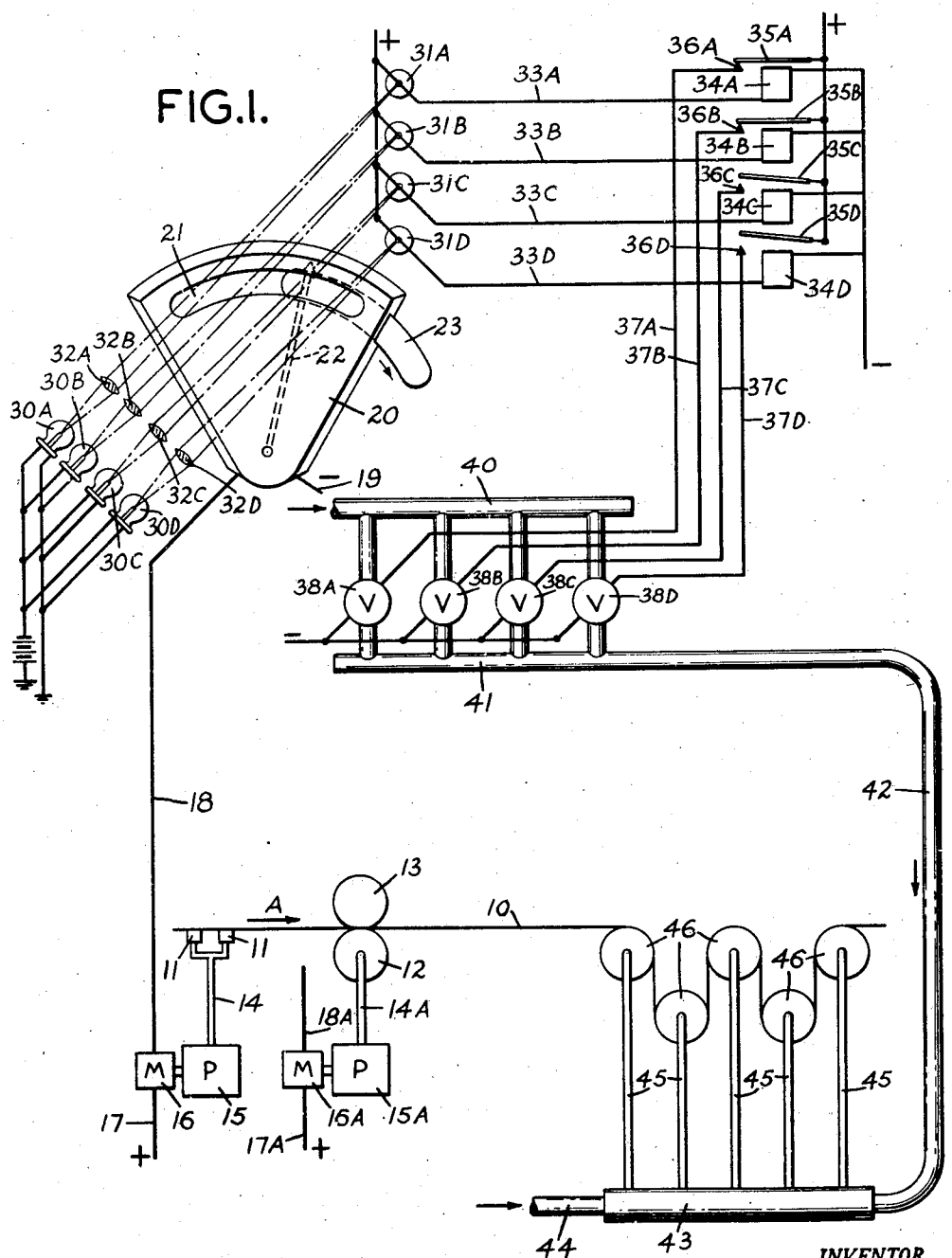


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METHOD OF AND APPARATUS FOR CONTROLLING
PAPER-MAKING MACHINES
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METHOD OF AND APPARATUS FOR CONTROLLING PAPER-MAKING MACHINES

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1

This invention relates to a method of and apparatus for controlling paper-making machines, and particularly to a system for controlling automatically the moisture content in a paper sheet as it is being formed.

When a sheet of wet pulp passes through a paper-making machine, as, for example, on the wire of a Fourdrinier machine, it passes through several instrumentalities or units for removing the water from the pulp. It is a common practice to pass the wire over suction boxes and then between a series of units, each comprising a suction couch roll and a press roll. The suction boxes are connected to a vacuum pump, and each of the suction couch rolls is connected to a vacuum pump. The vacuum pumps are commonly driven by individual constant-speed electric motors. The formed wet paper web is then passed over a series of heated drier rolls. When the web contains an excess of water, as it reaches the suction boxes and the suction rolls, the load on the motors is increased, because the sheet has less voids and the work done by the suction boxes and the suction rolls is increased. This additional load can be utilized to increase the heat in the drier rolls. According to my invention, this additional heat is provided automatically. More specifically, my invention relates to an electro-responsive device for introducing additional B. t. u.'s into the drier rolls when desired, which device is controlled automatically by an increase in the motor current through the medium of photo-electric cells.

I will describe my invention in the following specification, and point out its novel features in claims.

The drawing is a diagrammatic representation of some of the units of a paper-making machine and associated parts, together with electrical instrumentalities and interconnecting circuits combined in a manner which embodies the present invention.

10 designates a sheet of formed paper pulp on a wire screen which is driven in the direction indicated by the arrow A. It moves over suction boxes 11 and then between a suction couch roll 12 and a press roll 13. There are usually a larger number of suction boxes and a plurality of units, each comprising a suction couch roll and a press roll, but those shown are sufficient to illustrate my invention. The suction boxes are connected by a pipe 14 to a vacuum pump 15 driven by a constant-speed electric motor 16. The motor circuit passes from a positive main 17 through the motor, through a conductor 18 and

2

through an ammeter 20 to a negative main 19. The suction couch roll 12 is connected by a pipe 14A to a suction pump 15A driven by a motor 16A. 17A is a positive main connected to the motor 16A, and 18A is a conductor which may be connected to the ammeter 20. From the drying units the formed web of paper is led over a plurality of steam-heated drying rolls 46.

The ammeter has a transparent arcuate slot 21 through both of its sides. Its pointer 22 carries a shield 23, which covers this slot when the pointer is in its left-hand position, indicating a current flow of low intensity. On one side of the ammeter is a row of spaced electric light bulbs 30A, 30B, 30C, 30D, and on its other side is a row of similarly spaced photoelectric cells 31A, 31B, 31C, 31D. Between the electric light bulbs and the ammeter is a row of lenses, 32A, 32B, 32C, 32D, each of which is arranged to direct a beam of light from its respective electric light bulb through the slots 21 of the ammeter, when the latter are not covered by the shield 23, onto its respective photoelectric cell.

One of the terminals of each of the photoelectric cells is connected to a positive main from a source of electric energy. Conductors 33A, 33B, 33C, 33D connect the other terminals of the photoelectric cells to respective terminals of the electromagnets 34A, 34B, 34C, 34D of a series of relays. The other terminals of these electromagnets are connected to a negative main from the source of electric energy. The relays have movable contact arms 35A, 35B, 35C, 35D, which are connected to a positive main, and stationary contacts 36A, 36B, 36C, 36D, from which conductors 37A, 37B, 37C, 37D lead to one of the terminals of each of a series of electromagnetically actuated valves 38A, 38B, 38C, 38D, the other terminals of which are connected to a negative main. When the electromagnets are not energized, the movable contacts are not in contact with the stationary contacts.

The valves are interposed between a header 40, which is supplied with superheated steam, and a conduit 41, which is connected by a conduit 42 to a header 43. This header 43 is supplied with saturated steam introduced through a pipe 44 and is connected by pipes 45 with the drying rolls 46.

The operations is as follows: When the motor 15 is driving the vacuum pump 16 under normal conditions, the motor current is not sufficient to affect the ammeter 20. Under such normal conditions the saturated steam admitted to the drying rolls 46 from the pipe 44 furnishes enough

3

heat to dry the web adequately. If the sheet 10, when it reaches the suction boxes 11, contains an excess of water, the load on the vacuum pump 15 and the current through the motor 16 and ammeter 20 will increase. The shield 23 will be moved to the right to uncover one or more of the beams of light from the electric light bulbs, so that they will pass through the arcuate slots 21 to the photoelectric cells. In the drawing, the shield 23 is shown in a position to uncover the paths of the light beams from the electric light bulbs 30A and 30B to the photoelectric cells 31A, 31B. The latter will be energized to close circuits through the conductors 33A, 33B and the electromagnets 34A, 34B. Amplifier relays may be included in these circuits, if desired. The movable contacts 35A, 35B are moved onto the stationary contacts 36A, 36B to close the circuits through the valves 38A, 38B. The latter will open passages from the superheated steam header 40 through the header 41 and conduit 42 to the header 43 at substantially the same pressure as that of the saturated steam. From the header 43 additional B. t. u.'s will be led through the pipes 45 to the drier rolls 46, so that their heat will be increased.

It is to be understood that this automatic control can be employed to decrease the heat in the drier rolls when the sheet 10 is abnormally dry. To explain this action, it may be assumed that while the contacts 36A, 37A are closed, the sheet 10, as it reaches the suction boxes 11, contains less than a normal amount of water, so that the motor current through the ammeter is less than normal. This would cause the shield 23 to be moved to the left to shut off the light rays from the photoelectric cell 31B, and its current to the relay magnet 34B. A still weaker current will cause the relay magnet 34A to be deenergized. The operation under such circumstances will be obvious from the former description. The circuit through the motor 16A, instead of that through the motor 16, may be used to actuate the ammeter 20 if it is desired to effect the automatic heat control by the condition of the formed paper web as it reaches the suction couch roll 12.

Various modifications in construction, mode of operation, method and use of an invention may and do occur to others, especially after benefiting from knowledge of such a disclosure as that herein presented of the principles involved, but the invention itself is not confined to the present showing.

I claim:

1. The herein disclosed method of drying a formed paper web, which consists of passing the web across a power-driven suction water-removing unit, subsequently passing the web through a heated drying device, and controlling the heat of said device by variations in the power used in driving the water-removing unit.

2. The herein disclosed method of drying a formed paper web, which consists of passing the web across a suction water-removing unit actuated by an electric current which is varied proportionately to the amount of water in the web, subsequently passing the web through a heated drying device and utilizing the variations in said current to vary the amount of heat in the drying device.

3. The herein disclosed method of drying a formed paper web, which consists of passing the web across a suction water-removing unit in one part of a paper-making machine, said unit be-

4

ing actuated by an electric current which is varied proportionately to the amount of water in the web, subsequently passing the web through a heated drying device in another part of the paper-making machine and utilizing the variations in said current to vary the amount of heat in the drying device.

4. The herein disclosed method of drying a formed paper web, which consists in passing the web across a suction water-removing unit driven by a constant-speed electric motor, the current through which is varied proportionately to the amount of water in the web, subsequently passing the web through a drying device heated by steam, and utilizing the variations in the motor current to control the B. t. u.'s of the steam.

5. A paper-making machine in which a formed paper web is passed over a suction unit comprising a suction box, a vacuum pump, an electric motor and a circuit for said motor, and is subsequently passed over a drying roll spaced from said unit, to which roll a supply of saturated steam is connected, combined with a supply of superheated steam, an electrically actuated valve between said source of superheated steam and the drying roll, and means for controlling said valve by variations of current in said motor circuit.

6. A paper-making machine in which a formed paper web is passed over a suction unit comprising a suction box, a vacuum pump, an electric motor and a circuit for said motor, and is subsequently passed over a drying roll spaced from said unit, to which roll a supply of saturated steam is connected, combined with an electro-responsive device in the motor circuit, said electro-responsive device having a movable member actuated by variations of the current in said circuit, a supply of superheated steam, an electrically actuated valve between said source of superheated steam and the drying roll, and means for controlling said valve by the movements of said movable member.

7. A paper-making machine in which a formed paper web is passed over a suction unit comprising a suction box, a vacuum pump, an electric motor and a circuit for said motor, and is subsequently passed over a drying roll spaced from said unit, to which roll a supply of saturated steam is connected, combined with an ammeter in the motor circuit, a photo-electric cell on one side of the ammeter, means for projecting a beam of light from the other side of the ammeter onto the photo-electric cell, said ammeter having a shield movable by variations of current in the motor circuit into and out of the path of said beam of light, a supply of superheated steam, an electrically actuated valve between said source of superheated steam and the drying roll, and means for controlling said valve by current initiated by the beam of light and the photo-electric cell.

8. The combination defined in claim 7, in which said valve is electromagnetically actuated, a circuit for the valve, a relay in the valve circuit, and means for closing the relay by the current initiated by the beam of light and the photo-electric cell.

9. A paper-making machine in which a formed paper web is passed over a suction unit comprising a suction box, a vacuum pump, an electric motor and a circuit for said motor, and is subsequently passed over a drying roll spaced from said unit, to which roll a supply of saturated

steam is connected, combined with an ammeter in the motor circuit, a plurality of photo-electric cells on one side of the ammeter, a plurality of electric lights on the other side of the ammeter, each of said lights being arranged to project a beam of light onto one of the photo-electric cells, said ammeter having a shield movable by variations of current in the motor circuit into and out of the paths of said beams of light successively, a supply of superheated steam, a plurality of electrically actuated valves between said source of superheated steam and the drying roll, circuits for said valves, a relay in each valve circuit, and means for closing each of said valve relays by current initiated by one of said beams of light and its corresponding photo-electric cell.

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