

Sept. 19, 1967

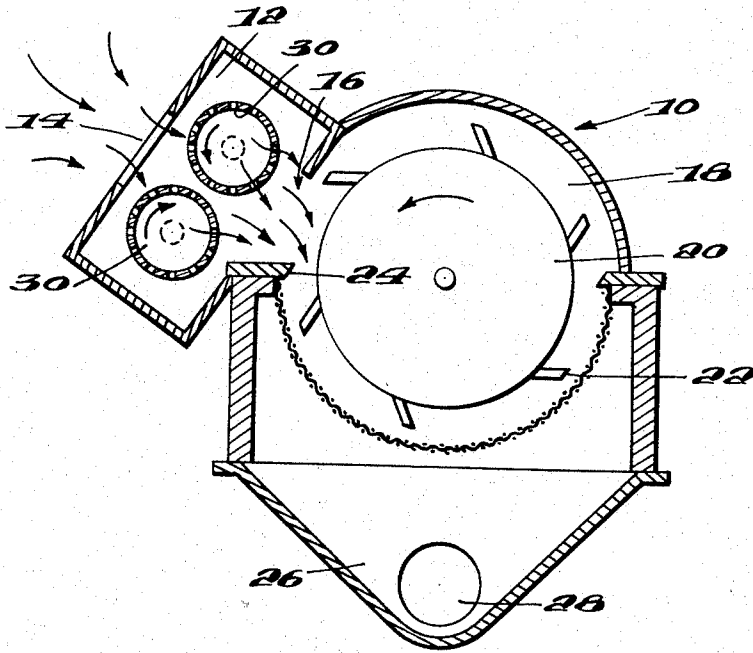
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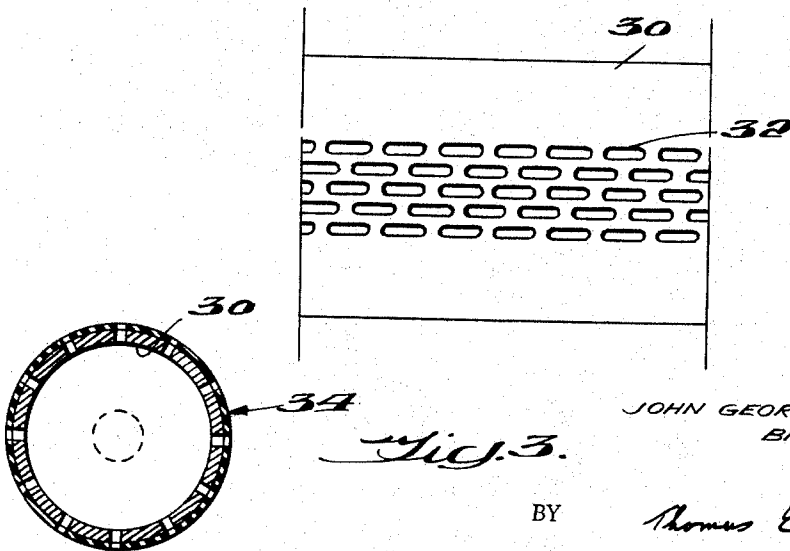
PERFORATED FEED ROLLS WITH INDUCED GAS FLOW THERE THROUGH

Filed Nov. 19, 1964

*Fig. 1.*



*Fig. 2.*



*Fig. 3.*

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**PERFORATED FEED ROLLS WITH INDUCED GAS FLOW THERETHROUGH**

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Filed Nov. 19, 1964, Ser. No. 412,432

6 Claims. (Cl. 83-402)

**ABSTRACT OF THE DISCLOSURE**

An improvement is provided in induced gas flow apparatus for transmitting film scrap to a multi-bladed knife cutter. The improvement consists of perforated feed rolls with hollow interiors which serve to transmit the film to the cutter. The induced gas, usually air, flows through the nip rolls and strips any film wrap from the rolls. Also, the pressure drop across the rolls as well as the heat buildup is diminished.

This invention concerns an improved feed roll design in gas consuming devices.

A particular, practical application is in processes reclaiming waste or scrap of predominantly thermoplastic films and fibers. The scrap is usually fed by means of solid nip rolls into a cutting chamber which is commonly a multi-bladed knife cutter. An induced gas flow, usually air, accompanies the material through the cutter and serves to sweep the cut material out of the cutting region and convey the material away. The induced gas flow rate, which also controls the pressure drop across the nip rolls, must be sufficient to avoid heat build-up and subsequent scrap melting in the cutting zone. The prime problem encountered with the use of solid nip rolls is the tendency for thin gauge films or small diameter fibers to wrap around the nip rolls instead of passing directly into the cutting chamber. The resulting necessity for unwrapping the films and fibers from the rolls leads to shut-downs which are both time consuming and costly. Another disadvantage evident is that in practical operation the gas flow with solid nip rolls causes a significant pressure drop across the nip rolls.

It is an object of this invention to provide a nip roll design which leads to improved cutter capacity in handling material and effectively decreases the amount of "downtime" consumed by shut-downs due to film wrap on the nip rolls.

According to the present invention, there is provided in a device having an induced gas flow therethrough and containing a pair of rotatably mounted material transmitting nip rolls in the path of said gas flow; the improvement wherein said nip rolls have hollow interiors and surfaces containing perforations, the perforations being of such a size and number that said gas flow is predominantly through said nip rolls. Through the use of perforated nip rolls, material wrap is avoided and a large quantity of gas may be induced through the apparatus. This in turn permits large amounts of material to be fed to the cutting chamber with an accompanying small pressure drop.

The invention will now be described in reference to the following drawings wherein:

FIGURE 1 is a cross-section view of a cutting apparatus.

FIGURE 2 is a fragmentary view of the surface of a perforated nip roll.

FIGURE 3 is a cross-section view of a modified embodiment of a perforated nip roll.

With reference to FIGURE 1, the invention is illustrated as being incorporated in a cutting apparatus indicated generally by the reference character 10. As illus-

trated, the cutting apparatus comprises a feed section 12 with an inlet opening 14 at one end and an exit opening 16 at the other end. A cutting chamber 18 is attached to the feed section such that induced gas and material entering the feed section through the inlet opening is transmitted to the cutting chamber through the exit opening. Rotatably mounted in the cutting chamber is a multibladed knife cutter 20, driven by means not shown, having knife blades 22. Material transmitted into the cutting chamber is cut by the shearing action between the rotating knife blades 22 and the bed knife 24. The induced gas flows through the cutting apparatus carrying the material out of the cutting chamber and into the discharge section 26 from which it is removed from the cutting apparatus through the discharge exit 28.

In the feed section 12 of FIGURE 1, there is rotatably mounted and driven by means not shown a pair of nip rolls 30 having hollow interiors with parallel central axes. The nip rolls are so arranged as to mutually engage material entering the feed section through the inlet opening and transmit the material through the exit opening into the cutting chamber.

Reference to FIGURE 2 shows that the surfaces of the nip rolls 30 contain a plurality of perforations 32. When the incoming induced gas enters the feed section, it flows predominantly through the perforations in the nip rolls exiting from the nip rolls on the cutting chamber side. The term "predominantly" is used since it must be recognized that some of the gas can flow around or between the nip rolls. Material being transmitted by the nip rolls, has a natural tendency to wrap about the rolls due to nip pressure and rotary motion of the rolls. The exit of induced gas from the perforations in the nip rolls strips the rolls of any material wrap that tends to occur and, thus, material is transmitted directly with the induced gas into the cutting chamber.

In a cutting apparatus such as described, the minimum gas flow requirement is generally determined by that necessary to convey the material and to avoid heat build-up in the cutting chamber. The minimum flow rate will depend upon whether fiber or film is being cut and the rate of material feed. For example, using a conventional 18 inch rotary knife cutter a minimum gas flow rate of 600 cubic feet per minute is desirable when cutting polyethylene film at a feed rate of 1000 pounds per hour. An equivalent fiber example is a minimum gas flow rate of 1000 cubic feet per minute for cutting 1200 pounds per hour of nylon fiber. Obviously, with other common films, such as polypropylene and polyesters and common fibers, such as acrylonitrile and polyesters, much the same minimum gas flow rates are desirable.

The configuration and size of the perforations in the nip roll surface, though not critically limited, is dependent upon the material to be cut. It is preferable for maximum gas flow to have a high area of perforation, however, this must be balanced by the necessity for structural stability of the nip rolls. It is also preferable when feeding film scrap and waste to have the perforation dimension that is parallel with the central axis smaller than the width of the film being cut to avoid introducing film into the interior of the nip rolls. A practical perforation design applicable for most common films and fibers is slot perforations 1/2 inch (parallel to central axis) x 1/8 inch on 1/4 inch alternate centers. However, any shape perforation can be used with almost any reasonable dimensions and arrangements. It is generally found practical, but by no means limiting, to use perforations having any of their standard surface dimensions (i.e., those dimensions usually specified, such as width and length for slots and diameters for circles) in the range from 1/16 inch to 1 inch. Useful examples of perforation designs are: slots, in any orienta-

tion, having standard surface dimensions of 1" x 1/16", 1/2" x 1/16", 1/4" x 1/16", 1/8" x 1/16", 1" x 1/8", 1/2" x 1/8", etc.; circles having diameters from 1/16 inch to 1 inch; other geometrical shapes with standard surface dimensions in the range from 1/16 inch to 1 inch. The arrangement of the perforations on the nip roll surface is generally on alternate centers with the distance between centers being from 1/8 inch to 1 inch. The term "alternate centers" implies a perforation arrangement with a staggered effect similar to that shown in FIGURE 2 wherein individual perforations in adjacent rows that run parallel to the nip roll axis are not aligned and permit maximum open area. The center distance is the distance between lines parallel to the nip roll axis taken through the geometrical center of perforations arranged on adjacent rows. Common center distances are 1/4", 3/8", 1/2", and 5/8".

The size of the nip rolls depends predominantly upon the size and type of cutter being used. A practical nip roll design useful for an 18 inch rotary knife cutter is 18 inches long with a diameter of 3 15/16 inches and a shell thickness of 1/8 inch.

The nip rolls are most commonly made of steel, however, any other material satisfying the necessary structural requirements can be used. In addition, as can be seen by reference to FIGURE 3, the perforated nip rolls 30 can be covered with an elastomeric material 34, perforated in register with the perforations on the nip roll surface. An elastomeric covering is desirable when films and fibers of varying thicknesses are being transmitted through the rolls at the same time. The elastomeric covering serves to take deformation resulting from the passage of thicker pieces while sufficient nip roll pressure is maintained on the thinner pieces. Suitable elastomeric materials can be, among others, natural rubber, butyl rubber, polychloroprene, butadiene/styrene copolymers, polyvinyl chloride, polyethylene, polypropylene, elastomeric copolymers of ethylene and propylene, and polyester and polyester urethanes.

For economic reasons the most common gas utilized in the cutting apparatus is air. However, it should be apparent that any inert gas, with reference to the particular process, can be used.

Although the apparatus described above shows the perforated nip rolls of this invention being used to feed film and fiber scrap and waste into a cutting chamber, many other applications of the invention are possible. The perforated nip rolls can be used in any application where it is necessary to feed thin material having a tendency to wrap. In particular, the perforated feed rolls of this invention are useful in applications where, in addition to the wrap problem, a gas flow must accompany the material for other reasons, such as cooling or transporting.

The advantages obtained from using perforated nip rolls are set forth by the results of the following tests. A test was conducted to measure the pressure drop across perforated and solid nip rolls operating on an 18 inch wide cutter. Both the solid and perforated rolls were 18 inches long and 3 15/16 inches in diameter with the perforations on the perforated nip rolls being longitudinally aligned slots of 1/2" by 1/8" on 1/4" centers. Shell thickness of the perforated rolls was 1/8". Three runs were carried out with an air velocity through the discharge section of the cutter being maintained at 2960 feet/minute for two of the runs and 2600 feet/minute for the other. Run A was made on solid nip rolls open 1 1/4 inches. Run B was made on

solid nip rolls operating at a nip pressure of 20 pounds/lineal inch of roll face. Run C was made on perforated nip rolls operating at a nip pressure of 20 pounds/lineal inch of roll face. Table I presents the pressure drop results of the above described tests:

TABLE I

| Run    | Nip Rolls              | Pressure Drop Across Nip Rolls (Inches of Water) |
|--------|------------------------|--|
| A..... | Solid-Open 1 1/4"..... | 2.4  |
| B..... | Solid-Closed.....      | 15.8   |
| C..... | Perforated-Closed..... | 2.6  |

<sup>1</sup> Conducted at an air velocity of 2,600 feet/minute, obtaining a result of 4.5 inches of water and extra-polated to 2,960 feet/minute.

In addition to the above pressure drop test, the relative "down-time" due to polyethylene film wrap on solid and perforated nip rolls was observed. The cutter design, nip roll design, and operating conditions were similar to those presented above. The observed "down-times" were 1 hour/8 hours of cutter operation for solid rolls and 1 hour/48 hours of cutter operation for perforated rolls.

What is claimed is:

1. In a material cutting apparatus having an induced gas flow therethrough and having in combination, a feed section containing, in the path of said gas flow, a pair of rotatably mounted material transmitting nip rolls, a cutting chamber, and a discharge section; the improvement wherein said nip rolls have hollow interiors and surfaces containing perforations, the perforations being of such a size and number that said gas flow is predominantly through said nip rolls.

2. The apparatus of claim 1 wherein said gas flow induced into said feed section flows predominantly through said nip rolls and strips said nip rolls of any material wrap.

3. The apparatus of claim 1 wherein said nip rolls are covered with an elastomeric material, said elastomeric material having perforations in register with those perforations in the surface of said nip rolls.

4. The apparatus of claim 3 wherein the elastomeric material is selected from the group consisting of natural rubber, butyl rubber, polychloroprene, butadiene/styrene copolymers, polyethylene, polypropylene, elastomeric copolymers of ethylene and propylene, and polyester and polyether urethanes.

5. The apparatus of claim 2 wherein said nip rolls are covered with an elastomeric material, said elastomeric material having perforations in register with those perforations in the surface of said nip rolls.

6. The apparatus of claim 5 wherein the elastomeric material is selected from the group consisting of natural rubber, butyl rubber, polychloroprene, butadiene/styrene copolymers, polyethylene, polypropylene, elastomeric copolymers of ethylene and propylene, and polyester and polyether urethanes.

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