

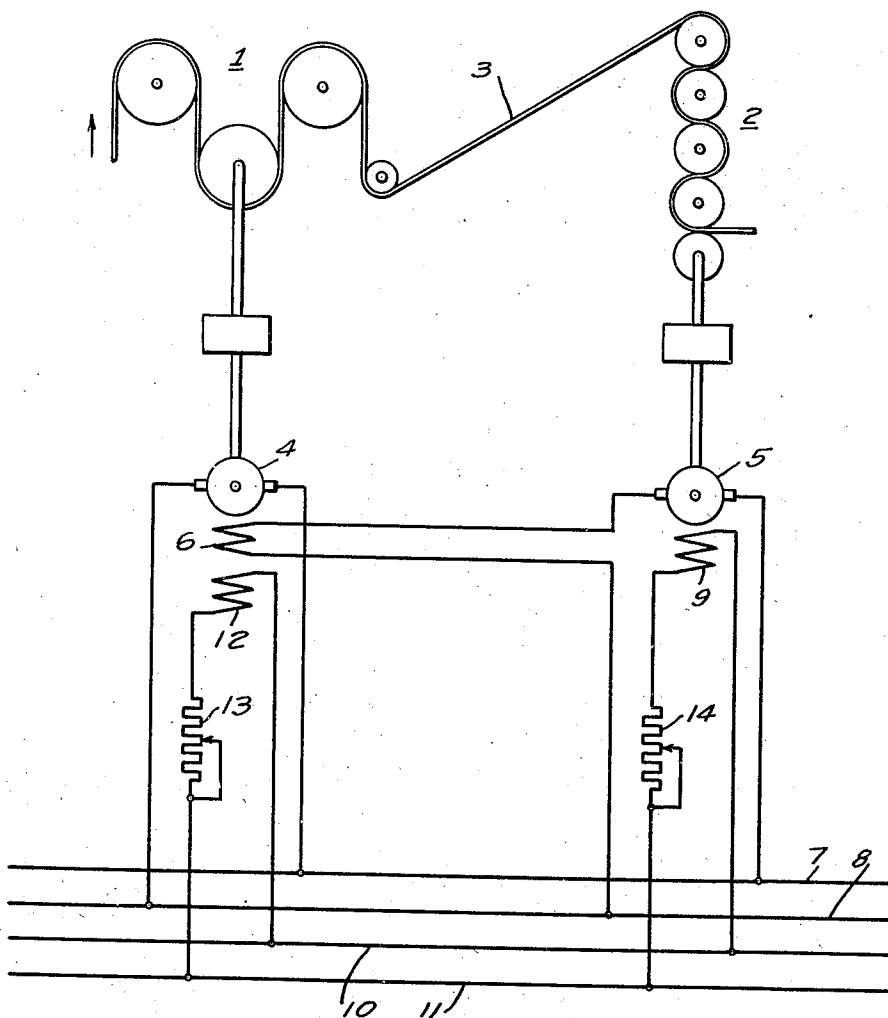
June 20, 1944.

R. R. BAKER

2,351,902

CONTROL SYSTEM FOR PAPER MAKING APPARATUS

Filed Jan. 8, 1943



WITNESSES:

E. A. M. Moskey

W. H. Young

INVENTOR

Rest R. Baker

BY

Paul E. Friedmann
ATTORNEY

UNITED STATES PATENT OFFICE

2,351,902

CONTROL SYSTEM FOR PAPERMAKING APPARATUS

Rest R. Baker, Swissvale, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application January 8, 1943, Serial No. 471,682

9 Claims. (Cl. 92—73)

This invention relates to a control system, and more particularly to an improved arrangement of a control system in paper making apparatus for preventing "sag back" upon breakage of the paper between the last set of drier rolls and the calender rolls, or similar applications.

In some forms of paper making apparatus, the paper is maintained under tension between the last set of drier rolls and the calender rolls. In so doing, the motor driving the calender rolls is caused to take up part of the load necessary to drive the last set of drier rolls. In other words, a part or more of the power than is necessary to drive the last set of drier rolls is furnished by the drive for the calender rolls, the amount of power being thus furnished being dependent upon the amount of tension in the strip of paper between the drier rolls and the calender rolls. In such apparatus the drier rolls and calender rolls are connected to direct-current machines, and where power is being supplied to the drier rolls from the calender rolls through tensioning of the paper, the direct current machine connected to the drier rolls will supply only a portion of the power or be overhauled and operated as a generator. In such case, it is necessary to strengthen the field on the direct current machine connected to the drier rolls in order to maintain the proper speed and in order to maintain the proper tension on the paper being fed to the calender rolls.

In the event that the paper snaps between the drier and calender rolls when it is under tension and supplying at least a portion of the power necessary to drive the calender rolls, it then becomes necessary to supply additional power for driving the drier rolls from a source other than the drive for the calender rolls, if "sag back" is to be prevented. This is accomplished by weakening the field on the direct current machine connected to the drier rolls in such manner as to cause it to take up the load on the drier rolls. However electrical paper mill drives thus far have been found defective in that the regulating apparatus for controlling the operation of the various roll sets do not function properly to remedy or prevent those conditions which cause "sag back". Since the paper is delivered to the last drier roll set at a constant predetermined speed, the time delay or sluggishness of speed regulating systems heretofore available resulted in a momentary slowing down of the last drier roll set and the formation of a loop or "sag back" of the paper being fed to the last drier roll set. The "sag back" of the paper

results in the formation of wrinkles and creases in the paper as it is subsequently fed through the last drier roll set. Such wrinkles interfere with the production of the machine in that they weaken the paper and thus cause further breakage between the calender rolls and drier rolls after subsequent rethreading of the paper through the calender rolls. Moreover, such wrinkles cause the paper to become fouled in the operating mechanisms with consequent loss of time in resuming normal operations.

One of the principal objects of this invention is to provide an improved arrangement of control apparatus for paper mill equipment which will be effective to prevent the so-called "sag back" of paper in front of the last drier roll set in the event of breakage of the paper in front of the calender roll set.

A further object of this invention is to provide an improved arrangement of control apparatus in paper mill equipment by which the drive for the last drier roll set is made directly responsive to the operating conditions of the drive for the calender roll set.

A further object is to provide a control field winding for the direct current machine connected to the last drier roll set which is connected in series with the armature circuit of the calender roll set drive motor so as to render the operation of such machine responsive to the operating conditions of the calender drive motor.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing in which the single figure is a diagrammatic showing of paper mill equipment constructed in accordance with the principles of this invention.

Referring to the drawing, the numeral 1 designates, as a whole, the last set of drier rolls and the numeral 2 designates, as a whole, a set of calender rolls in paper mill equipment. A strip of paper 3 is shown reeled around the rolls of a drier roll set and threaded through the stack of rolls in the calender roll set. A dynamo 4 is shown mechanically connected to the drier roll set, and a motor 5 is provided for driving the calender roll set 2. The paper is fed to the drier roll set 1 at a constant rate of speed from roll sets (not shown) preceding the drier roll set 1 in a manner customary in apparatus of this kind. As pointed out above, the paper 3 intermediate the roll sets 1 and 2 is commonly maintained under tension and motor 5 is thus effective to provide part of, all of, or more than, the power for

operating the drier roll set 1. During such operation, the paper will be effective to overhaul the dynamo 4. In case motor 5, supplies more power than necessary to drive roll set 1, machine 4 operates as a braking generator on the drive rolls. The parts thus far described, including the mechanical connections of the direct current machines 4 and 5 to, and the mountings of, the roll sets 1 and 2 form no part per se of this invention, this invention being limited to the control apparatus for the direct current machines 4 and 5. It will be understood that such control apparatus is used in connection with the conventional differential speed regulating devices (not shown) normally employed for matching the speeds of the various roll sets.

With respect to the novel features of this invention, the strip of paper 3 intermediate the roll sets 1 and 2 may be regarded as a "coupling mean" by which power is delivered from the calender roll set 2 to the drier roll set 1.

Control of the operation of the dynamo 4 is effected through a field winding 6 connected in series with the armature circuit of the motor 5. The motor 5 has its armature connected across a source of variable voltage supply such as the buses 7 and 8, and is provided with a field winding 9 connected across a source of constant potential such as the buses 10 and 11. The dynamo 4 likewise has its armature connected across the buses 7 and 8, and is provided with a field winding 12 connected across the buses 10 and 11. Adjustable resistances 13 and 14, normally controlled by conventional differential speed regulators (not shown) are provided, respectively, for varying the fields 12 and 9 to obtain the desired speed relation in operation of the machines 4 and 5.

The winding 6 is cumulatively arranged with respect to the winding 12. Since the winding 6 is connected in series with the armature of the motor 5, its ampere turns will be increased as the load on the motor 5 is increased, and will be decreased as the load on the motor 5 is decreased. Accordingly, it will be seen that the total field on the dynamo 4 will be varied directly with the loading of the motor 5. The field 6 is so designed that it will maintain constant the speed of operation of the dynamo 4 and drier roll set 1 for any given setting of the resistances 13 and 14 regardless of changes in load on the motor 5 such as will be had upon breakage of the paper between the roll sets.

The manner in which the control field 6 functions will be better understood by a consideration of the operation of the apparatus as paper is fed through the roll sets 1 and 2, and upon subsequent breakage of the paper intermediate such roll sets.

Initially the machines 4 and 5 are started by energizing the buses 7 and 8, and 10 and 11, without any paper present in the roll sets. The resistors 13 and 14 are adjusted to give the proper speed relation of the roll sets under idling conditions. Paper is then fed through the drier roll set 1 and thence through the calender roll set 2. As the paper is fed through the calender set 2, the portion between the sets will be placed under tension and power will be supplied to the drier roll set, by the motor 5. As pointed out above, the motor 5 may supply a part of, all of, or more than the power necessary to drive the drier roll set according to the amount of tension in the paper 3. Under the latter condition, the dynamo 4 must be operated as a braking generator. Under any of these conditions, it is necessary to

increase the field on the dynamo 4 if its speed is to be maintained constant as it is relieved of load or caused to operate as a braking generator. This is accomplished automatically with substantially no time delay by the field 6. As the load on the motor 5 increases, the ampere turns in the field 6 will increase an amount sufficient to prevent undesirable speed increases of the roll set 1.

In the event that the power supplied to the roll set 1 by the motor 5 decreases, such as would happen when the paper between the roll sets breaks, it becomes necessary to decrease the field on the dynamo 4 to cause it to take up the full load of the drier rolls. Under such condition, the field 6 functions automatically to perform the necessary adjustment. As the load on the motor 5 decreases, its armature current will also decrease and the ampere turns in the field 6 will be decreased the necessary amount. In the event of paper breakage, the field on the dynamo 4 will be restored immediately to the condition it had prior to taking up of any of the drier roll load by the motor 5. In this manner, the necessary adjustments are had with a minimum of time delay and a minimum of resulting "sag back." This arrangement regulates the operating characteristics of the dynamo 4 in such a manner that the speed of the drier roll set is maintained without any appreciable slowing down which would otherwise be effective to cause a loop or "sag back" in the paper being fed to the drier roll set 1.

Since certain changes may be made in the above construction and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, and means responsive to the loading of said motor for varying the field of said dynamo in such manner as to maintain the speed of operation thereof constant.

2. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, and means responsive to loading of said motor due to transfer of the drier roll load thereto for increasing the field on said dynamo to enable the same to be overhauled without varying the speed of said drier rolls.

3. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, and means responsive to loading of said motor due to transfer

of the drier roll load thereto for increasing the field on said dynamo to enable the same to be overhauled without varying the speed of said drier rolls, said means being also effective to decrease the field on said dynamo to enable the same to take up all of the drier roll load substantially without speed variation when said motor ceases to supply power thereto.

4. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, said dynamo having variable field means for controlling its speed of operation, and means responsive to loading of said motor due to transfer of drier roll load thereto for increasing the flux of said field means to enable said dynamo to be overhauled without speed change, said means being also effective to decrease the flux of said field means to enable said dynamo to take up all of the drier roll load without speed variation when said motor ceases to supply power thereto.

5. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, and a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, said dynamo having variable field means for controlling its speed of operation, said field means including a winding connected in series with the armature circuit of said motor effective to vary the flux of said field means in response to loading of said motor.

6. In paper making apparatus, a set of drier rolls to which a strip of paper is fed at a predetermined rate, a set of calender rolls to which said paper is fed from said drier rolls, a dynamo mechanically connected to said drier rolls, and a motor for driving said calender rolls which is adapted to supply power to said drier rolls by tensioning the paper between said roll sets, said dynamo having variable field means for controlling its speed of operation, said field means including a winding connected in series with the armature circuit of said motor, said winding being adapted to increase the total flux of said field means to enable said dynamo to be overhauled without speed change, and adapted to

decrease the flux of said field means to enable said dynamo to take up all of the drier roll load without speed variation when said motor ceases to supply power thereto.

7. In apparatus having a pair of machines for performing work, means coupling said machines together whereby the power for driving one of said machines may be supplied by the other of said machines, a dynamo mechanically connected to said one machine, a direct current motor for driving said other machine, and means responsive to the loading of said motor due to transfer of power through said coupling means for increasing the field on said dynamo to enable the same to be overhauled without varying the speed of said one machine, said means being also effective to decrease the field on said dynamo to enable the same to take up all of the load of said one machine when the power transmitted through said coupling means decreases.

8. In apparatus having a pair of machines for performing work, means coupling said machines together whereby the power for driving one of said machines may be supplied by the other of said machines, a dynamo mechanically connected to said one machine, and a direct current motor for driving said other machine, said dynamo having variable field means for controlling its speed of operation, said field means including a winding connected in series with the armature circuit of said motor effective to vary the flux of said field means in response to varying loads on said motor due to variations in the power transmitted through said coupling means.

9. In apparatus having a pair of machines for performing work, means coupling said machines together whereby the power for driving one of said machines may be supplied by the other of said machines, a dynamo mechanically connected to said one machine, and a direct current motor for driving said other machine, said dynamo having variable field means for controlling its speed of operation, said field means including a winding connected in series with the armature circuit of said motor, said winding being adapted to increase the total flux of said field means to enable said dynamo to be overhauled without speed change, and adapted to decrease the flux of said field means to enable said dynamo to take up all the load on said one machine without speed variation when the power supplied by said other machine through said coupling means decreases.

REST R. BAKER.