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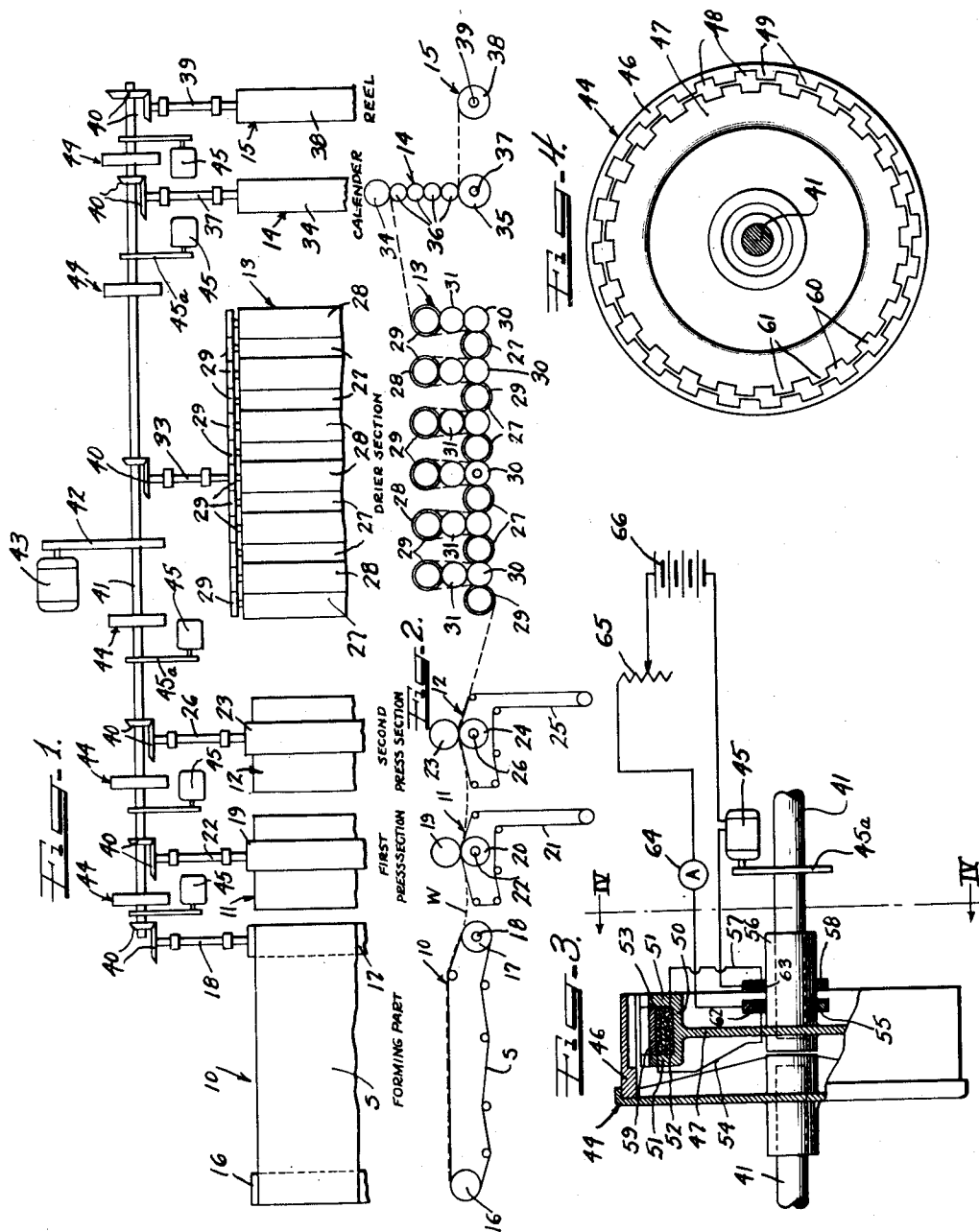
L. HORNBOSTEL

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DRIVE FOR PAPER MAKING MACHINES

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2 Sheets-Sheet 1



LLOYD HORNBOSTEL.

*Charles H. Miller* *Att. S.*

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LLOYD HORNBOSTEL.

Charles M. Webb

## UNITED STATES PATENT OFFICE

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## DRIVE FOR PAPERMAKING MACHINES

Lloyd Hornbostel, Beloit, Wis., assignor to Beloit Iron Works, Beloit, Wis., a corporation of Wisconsin

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This invention relates to drive assemblies for paper making machines, and more particularly relates to the driving of the constituent parts of a paper making machine in proper speed relation irrespective of changes in load on the various parts.

The proper relation of the speeds of various parts of a paper making machine to prevent undue tension or slack in the continuous web of paper passing through the machine is quite difficult. This continuous web in some cases, when dry, acts somewhat as a driving belt but, of course, is not strong enough to effect complete driving of the various parts or sections of the machine. In some machines where the wet felt passes through several sections of the machine, so-called "helper" drives are used for driving the various sections or parts to assist the web and felt in rotating the parts. These helper drives must be carefully regulated to give just the proper driving effort to the parts driven thereby, so that the draws of the web and felt between the various parts will not be too slack or too tense. In other machines where the wet felt does not pass through various parts or sections of the machine, such as the wet end section, then the various drives to each part or section have to have the relative speeds thereof positively controlled.

The web itself changes in length as it passes through the machine. Thus, the press roll sections and the calender portion of the machine tend to lengthen the sheet. The press sections are therefore driven faster than the forming part, the calender is driven faster than the drying section, and the reel is driven faster than the calender.

For example, in the Fourdrinier machine, if the drier section is operating at 100 feet per minute, the calender stack should operate at speeds around 102 feet per minute, while the winding reel should operate at speeds around 104 feet per minute. With this same drier section speed of 100 feet per minute, the forming part of the machine should only run about 88 feet per minute, the first press roll section about 92 feet per minute, and the second press section about 96 feet per minute.

If the press rolls of the press roll sections are adjusted to increase or decrease the nip pressure, the paper web may be lengthened for variable amounts thereby effecting the draws of the web between the press sections and between the last press section and drier section. Therefore, a mechanism must be provided for varying the

press roll speeds. Likewise an increased nip pressure throws an added load on the press roll drive, and some mechanism must be provided to prevent the rolls from slowing down due to this added load.

In accordance with the present invention, the various parts of a paper making machine are conveniently driven from a single prime mover through governor regulated electric slip couplings or dynamatic clutches which compensate for changes in speeds of the various parts due to variations in loads thereon by automatic control of the slippage in the couplings.

The electric slip couplings include driving and driven parts which are entirely free from rubbing connection. The couplings operate by means of magnetic flux between the driving and driven parts which in turn sets up eddy currents in these parts when there is any relative motion between them. The magnetic flux is induced from a controlled magnetic field generated in the driven member by direct current excitation of a coil. The degree of excitation will control the amount of slippage in the coupling, so that the speeds of the various parts of the machine can be exactly proportioned to maintain the desired tension on the sheet passing through the machine. This is accomplished simply by actuation of rheostats in the coil excitation circuits of the couplings.

A feature of this invention includes the use of an electrical governor, such as a bucking generator, in the excitation circuit, which generator is driven by the coupling itself for maintaining a constant driving speed of the coupling irrespective of changes in the load on the driven part.

Another feature of the invention resides in the provision of a drive shaft extending longitudinally along the back side of a Fourdrinier type paper making machine with a plurality of magnetic slip clutches or couplings interposed thereon for the purpose of controlling the driving speeds of the various in-shafts to the respective parts of the machine.

This drive shaft can be driven by a single prime mover and is preferably directly coupled to the drier section of the machine. A slip clutch is then interposed between the prime mover and the in-shaft to the second press section of the machine. A second slip clutch is interposed between the driven part of the first slip clutch and the in-shaft to the first press roll section. Still a third slip clutch is interposed between the driven part of the second slip clutch and the in-shaft to the couch roll of the forming part sec-

tion of the machine. Another slip clutch can be interposed between the drive shaft and the in-shaft to the calender stack, while still another clutch can be interposed between the drive to the calender stack and the in-shaft to the reel. The magnetic fields of the various clutches are excited electrically, and the excitation is accurately controlled by means of a rheostat, so that the driving speeds of the in-shafts will be properly related.

Bucking generators in the excitation circuits of the clutches are driven by the driven parts of the clutches and serve to resist the excitation of the magnetic fields, so that the drive shafts of the clutches will rotate at constant speed for each rheostat setting. This automatically compensates for any attempt to slow up any of the parts of the machine due to increased loads on these parts. If the load on a press roll, for example, should be increased, this would tend to slow down the driven part of the clutch to that press roll thereby slowing down the generator and automatically lowering the bucking action of the generator. This causes increased excitation of the magnetic field and decreased slippage of the clutch for maintaining the proper speed of the press roll.

It will be appreciated that the magnetic slip clutch installations of this invention provide greatly simplified drive assemblies and cut-off couplings for paper machines and that these drive assemblies are very flexible and easily controlled.

It is then an object of this invention to provide a drive assembly for paper making machines whereby the various parts of the machine are automatically driven in proper speed relation and wherein the speed of any part can be readily changed without change of gear ratios or the like.

A further object of the invention is to provide a paper machine drive assembly having a magnetic slip clutch coupling therein which is controlled by excitation of a magnetic field for maintaining proper speed relation of the various parts of the machine.

Another object of the invention is to provide a drive assembly for a Fourdrinier type paper making machine including a single prime mover and electrically controlled slip couplings between this prime mover and the various driven parts of the machine to vary the operating speeds of such parts.

A further object of this invention is to provide a drive assembly for a Fourdrinier type paper making machine including a longitudinal drive shaft extending along the length of the machine, in-shafts from this drive shaft to the various driven parts of the machine, and electrically excited slip couplings interposed at various points on the drive shaft for controlling the speeds of the in-shafts.

A further object of this invention is to help the driving of various parts of a paper making machine from a main driving source through electrically controlled slip couplings.

A further specific object of the invention is to control the driving of a press roll assembly in a Yankee type Fourdrinier machine from the prime mover for the Yankee drum drier of the machine.

Other and further objects of the invention and other and further features of the invention will be apparent to those skilled in the art from the following detailed description of the annexed

sheets of drawings which, by way of example, show two preferred embodiments of the invention.

On the drawings:

Figure 1 is a fragmentary top plan diagrammatic view of a Fourdrinier type paper making machine driven in accordance with this invention;

Figure 2 is a diagrammatic side elevational view of the machine shown in Figure 1;

Figure 3 is a fragmentary side elevational view, with parts in vertical cross section, illustrating one of the slip clutches or couplings shown in Figure 1 together with a diagrammatic electrical circuit for said coupling;

Figure 4 is a view taken substantially along the line IV—IV of Figure 3;

Figure 5 is a fragmentary side elevational diagrammatic view of the couch roll end of the forming section, the press roll section and drier drum of a Yankee type paper making machine; and

Figure 6 is a fragmentary top plan view, with the felts and top rolls omitted, of the machine shown in Figure 5, illustrating the drive for the drier drum, the press roll and couch roll.

As shown on the drawings:

In Figures 1 and 2, the illustrated paper machine is composed of a forming part 10, a first press section 11, a second press section 12, a drier section 13, a calender stack 14, and a reel 15.

The forming part 10 includes a breast roll 16, a couch roll 17, and a screen or forming wire S looped around the couch and breast rolls and trained therebetween to provide an upper run for receiving paper stock to form the stock fibres into a web. The couch roll 17 is driven from an in-shaft 18.

The first press section 11 is composed of a top press roll 19, a cooperating bottom press roll 20, and a felt 21 trained through the nip between the rolls. The bottom press roll 20 is driven from an in-shaft 22.

The second press section 12 is composed of a top press roll 23, a cooperating bottom press roll 24, and a felt 25 trained through the nip between the rolls. The bottom press roll 24 is driven from an in-shaft 26.

The drier section 13 is composed of a horizontal row of spaced bottom drying cylinders or drums 27 and a superimposed horizontal row of spaced top drums or drying cylinders 28. The cylinders 28 lie in superimposed relation above the cylinders 27 in the spaces between the cylinders 27. Each of the drums or cylinders 27 and 28 have a gear 29 on the rear end thereof. The gears 29 on the bottom row of cylinders 27 receive gears 30 therebetween in meshing relation therewith. Gears 31 are disposed intermediate the gears 30 and the gears 29 on the top row of cylinders 28 so that the cylinders 28 are driven from the gears 30 through the intermediate gears 31. An in-shaft 33 drives one of the gears 30 such as the gear between the central cylinders 27. This causes rotation of the entire gear train to drive all of the cylinders 27 and 28.

The calender stack 14 is composed of a plurality of rolls in vertical stacked relation and in pressure engagement with each other. For example, a top roll 34 is provided at the top of the stack and a bottom roll 35 is provided at the bottom of the stack. A plurality of intermediate rolls 36 is disposed in the stack between the top and bottom rolls. The bottom roll 35 of the stack is

driven from an in-shaft 37 and, in turn, imparts movement to the rolls 38 and 39.

The reel 18 is composed of a spool or spindle 38 which is driven by an in-shaft 39.

As shown in Figure 1, the in-shafts 18, 22, 26, 33, 37, and 39 are connected through beveled gears 40 with a main drive shaft 41 which is driven through a chain or belt 42 from a single prime mover such as an electric motor 43.

In accordance with this invention, slip clutches 44 are mounted in the main drive shaft 41 between the prime mover and each of the in-shafts 18, 22, 26, 37, and 39. Each slip coupling 44 is equipped with a generator 45 which is driven through a belt or chain 45a from the portion of the main drive shaft 41 which is driven by the coupling.

As shown in Figures 3 and 4, each slip coupling 44 is composed of an armature drum 46 on the drive portion of the main shaft 41 and a magnetic spider 47 on the driven portion of the shaft 41. The armature drum 46 surrounds the spider 47 and is internally slotted on the periphery thereof as at 48 to provide transverse teeth 49.

The spider 47 has a peripheral rim 50 with radially extending flanges 51 on the ends thereof defining an annular chamber 52 around the spider. An annular coil 53 is wound in this chamber 52 and has one end 54 thereof connected to a ring 55 secured on the hub 56 of the spider. The other end 57 of the coil is joined to a second ring 58 on the hub. These rings are in insulated relation to each other and to the spider.

A plate of non-magnetic material 59 covers the coil 53, and both the plate and the flanges 51 are grooved as at 60 (Figure 4) to provide a plurality of radial teeth 61 extending transversely across the peripheral of the spider. The spider may or may not have a different number of teeth than the drum 46.

A brush 62 engages the ring 55 in electrical contacting relation. A brush 63 likewise engages the ring 58 in electrical contacting relation therewith. The rings 55 and 58 rotate with the spider 47, but the brushes 62 and 63 are stationary. The brushes 62 and 63 are connected in an electrical circuit including an ammeter 64, a rheostat 65, a battery or other source of direct current 66, and the bucking generator 45 which is driven through the chain or belt 45a from the portion of the shaft 41 driven by the spider. In this manner, the coil 53 is excited with direct current to produce magnetic flux around the coil in the spider. The magnetic flux tries to couple the spider with the armature drum 46 between the teeth 61 and 49. The degree of excitation of the coil controls the degree of slippage of the coupling. If no direct current is applied to the coil, the armature drum 46 will rotate freely around the spider without rotating the spider.

No rubbing parts are provided, and the amount of slippage between the parts can be greatly reduced by heavy excitation of the coil.

A rheostat 65 determines the amount of slippage of each coupling, and the bucking generator 45 which opposes the direct current supply to the slip rings serves to maintain a constant driving speed. Thus, if the speed of the driven portion of the shaft 41 is decreased due to an increased load thereon, the speed of rotation of the generator 45 driven by this shaft would immediately decrease, and the bucking current produced by the generator would decrease. As a result more current from the source 66 could flow to the slip rings for increasing the excitation of the coil 53 there-

by decreasing the slippage of the clutch and bringing the shaft up to speed.

The generators need only be quite small, since the exciting current for the clutches is very small. The generators can be replaced with other types of governors.

The web W passing through the machine, as best shown in Figure 2, has an unsupported draw between each part or section of the machine. These draws must be maintained under proper tension to prevent rupturing or wrinkling of the sheet. As explained above, the various parts of the paper machine must be driven at different speeds for maintaining this proper tension, inasmuch as the web lengthens as it passes through the machine. The slip couplings 44 can be readily adjusted by means of the rheostat 65 provided in the excitation circuit for each coupling to produce an amount of slippage which will drive the in-shafts to the various sections at the exact desired speed and thereby maintain the exact desired tension on the draws of the web. If the tension on any draw changes, it is a simple matter to regulate the rheostat on the coupling controlling the part of the machine responsible for that particular condition of the draw.

If the load on any part of the paper making machine should be changed, such as, for example, by increasing the pressure between the rolls of the first press section, the result would be a slowing down of the speed of this part. However, the bucking generator would immediately slow down and the coil in the particular coupling would be further energized to decrease the slippage in the coupling and thereby again bring the parts up to speed. As a result a constant speed is maintained in each part of the paper making machine which speed is not affected by changes in load in the particular part. If the load is decreased, the speed of the bucking generator would be increased because that part would tend to speed up. However, the increased speed of the bucking generator would decrease the excitation of the coil causing more slippage in the coupling and thereby bringing the part down to the desired speed.

In Figure 5, the web W from the forming wire or screen S of a Yankee machine passes through couch and press sections 70 and 71 and is then transferred onto a Yankee drier drum 72. The couch section 70 is composed of a top roll 73 and a cooperating bottom roll 74. The press section is composed of a top roll 75 and a cooperating bottom roll 76. A top pick up felt 77 is trained through the nip between the rolls of the couch and press sections 70 and 71 and around a tail roll 78 under the drier drum 72. A transfer roll 79 is mounted in the loop of the felt 77 for transferring the web from the felt to drier drum 72.

A bottom felt 80 is trained through the nip between the rolls of the press section 71 and covers the web on the felt 77 as it passes through this press section.

The drier drum 72, as best shown in Figure 6, has a journal 81 receiving a pulley 82 thereon driven by a belt 83 from a pulley 84 on a main drive shaft 85. The main drive shaft 85 has a pulley 86 thereon driven by a belt 87 from a motor or other prime mover 88.

In accordance with this invention, the couch and press sections 70 and 71 are given the proper amount of driving effort from the drier drum 72 through in-shafts 89 and 90 respectively. Each in-shaft 89 and 90 has an eddy current coupler or

magnetic coupler 44, such as is described hereinabove, incorporated therein.

A pulley 91 on the main drive shaft 85 drives a belt 92 for rotating a pulley 93 on the driver part of the in-shaft 90. This same driver part of the in-shaft 90 has a pulley 94 thereon for driving a belt 95 to rotate the pulley 96 on the driver part of the in-shaft 89. The slip couplings 44 on each in-shaft 89 and 90 are interposed between the rolls 74—76 and the pulleys 96—94. Thus the driving effort applied to the couch and press sections 70 and 71 from the main drive shaft 85 is accurately regulated by the excitation of the coils in the slip clutches 44.

In this Yankee type of machine, therefore, the drier 72 is directly driven from a prime mover, and the couch and press sections of the machine are driven with any desired driving effort through the slip couplings so that the couch and press sections will receive just the desired amount of driving effort from the prime mover for maintaining a proper tension on the web and felt. Heretofore, the coordination and maintenance of the proper speed relation of the various sections and the drum drier on a Yankee type machine has been quite difficult. The slip coupling or eddy current coupling drive assembly of this invention now liberates the driving load on the felt and gives any desired helper drive effort to the presses from the drier.

From the above descriptions, it will be understood that this invention now provides for the application of a desired amount of driving effort to any part of a paper making machine through electrically controlled slip couplings or eddy current clutches which are free from rubbing parts and are accurately controlled by direct current excitation. The slip coupling drives of the present invention greatly simplify the proper driving of the parts of a paper making machine. The heretofore difficult task of maintaining proper driving speed relations of paper machine parts is now rendered easy and foolproof.

I claim as my invention:

1. A drive assembly for a paper making machine having a drier cylinder and a press roll, which comprises a prime mover directly coupled to the drying cylinder for rotating the same, an armature drum driven by said prime mover, a magnetic spider and coil driven by said armature drum, means coupling said magnetic spider and coil with the press roll, a direct current circuit for energizing the coil of said magnetic spider, an electrical governor controlled by the speed of rotation of said spider for directly regulating the degree of energization of the coil whereby any desired amount of driving energy from the prime mover can be supplied to the press roll and the speed of the press roll is automatically maintained in constant coordinated relation to the speed of the drying cylinder for imparting a desired degree of tension to a sheet of paper passing between the press roll and the drying cylinder.

2. A drive assembly for a paper making machine having a couch roll, a press roll, a drying cylinder, a calender stack, and a reel, which comprises a main drive shaft, a prime mover for said drive shaft, an in-shaft directly coupling said drier cylinder with said main drive shaft, in-shafts coupling said couch roll, said press roll, said calender roll, and said reel with said main drive shaft, eddy current slip clutches

having driving and driven parts interposed between said main drive shaft and said in-shafts for coupling the in-shafts with the prime mover, an electric excitation circuit for each eddy current slip clutch, and electrical governors driven by the driven parts of said slip clutches for directly controlling said excitation circuits to maintain the speeds of said couch roll, said press roll, said calender roll, and said reel at a constant rate irrespective of changes in loads on said rolls.

3. A drive assembly for a Fourdrinier paper making machine which comprises a main drive shaft extending longitudinally along the rear side of the machine, in-shafts driven by said main drive shaft coupled with various roll parts of the machine, eddy current slip clutches mounted in said main drive shaft between said in-shafts, means for electrically energizing said eddy current clutches to control the degree of slippage therein, and bucking generators driven by the driven parts of the clutches for automatically bucking the electric energization means to maintain predetermined speeds of the driven parts of the clutches irrespective of changes in load on said in-shafts driven by said driven parts of the clutches.

4. In a Fourdrinier type paper making machine including a forming part, a press section, a drier section, and a reel, a main drive shaft, a prime mover for said drive shaft, an in-shaft for driving said drier section coupled directly to said drive shaft, a first eddy current slip clutch driven by said main drive shaft, an in-shaft driven by said eddy current slip clutch driving said press section, a second eddy current clutch driven by said first eddy current clutch, an in-shaft driven by said second eddy current clutch driving said forming part, a third eddy current clutch driven by said main drive shaft, an in-shaft driven by said third eddy current clutch driving said reel, each of said clutches having driving and driven parts, means for exciting the eddy current clutches to control the amount of slippage therein, and bucking generators driven by the driven parts of each of said clutches to regulate the degree of excitation of the clutches for maintaining constant speeds of the driven members whereby the press section is adapted to be driven at a lower constant speed than the drier section, the forming part is adapted to be driven at a lower constant speed than the press section, and the reel is adapted to be driven at a higher constant speed than the drier section.

5. A drive assembly for a paper making machine having a plurality of driven sections, a prime mover coupled to a section for driving the section, an eddy current slip clutch having a driving part driven by said prime mover and a driven part coupled to another of said sections of the paper making machine, means for electrically energizing said eddy current slip clutch to control the degree of slippage between the driven and driving parts thereof, and an electrical governor driven by the driven part of said clutch to regulate the means for electrically energizing said clutch and maintain a desired constant coordinated speed relation between said sections of the paper making machine.

LLOYD HORNOSTEL.