

Nov. 9, 1943.

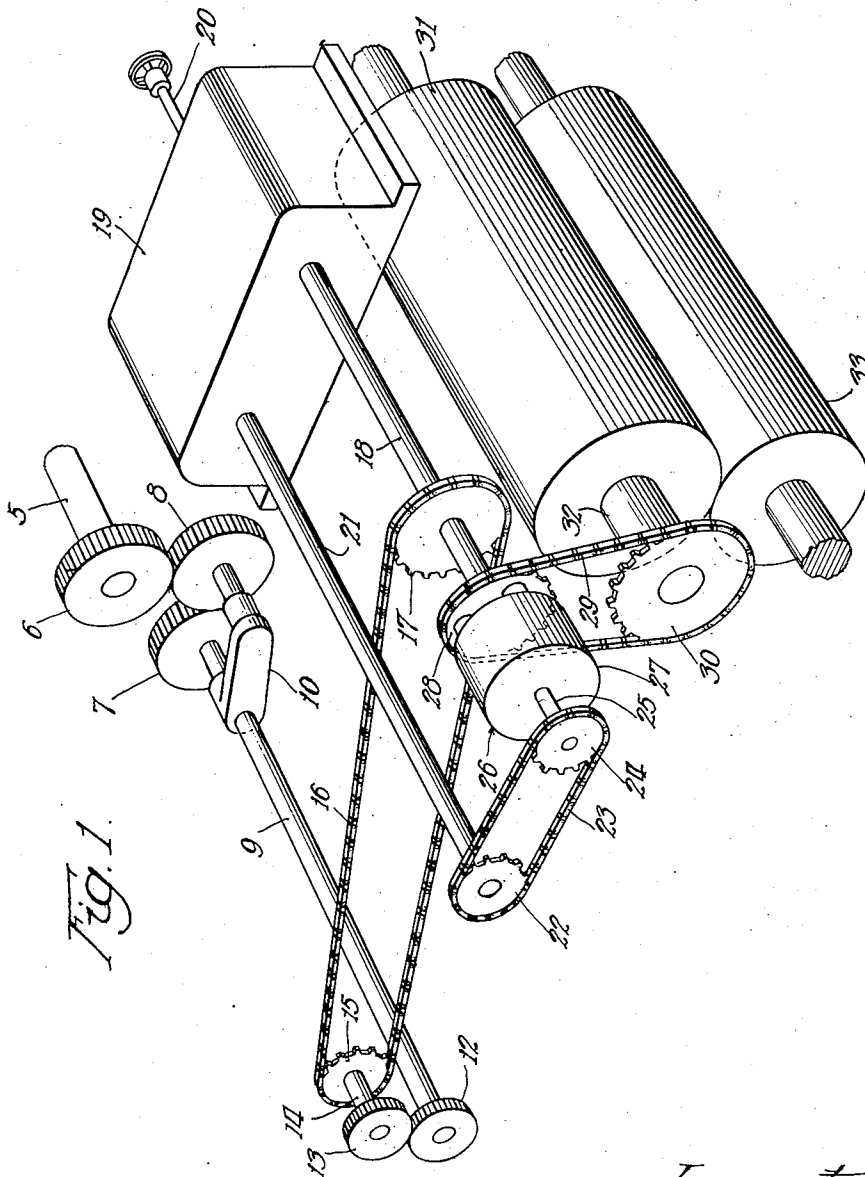
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2,334,074

VARIABLE SPEED CONTROL APPARATUS

Filed Nov. 16, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4

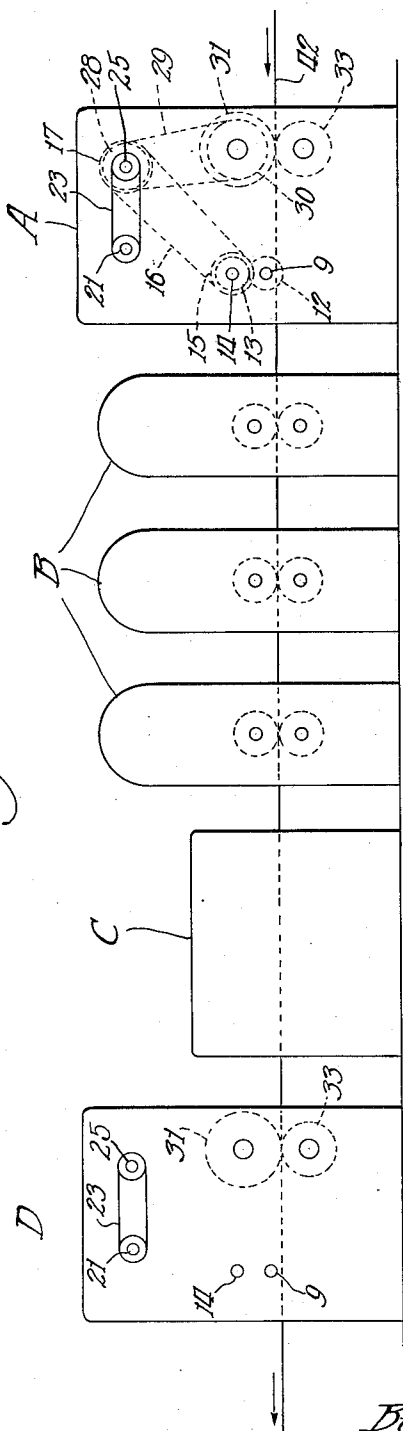


Fig. 3

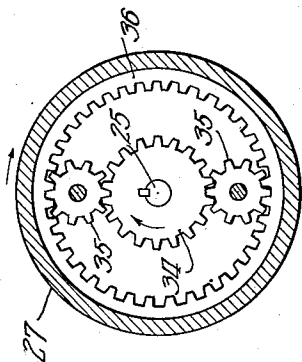
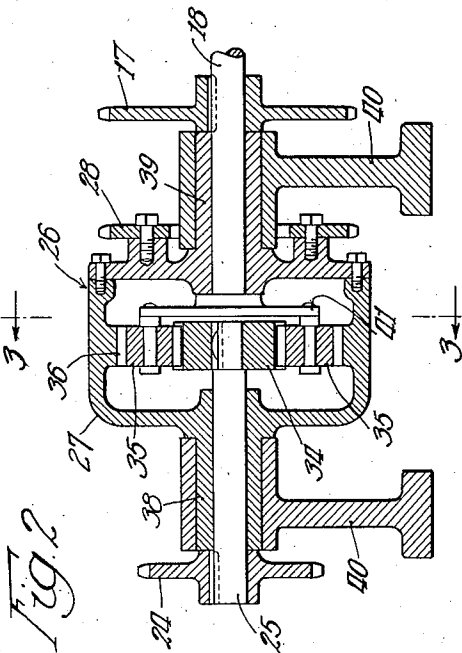


Fig. 2



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UNITED STATES PATENT OFFICE

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VARIABLE SPEED CONTROL APPARATUS

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4 Claims. (Cl. 101—181)

This invention relates to an improvement in the means for controlling the speed of a driven member, for example, for controlling the speed of a paper feeding roll in connection with printing presses or other mechanism for operating upon or treating paper or other continuous webs wherein it is advantageous to accurately control the speed of travel of such web. The main objects of the invention are to provide an improved variable speed controlling apparatus which may be embodied in independent mechanism for feeding a web of paper or other material or embodied in mechanism for printing or otherwise acting on such a web of material; to provide an apparatus which will afford very accurate and very minute control of the speed at which a web of material is propelled; to provide an apparatus for the purpose indicated wherein speed variation is effected through a means which transmits only a minor portion of the entire driving power to the web feeding mechanism so as to avoid accidental or undesirable variations due to slippage and the like; to provide an improved variable speed driving means of the character indicated which is very flexible in respect of the range of speed variation possible and which may be very easily adjusted to effect adjustment of the speed of the driven part; and in general, it is the object of the invention to provide an improved apparatus for the purpose indicated.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawings (two sheets) wherein there is a more or less diagrammatic illustration of a speed varying method and apparatus embodying a selected form of the invention.

In the drawings:

Fig. 1 is a perspective of a more or less diagrammatic character illustrating the main elements of an apparatus for variable speed control by the improved method;

Fig. 2 is a typical section through a unit of mechanism constituting a part of the apparatus;

Fig. 3 is a section on the line 3—3 of Fig. 2; and

Fig. 4 is a diagrammatic illustration of one practical situation in which the improved method and apparatus may be advantageously employed.

The apparatus illustrated in Figure 1 comprises a main driven shaft 5, the same being driven from any suitable source of power (not shown) and provided with a gear 6 removably secured thereto in any suitable manner. The gear 6 drives another gear 7 through the agency of an intermediate gear 8 which meshes with both of the gears 6 and 7 so as to transmit rotation from the shaft 5 to a shaft 9 on which the gear 7 is mounted.

The gear 8 is preferably mounted in a way which will facilitate lateral movement thereof so as to permit meshing therewith of gears of different sizes which may be interchangeably mounted on the shaft 5 in the place of the said gear 6. By thus facilitating the use of various-sized gears on the driving shaft 5, provision is made for an initial or principal change in the speed at which the shaft 9 is driven by the main drive shaft 5. As shown, the intermediate gear 8 may be rotatably mounted on an arm 10, the latter being journaled on the shaft 9. Spring or other means including non-yielding means (not shown) may be provided for holding the arm in such position that the intermediate gear will properly mesh with the gear 6 in addition to meshing with the gear 7.

In the arrangement shown in Figure 1, the shaft 9 is provided with another gear 12 which meshes with a gear 13 carried by a short shaft 14 which has affixed to it a sprocket, pulley, or equivalent of driving means, 15. The sprocket 15 could be mounted directly on the shaft 9 but for the purpose of changing the direction of rotation, the described countershaft 14 and gear connection with the shaft 9 is employed.

A chain 16 or the like meshes with the sprocket 15 and with a sprocket 17 which is secured to a shaft 18 so as to transmit rotation to the latter. The shaft 18 constitutes the in-put shaft of a commercially available type of variable speed changing apparatus indicated in its entirety at 19. The speed changing apparatus 19 may, for example, be of a type which comprises principally a pair of pulleys of variable effective diameter and a connecting belt. An operating handle 20 is illustrated, the same typifying the handle of such a device which is provided for manually or otherwise adjusting the relative diameter of the pulleys. The variable speed device 19 also has an out-put or driven shaft 21 which is driven at a speed dependent upon the adjustment of the variable speed device.

The shaft 21 has secured to it a sprocket 22 which operates through a chain 23 and another sprocket 24 to drive an in-put shaft 25 of a transmission device which is designated in its entirety by the reference numeral 26. The shaft 18 or an extension thereof constitutes the other of said pair of in-put shafts of said transmission device. In the present embodiment, the housing or body 27 of said transmission device constitutes the out-put or driven member of the transmission device and it has secured to it a sprocket 28. The sprocket 28 operates through a chain 29 and another sprocket 30 to drive a web feeding roller 31, said sprocket 30 being mounted on the shaft 32 of said web feeding roller 31. A suitable pressure roller 33 may be provided in association with the feeding roller 31 for insur-

ing feeding contact between the web of material and the feeding roller 31.

The transmission device 26 may be any of several forms of differential mechanism which are commercially available in the field of machinery. Merely for the purpose of facilitating explanation of the herein disclosed method and apparatus, a differential mechanism of a very common type is illustrated in Figures 2 and 3, and it should be understood that the construction shown may be replaced by other forms of transmission device which will effect the same ultimate result.

The common form of transmission illustrated in Figure 2 is of the planetary type including a sun gear 34, planetary gears or pinions 35 and a ring gear 36. The ring gear 36 is carried by or formed integrally with a portion of a drum-like housing 27 which has hubs 38 and 39 suitably journaled in bearing brackets such as indicated at 40.

The planetary gear or pinions 35 are carried by spider or frame member 41 which is formed integrally with or secured to a portion of the shaft 18 or to a shaft section suitably connected to said shaft 18. The sun gear 34 is secured to the other in-put shaft 25 of the transmission mechanism.

It will be seen that if the shafts 18 and 25 are driven simultaneously at the same rate of speed and in the same direction, their rotation will be imparted through the sun gear 34 and planetary gears 35 to the ring gear 36 and the housing 27.

Such rotation of the housing 27 is transmitted through the sprocket 28 and chain 29 to the web feeding roll 31. If, however, the driven speed of the shaft 25 and sun gear 34 is increased relative to the speed of the shaft 18 and planetary gears 35, independent rotation will be imparted to the planetary gears 35 with the result that the ring gear 36 and housing 27 will be caused to move rearwardly relative to the direction of rotation of the sun gear 34 and in which the planetary gears rotate about the axis of the shaft 18. There is, of course, normally no actual rearward rotation of the housing 27 but the effect is that the housing 27 is rotated at a lower speed than the shaft 25 and sun gear 34. Similarly, if the sun gear 34 is driven at a slower speed than the shaft 18 and planetary gears 35, the planetary gears will be caused to advance relative to the sun gear, thereby causing the planetary gears to revolve on their own axes and consequently increasing the speed of rotation of the housing 27.

It will be apparent that the described mechanism provides for a very minute or accurate control of the driving speed of the out-put member or housing 27 and gear 28 of the transmission mechanism 26 while at the same time affording a substantial range of variation through the agency of said speed varying device 19. A highly important advantage of the described method and apparatus for controlling speed variation is that the variable speed device 19 is not required to handle more than a minor portion of the driving power required for driving the web feeding roll 31.

The only power load required to be handled by the speed varying device 19 is that required to maintain the in-put shaft 25 of the transmission mechanism in rotation at a rate of speed which is the same as or greater or less than that of the shaft 18, the main driving load being

handled by the shaft 18 and its operating connection to the transmission out-put member 27. This arrangement eliminates slippage and consequent variation in the speed of the out-put member of the speed varying device 19, which, although sufficiently constant for most ordinary purposes, varies considerably especially when subjected to heavy duty and during acceleration and deceleration of speed.

Other types of transmission mechanism, many of which are commercially available, may be substituted for the planetary gear type above referred to.

In the diagrammatic illustration of Figure 4, a web of material such as paper is indicated at 42, the same being propelled by a paper feeding device A, comprising a web feeding roll 31, the speed of which is controlled by mechanism of the type illustrated in Figures 1 to 3, inclusive. The web is conducted from the feeding device A through one or more printing machines or other device B, for operating upon or treating the web 42, then through a drier or other device indicated at C, and then through a second web feeding apparatus designated in its entirety D, the same including a web feeding roll 31 which is also controlled by apparatus such as shown in Figures 1 to 3, inclusive.

In conducting a paper or like web through a battery of printing presses and a drying unit or other mechanisms, shrinkage or stretching of the web incident to the operations performed on it are known to produce different rates of travel in the web portions immediately preceding entry of the web to the printing or other mechanisms, and the portion emerging therefrom. Such different rates of travel are, of course, of a minute character and the difference itself varies due to numerous varying factors such as the quality and thickness of the web, atmospheric conditions and the like. Hence, considerable difficulty has heretofore been experienced in maintaining a web in the desired degree of tautness in its passage through the printing or other mechanisms.

The maintenance of the web in the proper condition in its passage through the operating mechanisms is an important element in securing proper registration of subsequent printings, cutting or like operations. The improved speed controlling method and apparatus when employed in the manner illustrated in Figure 4 to both feed the web to operating apparatus and to withdraw the web therefrom provides an efficient and effective means for maintaining the web in the desired condition during its passage through mechanisms such as represented at B and C. The very minute character of speed adjustment made possible by the described arrangement makes the described apparatus especially adaptable to situations such as typified in Figure 4 but it will be understood that the improved apparatus may be employed in other situations where the feed of a web of material is desirably maintained at a predetermined rate with a high degree of accuracy. The improved apparatus may be employed either in single units or in pairs of units as in the typical installation shown in Figure 4.

A further important advantage flowing from the described speed controlling method and apparatus is the convenience and facility with which the paper feeding mechanism may be adapted for use with printing rollers of various sizes. Heretofore, if printing rolls of, say, 8" diameter were to be used, paper feeding rolls (corresponding to rolls 31 and 33) of approximately the same diam-

eter were found necessary so as to obtain the proper speed of travel of the paper web. If the printing apparatus were changed to use a larger or smaller roll, the paper feeding rolls would have to be changed accordingly.

In the new feeding mechanism herein described, the paper feeding rolls 31 and 33 need not be changed even though the printing rolls are changed from a relatively large size to a relatively small size. All that is required is that the gear 6 be replaced with another one of proper pitch diameter to effect a main or principal change in the speed at which the feed rolls 31 and 33 are driven. Final, accurate adjustment of the driven speed of said feed rolls may be effected through the agency of the speed varying device 19.

The very accurate adjustment which is possible by means of the described structure is especially important in connection with multi-color printing where various portions of a printed design or printed matter are applied successively by a series of presses. By the improved control mechanism the travel of the web may be so regulated that it will be maintained at the most advantageous degree of tautness, thereby facilitating registration of the successively applied portions of the printed matter.

The very accurate adjustment made possible by the described structure is furthermore important in that it facilitates the use of different paper thicknesses for the same printing work. For example, in multiple printing work where the web is fed successively through a plurality of printing units, the condition and tautness of the paper in its travel through the successive printing units must be accurately maintained in order to insure proper registration of the successively applied printing. The speed at which the paper feeding rolls are driven must, of course, be adjusted with due consideration for the thickness of the paper web. When a change is made in the thickness of the paper to be run on a given size of printing rolls, the speed at which the paper feeding rolls are driven must be adjusted to compensate for the speed change resulting from the difference in paper thickness, if the same size feeding rolls are to be utilized. Such adjustment of the speed may readily be made by means of the variable speed unit 19.

Changes in the described structure may be made without departing from the described principles of the invention and the scope thereof should be determined by reference to the following claims, the same being construed as broadly as possible consistent with the state of the art.

I claim:

1. In web feeding mechanism, a web feeding roll, means for driving said roll comprising transmission mechanism having a pair of independently rotatable in-put members and a rotatable out-put member adapted to be driven cooperatively by said in-put members, variable speed means for driving one of said in-put members, means common to the other of said in-put members and said variable speed means for driving the same, said means comprising a pair of gears and an intermediate gear for operatively connecting said pair of gears, and means for mounting said intermediate gear so as to permit movement thereof circumferentially of one of said pair of gears while maintaining operative connection therebetween, whereby the other of said pair of gears may be of various selected sizes to

thereby permit variation of the speed at which said in-put member and variable speed means are driven, and a driving connection between said out-put member and said web feeding roll, the speed of rotation of said out-put member being controllable by adjustment of said variable speed driving means with incident adjustment of the speed of rotation imparted to the in-put member driven thereby while maintaining substantially constant the driving force of the other in-put member.

2. In printing equipment, the combination of a plurality of printing presses adapted to successively print in predetermined, registered relationship on a web, a pair of web feeding devices, one of said web feeding devices being arranged to feed the web to the first of said printing presses and the other of said web feeding devices being arranged to pull the web from the last of said printing presses, said web feeding devices comprising a web feeding roll, a differential mechanism, a normally fixed but changeable gear mechanism for driving a portion of said differential mechanism, said gear mechanism being changeable so as to effect driving of said differential mechanism approximately at a predetermined speed, a variable speed mechanism also driven by said gear mechanism and having a driving connection to another portion of said differential mechanism for controlling the driving effect thereon of said gear mechanism, and a driving connection between a portion of said differential mechanism and said web feeding roll, said web feeding mechanism being capable of minutely and independently adjusting the web propelling effect at the entrance and exit of the web to and from the printing presses.

3. A web feeding mechanism comprising a feed roll, a differential mechanism embodying a pair of driven elements and a driving part, means for actuating one of said driven elements and comprising a normally fixed but changeable gear train, variable speed mechanism connected to said gear train so as to be actuated thereby, means connecting said variable speed mechanism with the other driven element of said differential mechanism so as to actuate said other driven element, and means connecting said driving part of said differential mechanism with said feed roll, said gear train being changeable so as to be operative to drive said differential part at various predetermined speeds, and said variable speed means being operative to alter the speed at which said driving part of the differential mechanism is driven, thereby providing minute control of the speed at which said feed roll is driven by said differential mechanism.

4. A web feeding mechanism comprising a feed roll, a differential mechanism embodying a pair of driven elements and a driving part, normally fixed but changeable means for actuating one of said driven elements at selected speed, variable speed mechanism connected to and actuated by said actuating means, means connecting said variable speed mechanism with the other of said driven elements to actuate the same at variable speed, and means connecting said driving part of said differential mechanism with said feed roll for driving the latter, said actuating means being changeable so as to be operative to drive said differential part and said variable speed mechanism at various selected speeds.

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