United States Patent [19]

Obenshain

[11] **3,736,821**

[45] **June 5, 1973**

[54] **ELECTRONICALLY ADJUSTED VARIABLE RATIO DRIVE**

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[52] **U.S. Cl.** **83/76,** 74/192

[51] **Int. Cl.** **B26d 5/24**

[58] **Field of Search** 83/76, 72; 74/192, 74/193, 191

[56] **References Cited**

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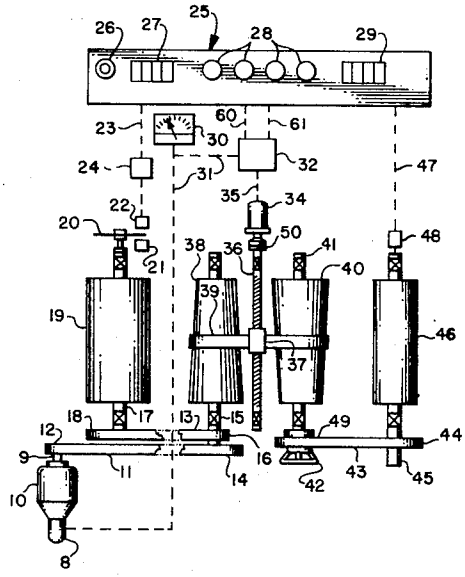
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[57] **ABSTRACT**

A widely adjustable ratio drive mechanism capable of infinite variation in ratio utilizing timing belts and timing gears is presented which employs an electronic sensing device for actuating a cone pulley transmission to change the ratio of the drive either on demand or automatically, depending upon the mode of operation of the electronic sensing means.

5 Claims, 3 Drawing Figures



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SHEET 1 OF 3

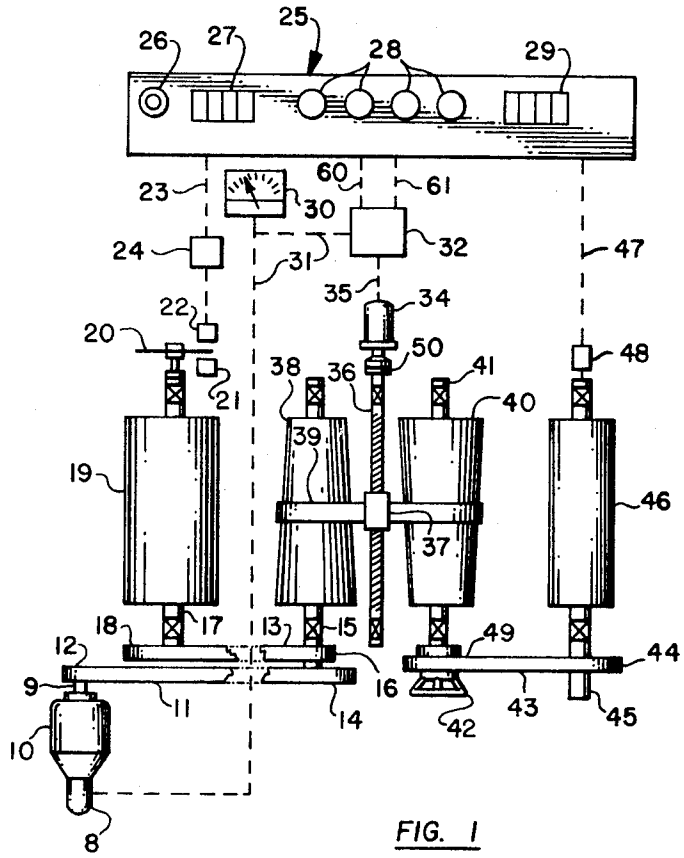


FIG. 1

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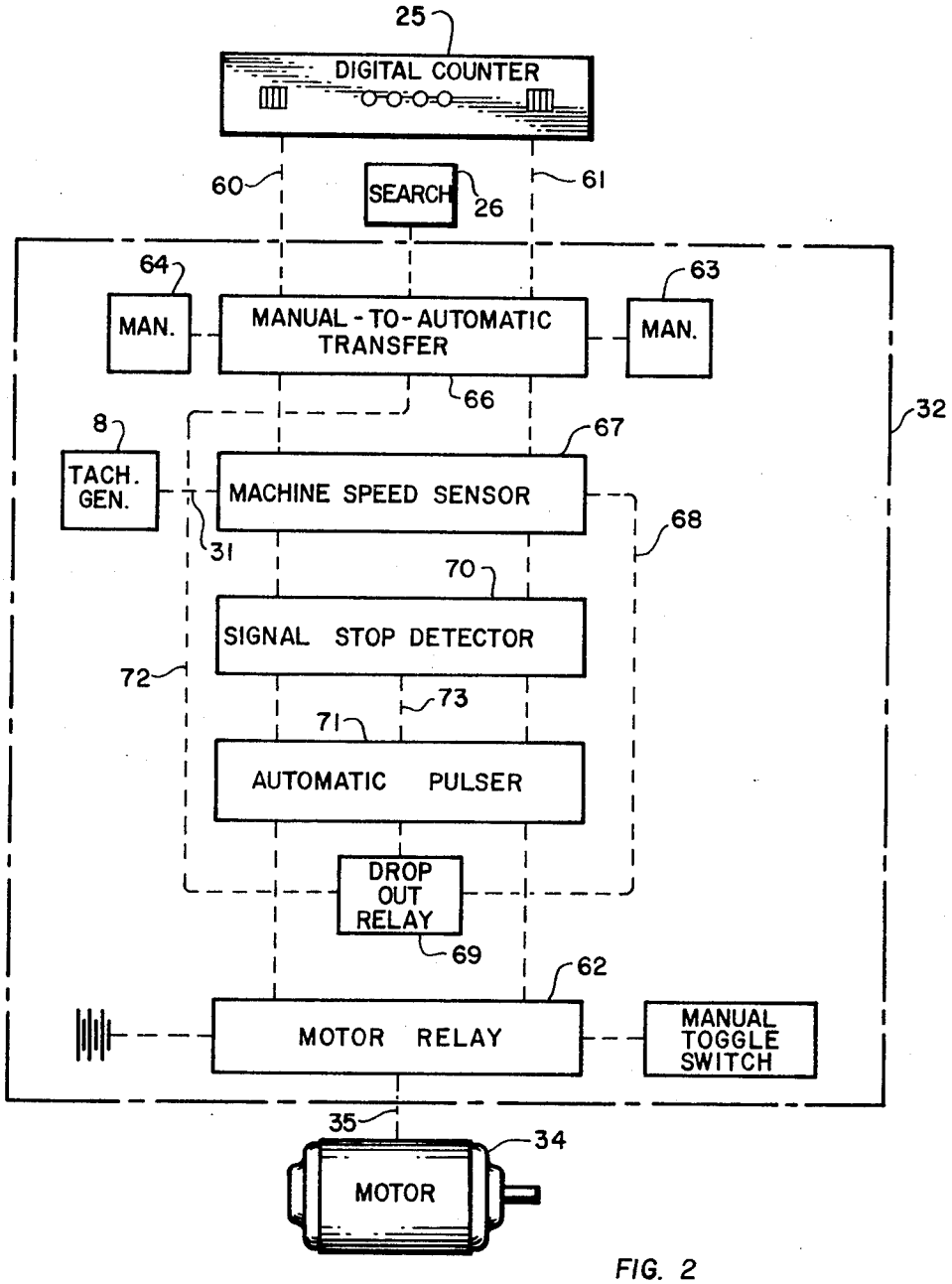


FIG. 2

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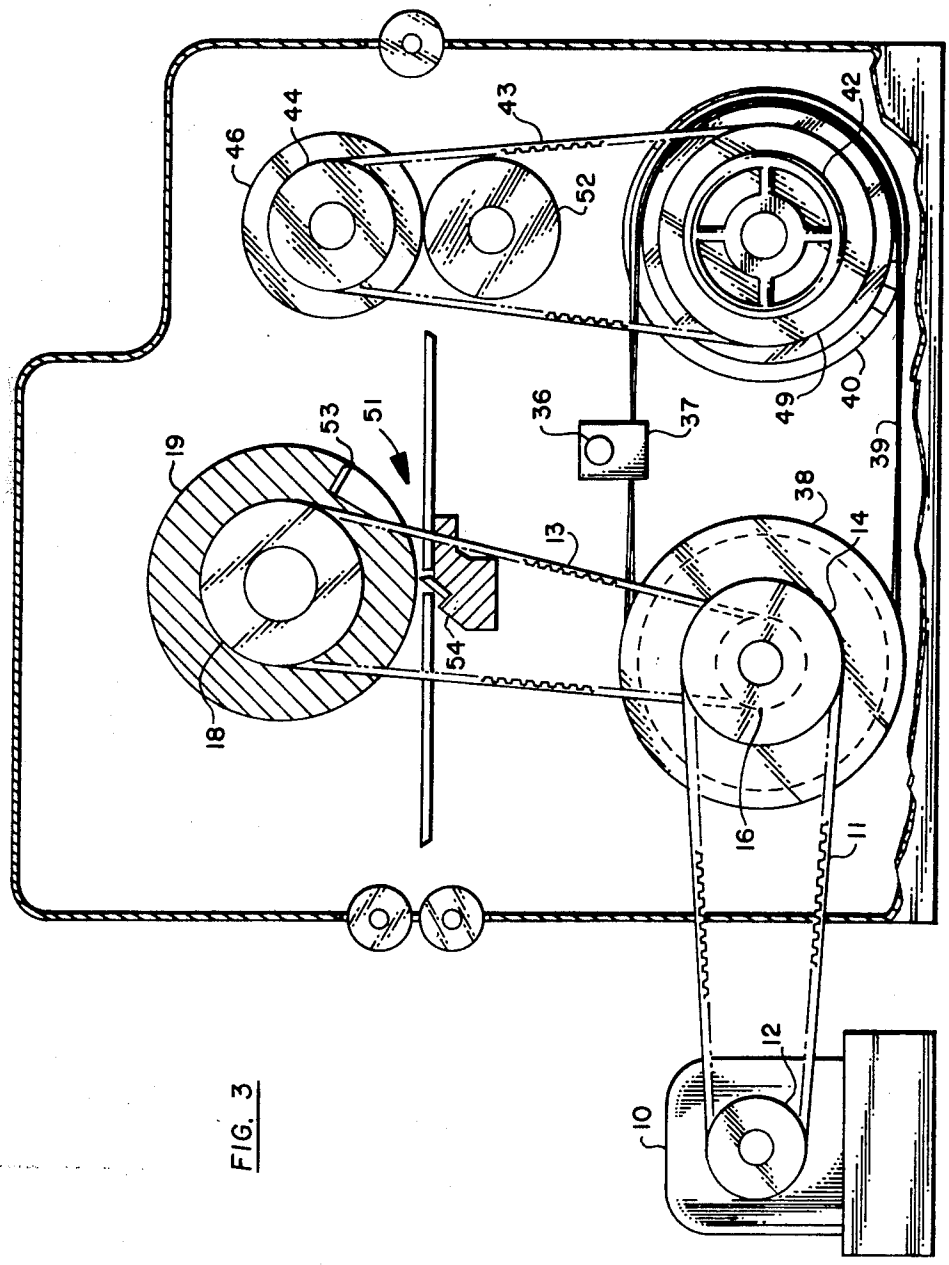


FIG. 3

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ELECTRONICALLY ADJUSTED VARIABLE RATIO DRIVE

SUMMARY OF INVENTION

This invention relates generally to a drive mechanism and more particularly to a drive mechanism that is electronically adjusted to provide infinitesimal variations in the ratio of the drive. The drive mechanism contemplated by this invention utilizes a cone pulley transmission that is driven by exchangeable timing gears and timing belts. The drive mechanism is further actuated by an electronic adjusting means to shift the drive belt in the cone pulley transmission, to yield an adjustable ratio drive of high power and speed, and one having a degree of precision not formerly achieved.

The present invention is an improvement in applicant's prior U.S. Pat. No. 3,572,147 and represents the latest and most successful development in a series of drive mechanisms that have been used in applicant's patented paper sheeting machine disclosed initially in U.S. Pat. No. 3,203,326. Specifically, the invention pertains to a novel drive mechanism for use in paper cutting machinery. However the drive mechanism disclosed herein could obviously find use in other applications requiring an widely adjustable and extremely precise ratio drive capable of transmitting appreciable power.

As set forth in applicant's prior U.S. Pat. No. 3,572,147, it is desirable in a paper sheeting machine that the length of the web fed in a cutter cycle be precisely predetermined and accurately controlled. If this criteria is observed, the need for subsequent edge trimming of the cut sheets before shipment to the user is eliminated. Moreover, the machine should be arranged and driven so that it might be quickly and conveniently set to feed consistently any one of a multiplicity of predetermined sheet lengths per cutter cycle. The different sheet lengths desirable differ only slightly from one another and form collectively an unbroken arithmetical series between widely spaced lower and upper limits.

In the above noted prior patent the ability to precisely cut up to 90 percent of the sheet lengths required was achieved by employing three exchangeable timing gears and a fixed timing gear driven by two fixed length timing belts on the paper cutting machine feed roll and cutter drum. In a conventional sheet cutter, there is usually a cutter drum having mounted in its periphery one or more flyknives, and a set of feed rolls feeding the paper web to the cutting zone. The ratio drive between the rotary cutter drum and the feed rolls determines the sheet length to be cut.

In the past, some sheet cutters have been driven with complicated gear boxes to control the sheet length being cut. For instance, in applicant's prior U.S. Pat. No. 3,128,662, a gear box was described which utilized a spur gear on the cutter drum shaft that cooperated with a second spur gear on the feed roll shaft, with the ratio of the two gears and the diameter of the feed roll determining the sheet length obtained. It was found, however, that the inherent backlash in this form of change-type spur gearing, plus torsional vibrations in the various gears, shafts and supporting structures of the gear box, promoted a variation in the actual sheet length cut that was not acceptable. To overcome these problems, the timing belt drive of applicant's U.S. Pat. No. 3,572,147 was devised.

However, as noted above, only 90 percent of the desired sheet lengths could be cut precisely with the timing belt drive. Accordingly, further research was invested using previously untried mechanical elements to yield the infinitesimal sheet length adjustment achieved with the present invention.

The device disclosed herein, which employs an electronically actuated cone pulley transmission, gives the same good precision obtained with the timing belt drive of U.S. Pat. 3,572,147, but further permits the user to cut 100 percent of all sheet lengths required. The present device also minimizes wrap-ups and snap-offs that had occurred when operating at the abnormal web tensions often required with the timing belt drive. With the device disclosed herein, the optimum web tension for each grade and condition of paper may be employed.

Furthermore, with the cone pulley drive disclosed herein, only 12 exchangeable timing gears are necessary to cover the entire sheet length range from 29 to 78 inches. With the timing belt drive of applicant's prior patent, over 70 different timing gears were required for the same sheet length range. Accordingly, the present invention utilizes the timing gears and specially manufactured timing belts which were found desirable in applicant's prior patent. In addition the pressure actuated timing gear changing mechanism described in applicant's prior U.S. Pat. No. 3,572,147 is also used herein. The two improvements found in this disclosure are the addition of a cone pulley drive between the feed roll and the cutter drum and an automatic, electronically controlled belt positioning system for adjusting the location of the cone pulley drive belt on the cone pulleys.

DESCRIPTION OF THE DRAWING

FIG. 1 shows schematically how the different elements of the present invention are connected together;

FIG. 2 illustrates in block diagram form the different components of the electronic sensing device for changing the ratio of the drive mechanism described herein; and,

FIG. 3 shows a side view of the different elements of the present invention as applied to a typical paper sheeting machine.

DETAILED DESCRIPTION

In conventional sheeting operations at a paper mill, a single web of paper, or, multiple webs from a plurality of rolls, are combined and directed through a sheet cutting machine at relatively low speed. The sheets thus cut are then edge trimmed, sorted and packaged for shipment to the user.

In applicant's patented sheeting machine, disclosed initially in U.S. Pat. No. 3,203,326, a machine for feeding, inspecting, cutting, sorting and stacking sheets of paper was claimed. For that apparatus a gear change unit as disclosed in applicant's U.S. Pat. No. 3,128,662 was employed to selectively change the length of the sheet to be cut so that no subsequent edge trimming was necessary. Finally, the gear change unit of the last mentioned patent was replaced by the timing belt drive disclosed in applicant's most recent U.S. Pat. No. 3,572,147.

The system as outlined above proved quite satisfactory from the point of view of precise sheet length requirements, but it still had certain restrictive characteristics as set forth hereinbefore. Accordingly, the pres-

ent variable ratio drive was developed to overcome each of the deficiencies of the prior system. The drive means employed in the present invention still uses a common driving means for the cutter drum and the web feeding means, and the length of sheet cut still depends on the length of web fed during a cutting cycle as in a conventional flying cutter. Now, however, with the added electronically controlled variable cone pulley transmission in the system, the user is able to cut any desired sheet length that is required.

In general, and with particular reference to the schematic diagram of FIG. **1**, there is shown a common drive motor **10** driving a shaft **9** and timing gear **12** for powering the feed roll **46** and cutter drum **19**. The drive is accomplished via a timing belt **11** between the timing gear **12** on shaft **9** and a second timing gear **14** on cone pulley shaft **15**. A third timing gear **16** on cone pulley shaft **15** is connected to the timing gear **18** on shaft **17** of the cutter drum **19** by the timing belt **13**. Thus the motor **10** drives the cutter drum **19** indirectly via the elements above noted. Of course, the two cone pulleys **38** and **40** are driven by the adjustable belt **39**. Therefore, cone pulley **38** drives the cone pulley **40** and cone pulley shaft **41**. Attached to the cone pulley shaft **41** is a replaceable timing gear **49** that includes the pneumatic gear changing assembly **42** disclosed and claimed in applicant's prior U.S. Pat. No. 3,572,147. A final timing belt **43** is shown connecting the replaceable timing gear **49** with the feed roll timing gear **44** on feed roll shaft **45**. Accordingly, the motor **10** similarly drives the feed roll **46** indirectly via the elements noted above.

Each of the timing gears used in the invention are constructed to special concentricity tolerances not exceeding 0.001 inch. Similarly, the timing belts must also have very precise tooth spacing. All belts are selected and tested under running conditions on a testing rig which can detect non-linearities of one part in five thousand. The teeth in the belts fit very snugly in the grooves of the timing gears thereby substantially eliminating backlash. In addition, the belts have steel cables in their construction and therefore stretch only very slightly under load.

As a further convenience for the machine operators, the drive mechanism has been arranged so that they need only select an exchangeable timing gear **49** having the same number of teeth as the sheet length desired. The pneumatic gear changing assembly **42** described in U.S. Pat. No. 3,572,147 assures that the selected timing gear **49** can be easily and quickly removed and replaced. Where the replaceable timing gears **49** are available in one-tooth increments, the selection of the proper timing gear for the desired sheet length is made quite easily. Thus for a 50 inch sheet, a timing gear **49** having 50 teeth would be fitted on shaft **41** with the pneumatic gear changing assembly **42**. As stated hereinbefore, using the cone pulley drive **38, 39, 40** of the present invention, only 12 quick change replaceable timing gears **49** are needed to cover the entire sheet length range from 29 to 78 inches. The table reproduced below shows the relationship between the number of teeth on the quick change timing gear **49** and the sheet length obtained. In addition, the table also shows the shortest and longest sheet length obtained with each respective timing gear along with the sheet length span for each timing gear that is obtainable using the novel cone pulley drive disclosed herein.

CORRELATION BETWEEN TIMING GEARS AND SHEET LENGTH

Quick-Change Timing Gear Teeth	Mean Sheet Length	Shortest Sheet Length	Longest Sheet Length	Sheet Length Span
30	30.000	28.516	31.562	3.046
33	33.000	31.367	34.718	3.351
36	36.000	34.219	37.874	3.655
39	39.000	37.070	41.030	3.960
42	42.000	39.922	44.187	4.265
46	46.000	43.724	48.395	4.671
50	50.000	47.526	52.603	5.077
55	55.000	52.279	57.863	5.584
60	60.000	57.031	63.124	6.093
65	65.000	61.784	68.384	6.600
70	70.000	66.536	73.644	7.108
75	75.000	71.289	78.905	7.616

It will be noted from a consideration of the table above that the span of sheet lengths obtainable using the cone pulley drive varies from 3.046 inches with the 30-tooth timing gear to 7.616 inches with the 75-tooth timing gear. This variation precluded the use of a simple scale on the cone pulley belt shifter **37** for indicating the prescribed sheet length. Accordingly, to solve this problem, the automatically acutated, electronic counter belt positioner was added to the system.

The cone pulleys **38, 40** for the drive mechanism shown in FIG. **1** would typically be 17.500 inches in diameter at the small end and 18.500 inches in diameter at the larger end. The face of each cone pulley in our own preferred embodiment is 54 inches long. The maximum belt travel is thus limited to 50 inches, with the center line of belt **39** approaching to within 2 inches of either end of the cone pulleys. In order to achieve the accuaracy obtained with the present device, the pulleys must have concentricity tolerances not exceeding 0.001 inch and they must be fabricated with very heavy shafts that are integral with the pulleys. An eccentricity of only 0.005 inch in either of the pulleys **38, 40**, could cause an 0.057 inch variation in sheet length when cutting a 51.5 inch sheet. This would be intolerable since the total shipping tolerance of the paper sheets is only 0.063 inch, and the other elements in the machine each contribute their own small amount of variation. Every element in the system has to be as near perfect as technically possible in order to achieve the sheet length precision required for shipping paper directly without guillotine trimming. The very slight taper in the cone pulleys **38, 40** described above allows excellent ratio resolution. A belt shift of one-fourth inch only changes the sheet length 0.025 inch in the 50 inch sheet length range.

The extreme precision obtained with the cone pulley drive of the present invention is due in part to the close tolerances of the pulleys. However, another important reason for achieving the results obtained can be attributed to the use of relatively new plastic belting for the cone pulley drive belt **39**. The preferred belt used in the system is made from an oriented nylon polymer core with a special chrome-tanned leather face. The particular belting used is "Extremultus LT 3CV" made by Extremultus, Incorporated of Englewood, N.J. The nylon core has a tensile strength of 28,500 p.s.i. and a modulus of elasticity of 85,000 p.s.i. The special leather face of the belt **39** has a coefficient of friction between 0.6 and 0.8. The belt presently being used on production machines is three inches wide and is applied with 2 percent stretch. At 300 rpm, the cones of the pulley system can readily transmit 45 horsepower, which is more than

six times that actually required in normal operation. The high modulus of elasticity of the belt **39** minimizes the tendency toward low frequency torsional vibrations which were found to be troublesome in applicant's previously used gear box ratio drive.

With further reference to FIG. **1**, it was noted hereinbefore that the belt **39** between the cone pulleys **38, 40** is shifted in position with the belt guide **37** to achieve the desired infinitesimal variation in sheet length cut. For this purpose, the belt guide **37** and accordingly the belt **39** is moved longitudinally of the cone pulleys **38, 40** by a screw shaft **36** driven by a motor **34** through a coupling **50**. The operation of the motor **34** is controlled by a motor controller relay **32** which is responsive to signals **60, 61** from the pre-set digital counter **25,** and, from a signal **31** generated by a tachometer **8** on the main drive motor **10.** The tachometer **8** sends signals, line **31,** to a tachometer **30** and further introduces a signal to the motor controller **32.** The motor controller **32** then compares the signal at **31** with the signal at **60, 61** before activating the motor **34** to drive the screw shaft **36** and thereby move the belt guide **37** and belt **39** on the cone pulleys **38, 40** to correct the sheet length differential.

The signal generated at **60, 61** by the pre-set digital counter is responsive to a signal **23** from the cutter drum **19** and a signal **47** from the feed roll **46.** In the preferred embodiment shown herein, and on which this invention is based, the feed roll circumference is precisely 36.000 inches. Accordingly a 3,600 pulse per revolution generator **48** (W. & L.E. Gurley, Troy, N.Y.) is directly coupled to the shaft **45** of the feed roll **46** as illustrated in FIG. **1.** With this particular chosen ratio, each pulse from pulse generator **48** represents 0.01 inch of web fed to the cutting zone of the paper machine.

On the other hand, the cutting drum **19** is equipped with a light disk **20** mounted on the shaft **17,** and the disk **20** includes a single slot giving one pulse per revolution of the cutting drum. The single pulse per revolution is captured by the lamp and photocell arrangement **21, 22** shown in FIG. **1** and directed through a preamplifier and pulse shaper **24** to produce the signal **23** going into the pre-set digital counter **25.** The digital counter found desirable for applicant's preffered use is a dual pre-set digital counter, Model RP-101R, manufactured by Anadex Instruments, Incorporated, Van Nuys, Cal.

Thus, the digital counter **25** gets a signal **23** from the cutter drum **19** for each revolution of the cutter drum, and a signal **47** from the pulse generator **48** on the feed roll **46** to provide a read-out of the sheet length cut in each revolution of the cutter drum. Since a four digit number is reproduced by the digital counter at the sheet length indicators **28,** the true length of the sheet cut in inches and hundreds is obtained by moving the decimal point two places to the left.

It is noted however, that the pre-set digital counter **25** includes a pair of manually settable dials **27, 29** wherein the lower and upper limits respectfully, of a desired sheet length can be pre-set. Thus for any desired sheet length, the upper and lower limit dials would be set several points above and below the specified sheet length, and within the tolerances permitted by the user. If the sheet length indicator read-out at **28** results in a sheet length either less than or greater than the pre-set limits at **27** or **29,** a signal is generated at either **60** or **61** respectively to the motor controller **32,** to shift the belt **39** in the proper direction to bring the read-out into a range between the two limits. However, the primary value of the drive system is experienced when changing sheet lengths to be cut.

When a different length sheet is to be cut on the machine, the operator installs the appropriate quick change timing gear at **49,** sets the two pre-set dials at **27, 29** for the new sheet length, and pushes the search button **26** of the digital counter. The machine is then started without paper and other adjustments are made to the machine for the new sheet size. As soon as the machine gets above a minimum speed of approximately 70 cuts per minute, selected to avoid jamming of the cone pulley belt guide **37,** the drive motor **34** is actuated and begins to run in the proper direction to bring the read-out at **28** into the range indicated by pre-set dials **27, 29.** When the read-out at **28** reaches a value equal to that of one of the pre-set dials, the belt shifter motor controller **32** begins a pulsed mode operation. Prior to the time that one of the pre-set dial readings is reached the motor controller **32** operates the motor **34** continuously, and at a speed that would cause back and forth "hunting" of the motor controller **32** once within the range of the pre-set dials. Consequently, after one of the pre-set conditions is reached, and under normal operating conditions, the belt shifter motor **34** is deactivated. The counter continues to function, however, and by means of other indicators (indicator lights, not shown) informs the operator of the machine of any fluctuations beyond the limits set that might occur.

FIG. **2** illustrates the functional diagram of the motor control system that is designated **32** in FIG. **1.**

Whenever the read-out displayed at **28** in the digital counter **25** falls outside of the limits set into the pre-set dials **27, 29,** a pulse is produced by the counter **25** which is converted into a continuous signal either at low channel **60** or high channel **61,** depending upon whether the pulse is below the reading at **27** or above the reading at **29.** However, with the machine running, and, under normal conditions, the system is left in the manual mode so that the signals have no effect. Should the operator note the incorrect read-out at **28,** he is able to actuate the motor relay **62** with the system in manual mode, by pressing one of the manual operation buttons **63, 64** to shift the belt **39** in the proper direction on the cone pulleys **38, 40.**

Of course, when the search button **26** is pressed, the system is transferred from manual to automatic operation by the transfer device **66.** In the automatic mode, the signals generated at either **60** or **61** are permitted to pass through the transfer device **66** and on to the machine speed sensor **67.** As noted hereinbefore, if the machine is idle, or has not reached a suitable operating speed to permit shifting the belt without damage, the signal either at **60** or **61** is stopped at the sensor **67.** Note that the tachometer generator **8** driven by the primary drive motor **10** feeds a signal **31** into the machine speed sensor **67** which informs the sensor **67** of the speed of operation of the machine. When the machine is running, and a satisfactory speed has been reached (**70** cuts per minute), the signal either at **60** or **61** is permitted to pass through the machine speed sensor **67,** and, at the same time, an additional signal is directed to the drop-out relay **69** through line **68** thereby starting its timing cycle. The signal either at **60** or **61** next

passes through the signal stop detector **70**, and through the automatic pulser **71** to the motor relay **62**. At this point, one signal **35** is directed to tne motor **34** to drive the motor in the proper direction to shift the belt **39** and thereby bring the read-out **28** back into the range established by the pre-set dials **27, 29**. Obviously only one signal **60** or **61** will be generated at one time to indicate a short sheet condition or a long sheet condition.

When the signals either at **60** or **61** stop, and no signal returns for 15 seconds, the drop-out delay **69** automatically sends a signal **72** back to the transfer device **66** to return the system to manual mode. The search button **26** may then be pushed again, and if no signal is produced at **60** or **61**, the system will again return to manual mode after the 15 second delay.

If we presume that a signal is coming through **60** for instance, from the digital counter **25**, and the belt is being shifted accordingly, as soon as the read-out at **28** reaches or passes the preset limit at **27** or **29**, the signal at **60** will stop. However, very likely, the belt shifter **37** will overshoot its predetermined stopping point due to drifting of the motor **34**. To prevent the "hunting" back and forth previously mentioned, which would normally occur in this condition, the signal stop detector **70** senses this condition and causes the automatic pulser **71** to be actuated through line **73**. In this new pulsed mode of operation, a signal either at **60** or **61** is permitted to get through to the motor relay **62** only 1 second out of every 6 seconds. In this manner, the belt shifter **37** is moved only very slowly to reposition the belt **39** on the cone pulleys **38, 40** until the read-out at **28** is settled down within the pre-set limits at **27, 29**. Again, if this condition persists for the 15 second period allowed by the drop-out delay **69**, the system is once again returned to manual operation. Every time a signal at **60** or **61** is transmitted through the system, the drop-out delay **69** is reset in its timing cycle so that the system can only be returned to the manual mode after all signals have ceased for 15 seconds.

It was originally planned to allow the system to remain in its automatic mode of operation, unless it was purposely returned to the manual mode by the machine operator. This operation would have permitted the system to correct, automatically, any deviations in ratio caused by belt creep or speed of operation. However it was found that occasional transient signals, generated by other equipment in the area, would trigger the counter input even though the system was shielded with the most careful shielding practical. Of course, these transient signals tended to cause a false shifting of the cone pulley belt with the system in the automatic mode. Moreover, even though the system quickly corrected the false signal errors, a few off-sized cut sheets were collected during the period of time that the transient signals were present. Accordingly, the previously mentioned provision in the system for an automatic return to the manual mode after a 15 second delay, proved to be a simple expedient for eliminating the problems caused by transient, unwanted signals. Furthermore, the drop-out delay also eliminated the necessity for the machine operator to check each time to insure that the system was not left in automatic mode after the machine reached its normal operating condition.

All of the above functions are performed by solid state logic elements, the details of which will be understood by those versed in solid state electronics. The motor relay **62**, on the other hand, is of the electro-magnetic type. Therefore all functions could be performed by electro-magnetic relays in place of the solid state logic systems if preferred.

Exact sheet length is not only a function of the feed roll rate, which is what the pulse generator **48** actually records, but it is also a function of the stretch of the sheet while it is being metered by the feed roll. The 36.000 inch circumference feed roll would feed 36.000 inches of paper in a single revolution only when the paper was under no tension. However, the web entering the feed roll is always under some tension, because if operated with no tension, there would always be problems with handling the web or wrinkling of the web. Nominal web tensions range from 1 to 5 pounds per lineal inch (pli) of web width, and paper of 30 pound basis weight stretches approximately 0.059 percent per inch of width. 120 pound basis weight paper stretches only 0.013 percent per pound per inch of width. Therefore the actual amount of sheet length fed by the feed roll **46** in a single revolution is always somewhat less than 36.000 inches. However, the machine operator knows from experience or from charts provided therefor, how much of an increment nust be added to achieve the desired sheet length when setting the digital counter preset dials **27, 29**. After a few sheets are cut, the operator carefully measures them to see if the specified tolerances are being met. If the sheets are either too long or too short, the operator need only reset the dials **27, 29** accordingly, then press the search button **26** to allow the belt shifter **37** to reposition the cone pulley drive belt **39**.

Using the system described herein, the operator rarely has to make a second adjustment. Unfortunately, paper stretch is influenced by many factors other than basis weight, including moisture, degree of calendering, tightness of the roll winding operation, etc., so that exact settings are not alwsys made the first time.

The illustration in FIG. **3** shows how the different elements of the invention are arranged for use in applicant's paper sheeting machine. For this purpose, the paper web is directed from an unwind stand (not shown) and between a feed roll **46** and a squeeze roll **52** into the cutting zone **51** of the machine. The motor **10** drives the cone pulley **38** which is connected to the cutter drum **19** as shown. The cutter drum **19** includes a conventional rotary knife **53** which cooperates with the fixed bed knife **54** to perform the cutting action. Of course, the remaining elements including cone pulley **40** and feed roll **46**, are also connected to one another as described in conjunction with the schematic illustration in FIG. **1**.

The squeeze roll **52** is shown as being mounted beneath the feed roll **46** in FIG. **3** which is somewhat unorthodox when compared with conventional sheeting equipment. However the arrangement shown has worked very nicely for applicant and it was found to be desirable in connection with the timing belt drive system employed herein.

From the foregoing specification, it will be readily apparent that the present invention makes possible an extremely precise means for accurately feeding and cutting paper. It should be clear however, that sheets of other material could also readily be handled by the novel apparatus described herein in a like manner.

Finally, the invention should not be deemed to be limited only to a sheeting operation. It should be obvious that the apparatus disclosed herein could just as

readily be used on other types of machinery where an extremely precise ratio drive was required.

With these features in mind, and having now described the invention and the manner in which it might be used, the following claims are deemed to define what is new and what is to be protected by Letters Patent.

I claim:

1. A widely adjustable drive mechanism having an infinitesimal variation in ratio for consistently feeding and cutting a web of material into sheets of a prescribed length comprising:
   a. a driving motor;
   b. first means connecting said driving motor to a first portion of an adjustable ratio transmission means;
   c. second means connecting the first portion of said adjustable ratio transmission means to a cutter drum assembly;
   d. third means connecting the first portion of said adjustable ratio transmission means to a second portion of said adjustable ratio transmission means wherein the first and second portions of said adjustable ratio transmission means each comprise a cone pulley, and said third means comprises a drive belt connecting the two cone pulleys together, a cone pulley belt guide and an actuation means for moving the cone pulley belt guide;
   e. fourth means connecting the second portion of said adjustable ratio transmission means to a feed roll assembly; and,
   f. an electronic means responsive to signals from the feed roll assembly and the cutter drum assembly for driving said actuation means and adjusting the ratio of said adjustable ratio transmission means by moving the cone pulley belt guide and shifting the position of the belt on the two cone pulleys to produce infinitely small changes in the ratio of said adjustable ratio transmission.

2. The adjustable drive mechanism of claim 1 wherein said feed roll assembly and said cutter drum assembly each include timing gear drive means attached to the driven ends thereof and said first, second and fourth connecting means each comprise fixed length timing belts.

3. The adjustable drive mechanism of claim 2 wherein said adjustable ratio transmission means has at least one exchangeable timing gear drive means removably attached to the driven end of one of the portions thereof.

4. The adjustable drive mechanism of claim 3 which includes means for assisting the selective removal and seating of the exchangeable timing gear drive means for changing the prescribed sheet length to be cut.

5. A precision web feeding and sheet cutting apparatus including a widely adjustable drive mechanism capable of infinitesimal changes in drive ratio comprising:
   a. a feed roll and squeeze roll mounted on said apparatus to form a pressure nip through which a web of material is fed;
   b. a rotary sheet cutting mechanism mounted on said apparatus in line with said feed roll and squeeze roll for cutting said web of material into sheets;
   c. an adjustable drive mechanism connected to both said feed roll and said rotary sheet cutting mechanism for precisely feeding and cutting the sheets into prescribed length, said adjustable drive mechanism further comprising:
      1. a cone pulley drive including a pair of oppositely mounted cone pulleys each having an exterior slope of very slight taper;
      2. a first means connecting one of the cone pulleys with said feed roll;
      3. a second means connecting the other cone pulley with said rotary cutting mechanism;
      4. a third means connecting the two cone pulleys to one another, said third means comprising a drive belt, a belt guide and a drive means for said belt guide; and,
      5. an electronic means responsive to signals generated by said feed roll and said rotary cutting mechanism for activating said drive means to move the belt guide and thus shift the position of said drive belt on the two cone pulleys to effect infinitesimal changes in the ratio of said adjustable drive mechanism for precisely controlling the length of the sheets being cut.

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