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THERMAL EXPANSION MEANS FOR MAINTAINING AND ADJUSTING CUTTER KNIFE CLEARANCE

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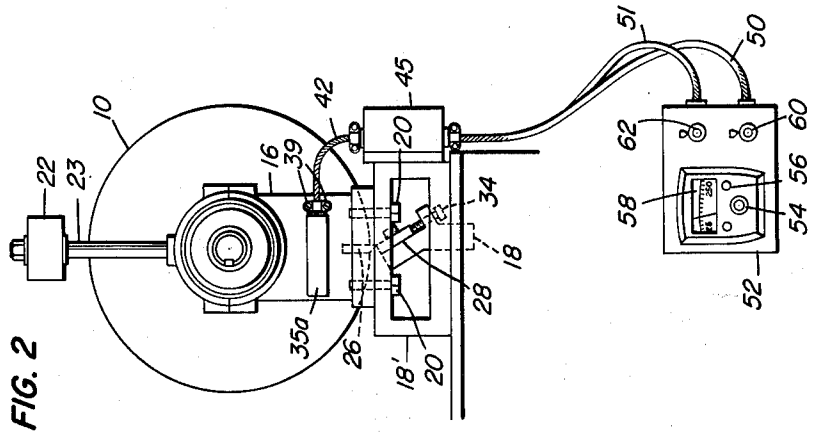


FIG. 2

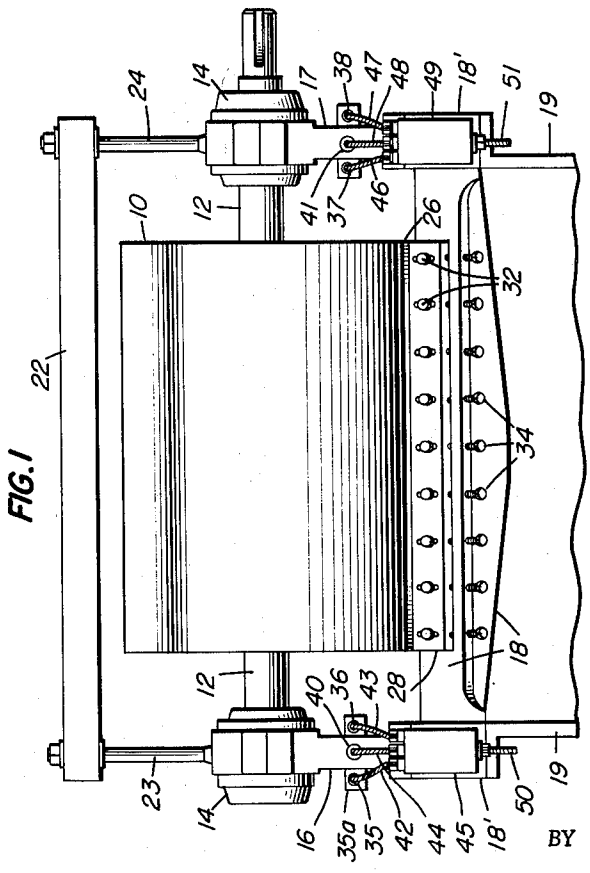


FIG. 1

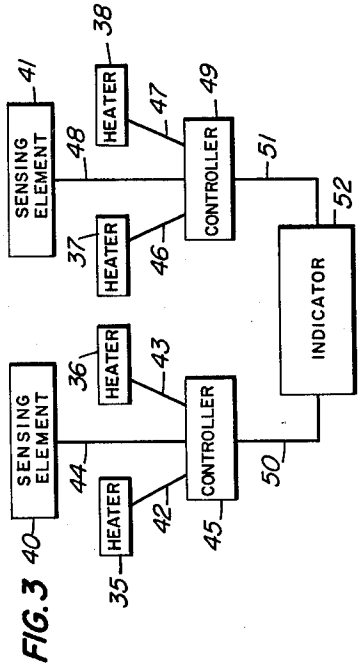


FIG. 3

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THERMAL EXPANSION MEANS FOR MAINTAINING AND ADJUSTING CUTTER KNIFE CLEARANCE

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This invention relates to the cutting of web material into sheets, and more particularly, it relates to rotary web cutting apparatus equipped with means for thermally controlling the expansion of the pedestals of the cutting apparatus and, thereby, controlling the clearance between the cutting knives.

With most rotary web cutters, difficulties are encountered when starting the cutter after an appreciable down time in that the cutting knives tend to hit or pound very heavily. The pounding of the knives gradually decreases as running of the cutter continues, until cutting action becomes normal after several hours of continued operation. The heavy pounding during start-up often damages the cutting edges of the knives. If the knives are adjusted at start-up to reduce the pounding and prolong the life of the knives, proper cutting can not be achieved after the cutter has run for several hours. It has been felt in the past that the pounding effect was due to the fact that the knives or the cutter drum had not yet "warmed up." In reality, if such warming of the knives or drum did occur, the knife clearance would actually decrease and pounding of the knives would increase due to thermal expansion of the knives or the drum. However, this explanation has been accepted for many years in the web cutting field, with little effort being expended on defining the real problem.

It has now been discovered that the real problem in this area is that the pedestals supporting the cutter drum, and the bearings associated therewith, are warmed by heat created in the bearings due to the rotation of the cutter drum. The pedestals, being warmed, expand in length as cutting continues until an equilibrium heat exchange obtains, at which time the pounding of the cutting knives no longer exists since expansion of the pedestals increases the clearance between the knives. This also explains why, if at start-up the knives are adjusted to avoid pounding, poor cutting results in a few hours' running time, since the clearance between the knives increases beyond proper cutting clearance due to the thermal expansion of the cutter pedestals. No one before has defined the real problem, and, therefore, an improved rotary web cutter designed to compensate for this phenomenon has not been previously disclosed.

On the basis of the above discovery, heating means were mounted on the cutter pedestals, and a temperature sensing device was installed in each cutter pedestal. The pedestals were quickly heated by the heating means to a suitable selected temperature before start-up of the cutter, and the selected temperature of the pedestals was controlled by means of temperature controllers. By controlling the temperature of the pedestals, and thus the thermal expansion of the pedestals, proper clearance between the cutting knives was maintained, and critical changes in the clearance between the cutting knives were effected merely by altering the temperature of the pedestals.

The invention will be best understood by reference to the following detailed description and drawing forming part of this specification in which:

FIGURE 1 is an elevational view of a rotary web cutter in which the pedestals of the cutter are equipped with heat producing and temperature sensing means;

FIGURE 2 is a side view of FIGURE 1 showing heat producing means on a cutter pedestal and showing a type of temperature controlling means;

FIGURE 3 is a block diagram illustrating the arrangement of the heat producing, temperature sensing, and control means.

Referring to FIGURE 1, rotary cutter drum 10 is carried on journals 12, and drum 10 turns through one complete revolution for each cutting operation performed. Drum 10 is driven by any suitable means, usually by mechanical linkage to a drive motor (not shown). Journals 12 are supported in suitable bearings 14 carried on front pedestal 16 and back pedestal 17. Pedestals 16 and 17 are mounted on the bed knife support frames 18' by means of screws 20, and the bed knife support frames 18' are suitably mounted on the machine frame 19. A guard 22 is usually provided between pedestal extensions 23 and 24. A blade or fly knife 26 is suitably housed within a notch in the cutter drum 10 (as by means of clamping screws not shown.) Stationary blade or bed knife 28 is mounted on the bed knife support 18 by means 32, and the bed knife 28 is adjustable toward and away from the fly knife 26 by means of adjusting screws 34. In the main, the above cutting apparatus is of conventional construction, and it can be seen that the pedestals 16 and 17 serve as the supporting structures for the rotatable carrier (drum 10) of the fly knife 26.

Each of the cutter pedestals 16 and 17 is equipped with heating means, as for example electrical strip heaters 35, 36, 37, and 38. Preferably, one such heater is mounted on each of two opposite sides of each pedestal 16 and 17 by means of screws 39 (FIGURE 2). In some instances, one heater on each pedestal may be sufficient, and more than two such heaters on each pedestal may be employed. Appropriate shields are provided over each such heater, as for example shield 35*a* associated with heater 35. Each of the cutter pedestals 16 and 17 is equipped with temperature sensing means, as for example temperature sensing bulbs 40 and 41. A temperature sensing bulb is installed in each pedestal preferably by boring a hole into each pedestal and placing a temperature sensing bulb into each hole. Electrical conduits 42 and 43 connect the strip heaters 35 and 36, respectively, to a temperature controller 45 mounted on the bed knife support 18 at the front side of the cutter, and temperature sensing bulb 40 is connected to the temperature controller 45 by means of electrical conduit 44. Electrical conduits 46 and 47 connect the strip heaters 37 and 38, respectively, to a temperature controller 49 mounted on the bed knife support 18 at the back side of the cutter, and temperature sensing bulb 41 is connected to the temperature controller 49 by means of electrical conduit 48. Temperature controllers 45 and 49 are connected by means of electrical conduits 50 and 51, respectively, to a temperature indicator unit 52.

When the cutter is to be started, the indicator unit 52 is supplied with electrical power which is transmitted by means of conduits 50 and 51, temperature controllers 45 and 49, and conduits 42, 43, 46 and 47 to the strip heaters 35, 36, 37 and 38 associated with pedestals 16 and 17. The pedestals 16 and 17 are heated to some selected temperature above room or ambient temperature and above the maximum temperature normally reached by the pedestals due to heat transferred from the bearings 14. It has been found that with the equipment employed, a temperature of about 130° F., as indicated by the temperature sensing bulbs 40 and 41, is a suitable temperature for the pedestals. This set temperature is maintained by the temperature controllers 45 and 49, which supply electrical energy to the strip heaters 35, 36, 37, and 38 when necessary in response to temperature changes indicated by the temperature sensing bulbs 40 and 41, to maintain the de-

sired temperature of each pedestal. With the equipment employed, the pedestals **16** and **17** are quickly brought to the desired temperature. Cutter knife clearance can then be mechanically adjusted, if necessary, before the cutter is started, and due to the substantially constant temperature maintained at the cutter pedestals, the clearance between the fly knife **26** and the bed knife **28** will remain constant under any and all operating conditions.

Conventional electrical strip heaters, temperature controllers, sensing elements and indicator unit have been employed. For example, suitable equipment is marketed as follows under the respective trade designations: resistance-type Chromalox PT Strip Heaters, 150 watts, 120 V.A.C., manufactured and marketed by Edwin L. Wiegand Co., and described in the manufacturer's catalog No. 60; Fenwal No. 53602–1 Temperature Controller (potentiometer), using a thermistor sensing element Fenwal No. 74202–106, and the circuitry associated therewith, and Fenwal No. 58002–2 Indicator Unit, which is a milliammeter with appropriate selector switches, manufactured by Fenwal Inc., and described in the manufacturer's Bulletin MC–190. This equipment permits very precise control of the temperature of the pedestals. It has been noted that a change of 2° F. in the pedestal temperature may effect a change in knife clearance of .0001 of an inch, which in many cases will be the difference between cutting or not cutting completely a traveling web passing between the cutting knives.

The indicator unit **52** referred to above and shown in FIGURE 2 has a center knob **54** which permits selection of the front or back pedestal temperature for display. By pressing and holding the push button **56**, the set temperature for a pedestal is displayed on scale **58**. The temperature desired is roughly set by means of calibrated knobs **60** and **62**, knob **60** being associated with the front pedestal **16**, knob **62** being associated with the back pedestal **17**, and a precise temperature is set (as for example for the front pedestal **16**) by holding down button **56** and adjusting knob **60** until the desired temperature is displayed on scale **58**.

It was noted that when the speed of the cutter changed or was changed to accommodate a different basis weight of paper, knife adjustment was necessary in order to obtain a clean cut through the traveling web. If machine speed was increased, the bearings **14** created additional heat causing the pedestals to expand, thus effecting a change in knife clearance. However, by means of the present invention, a pedestal temperature can be set above the maximum temperature brought about by bearing heat-up, and increases in machine speed will have no effect on the knife clearance. Thus, the pedestal heaters not only find utility in overcoming the pounding of the cutting knives at the beginning of a run, and thereby prolong the life of the knives, but they compensate for changes in the speed of the cutter, maintaining optimum knife clearance under all operating conditions. Further, critical changes in knife clearance can be made by merely raising or lowering the set temperature of the pedestals, thereby changing the knife clearance as the pedestals expand or contract and obviating the mechanical readjustment of the knife clearance.

Obviously, means for cooling rather than heating the pedestals may be employed for maintaining the pedestals at the desired constant temperature. Such means as water jackets, associated with the pedestals, through which cold water or other cold fluids are circulated, or direct cooling by means of cool air blasts directed against the pedestals, or thermoelectric cooling, may be employed.

For reasons of simplicity, a web cutting mechanism employing a rotating fly knife and stationary bed knife has been described. However, means for thermal expansion control, as described herein, could be applied to web cutting mechanisms in which both the fly knife and the bed knife are rotated.

The thermal expansion phenomenon, and the means for controlling the same as disclosed in this patent, can have

applications with other paper manufacturing and converting machinery such as in bag making machines, box making machines, textile machines, metal working machines, etc. where the maintenance of very precise clearance between elements of the machines is required.

While a preferred embodiment of the invention has been illustrated and described in detail, it is to be understood that changes may be made therein and the invention embodied in other structures. Hence, the present embodiment is to be considered as illustrative and not as restrictive, and it is intended to cover the invention in whatever form its principles may be utilized.

I claim:

1. A web cutting machine comprised of a bed knife, a rotary cutter drum, a fly knife carried in fixed position on the cutter drum and cooperating with said bed knife at a selected clearance therefrom to sever a traveling web passing between said bed knife and said fly knife, journals upon which said drum is carried, and pedestals supporting said journals; characterized in that heating means are mounted on said pedestals for heating said pedestals above the normal maximum temperature of the pedestals attained during running of the machine, temperature sensing means are mounted on said pedestals for measuring the temperature of the pedestals, and control means are associated with the heating means and temperature sensing means for activating said heating means in response to temperature changes of the pedestals indicated by said temperature sensing means, to maintain a selected temperature of the pedestals, and thereby maintain the selected cutting clearance between the fly knife and the bed knife.

2. A web cutting machine comprised of a bed knife, a rotary cutter drum, a fly knife carried in fixed position on the cutter drum and cooperating with said bed knife at a selected knife clearance to sever a traveling web passing between said bed knife and said fly knife, journals upon which said drum is carried, and pedestals supporting said journals; characterized in that at least one electrical strip heater is mounted on each pedestal for heating each pedestal above the normal maximum temperature attained by each pedestal during running of the machine, a temperature sensing bulb is mounted into the interior of each pedestal, and control means are associated with the electrical strip heaters and temperature sensing bulbs, said control means responsive to changes in the temperature of the pedestals as indicated by said temperature sensing bulbs to activate said electrical strip heaters to heat the pedestals and thereby maintain a selected temperature of the pedestals, whereby the clearance between the fly knife and the bed knife is maintained constant irrespective of machine speed and increased heat developed therefrom.

3. In a rotary web cutting mechanism, in combination, a fly knife, a rotatable carrier for said fly knife, supporting structures for said rotatable fly knife carrier, heating means mounted on said supporting structures for heating said supporting structures above the normal maximum temperature of said supporting structures attained during running of the web cutting mechanism, temperature sensing means mounted on said supporting structures for measuring the temperature of said supporting structures, and control means associated with the heating means and temperature sensing means for activating said heating means in response to temperature changes of the supporting structures indicated by said temperature sensing means, to maintain a selected temperature of said supporting structures.

4. In a rotary web cutting mechanism, in combination, a fly knife, a rotatable carrier for said fly knife, pedestals supporting said rotatable fly knife carrier, at least one electrical strip heater mounted on each pedestal for heating each pedestal above the normal maximum temperature attained by each pedestal during running of the machine, a temperature sensing bulb mounted into the interior of each pedestal, and control means associated with the electrical strip heaters and temperature sensing

bulbs, said control means responsive to changes in the temperature of the pedestals as indicated by said temperature sensing bulbs to activate said electrical strip heaters and thereby maintain a selected temperature of said pedestals.

5. In a rotary web cutting mechanism, in combination, a bed knife, a rotary cutter drum, a fly knife carried in fixed position on the cutter drum and cooperating with said bed knife at a selected clearance therefrom to sever a traveling web passing between said bed knife and said fly knife, supporting structures for said rotary cutter drum, and temperature varying means mounted on said supporting structures for normally maintaining said supporting structures at a constant temperature above the maximum temperature of the supporting structures attained during running of the mechanism, and control means associated with the temperature varying means for activating said temperature varying means to vary the temperature of the supporting structures and thereby change dimensions of the supporting structures and effect a change in the clearance between said fly knife and said bed knife.

6. In a rotary web cutting mechanism, in combination, a bed knife, a rotary cutter drum, a fly knife carried in

fixed position on the cutter drum and cooperating with said bed knife at a selected clearance therefrom to sever a traveling web passing between said bed knife and said fly knife, pedestals supporting said rotary cutter drum, heating means mounted on said pedestals for normally heating the pedestals to a constant temperature above the maximum temperature of the pedestals attained during running of the mechanism, and control means associated with the heating means for activating the heating means to further heat the pedestals and thereby thermally expand the pedestals and effect a change in the clearance between said fly knife and said bed knife.

References Cited by the Examiner

UNITED STATES PATENTS

1,978,894	10/34	Clark.	
1,982,571	11/34	Clark.	
2,271,637	2/42	Garrison	83—171 X
2,621,736	12/52	Scruggs	83—170 X
2,782,853	2/57	Heffelfinger	83—170 X
3,064,563	11/62	Cook.	

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