roll diameter decreases, the braking force may be reduced by reducing the pneumatic pressure on the piston **20**. Since the slip is infinitely variable on the coupling, it is possible to make adjustment to any tension desired at any time in dependence on the diameter of the still remaining roll.

Up to operating speeds of 100 meters per minute, triggering of the swivel motion of the arm **26** by actuation of a pressure contact **74** which causes the pressure medium to flow through the ducts **76, 77** into the cylinders **29** and **30** via a magnetic valve **75** can be accomplished manually. At greater speeds, however, it is recommended that a device be used which will prevent triggering of the movement of the brush **31** at an inopportune time, namely, at the movement of passage of the beginning of the new roll which has been prepared for adhesion. Such a device may consist of a magnetic switch **78** which cooperates with a permanent magnet **79** secured on the shaft of the new roll W so that release is only possible at a specific angular position of the beginning of the strip on the new roll. When the switch **74** controlling the magnetic valve **75** for the cylinder **29** is actuated, it closes only during the next passage of the magnet rotating with the new roll past the magnetic switch and it is only at this moment that adhesion occurs. This device prevents the brush **31** from applying pressure in such a moment when the adhesion area has already partially passed over the brush, so that complete adhesion does not occur. In order that the knife **32** may become actuated shortly after the brush **31** is applied, a time switch **80** is preferably installed for releasing the magnetic valve which controls the cylinder **30**.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. An apparatus for connecting the terminal end of a moving strip of material continuously drawn off a roll with the beginning of a new roll of the same material, said new roll being mounted with its periphery closely adjacent a point in the path of said strip and a beginning portion of said new roll having adhesive applied thereto for subsequent adhesion to said strip, comprising a main drive means for moving said strip, means for pressing the strip running off the old roll against the circumference of the new roll and adhering them together, and transmission means driven by said main drive means for rotating the new roll at a circumferential speed corresponding to the speed of the strip, said transmission means comprising a gearing which is infinitely adjustable to various transmission ratios, means for maintaining rigidly a chosen transmission ratio, and a slip coupling in series therewith.

2. The apparatus of claim **1**, having a swivel frame with a pair of shafts for receiving rolls disposed on exchangeable mandrels, a said slip coupling being mounted on each said shaft and having means for adjusting its degree of slip.

3. The apparatus of claim **2** wherein said slip couplings comprise a driving coupling portion having a frictional surface, a driven coupling portion having a frictional surface, and fluid-actuated pistons which compress said frictional surfaces with varying degrees of pressure.

4. The apparatus of claim **1**, wherein the strip material, at a location in between its roll and said main drive means, passes through a tensioning device comprising movable rollers whose resistance to adjustment, in the sense of a reduction of tension in the strip, corresponds to the highest-admissible tension of the strip, and whose restoring force, in the sense of an increase of tension, is attuned to the least-required strip tension.

5. The apparatus of claim **1** wherein said means for pressing includes a movable brush which urges the strip coming from the old roll against the new roll at the portion thereon provided with adhesive, said brush having bristles with a coefficient of friction relative to the strip from the old roll lower than what the strips have relative to each other.

6. The apparatus of claim **1** in which the beginning end of said new roll is secured to said new roll by adhesive whose adhesive force is less and whose area is much less than that of the adhesive used for joining the strips.

7. An apparatus for connecting the terminal end of a moving strip of material continuously drawn off a roll with the beginning of a new roll of the same material, said new roll being mounted with its periphery closely adjacent a point in the path of said strip and a beginning portion of said new roll having adhesive applied thereto for subsequent adhesion to said strip, comprising main drive means for moving said strip, transmission means driven by said main drive means for rotating the new roll at a circumferential speed corresponding to the speed of the strip, said transmission means comprising gearing set to a desired transmission ratio and slip coupling means in series therewith, and means for forcing said strip against said beginning portion.

8. The apparatus of claim **7**, having a swivel frame with two shafts for rotatably supporting said rolls, one said slip coupling means being mounted on each said shaft.

9. The apparatus of claim **7** wherein said slip coupling has means for adjusting the degree of slip.

10. The apparatus of claim **7** wherein each said slip coupling comprises a driving coupling portion and a driven coupling portion and pneumatic means for compressing said portions together.

11. The apparatus of claim **7** having between said rolls and said main drive means, a tensioning device comprising movable tensioning rollers whose resistance to reduction of tension in the strip corresponds to the highest-admissible tension applicable to the strip, and whose restoring force for increasing tension is attuned to the least-required strip tension.

12. The apparatus of claim **7** wherein the means for forcing comprises a brush having bristles with a coefficient of friction relative to said strip lower than the coefficient of friction of the two strips relative to each other.

References Cited

UNITED STATES PATENTS

3,194,508	7/1965	Netze	242—58.3
3,223,339	12/1965	Justus et al.	242—58.3
3,327,959	6/1967	Link et al.	242—58.3

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