United States Patent

Kesten et al.

[15] **3,698,272**

[45] **Oct. 17, 1972**

[54] ROTARY AIR EJECT DIE-CUTTING ASSEMBLY

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[22] Filed: **May 3, 1971**

[21] Appl. No.: **139,378**

[52] **U.S. Cl.** **83/99**

[51] **Int. Cl.** **B26d 7/18**

[58] **Field of Search** 83/98–100, 911, 83/343

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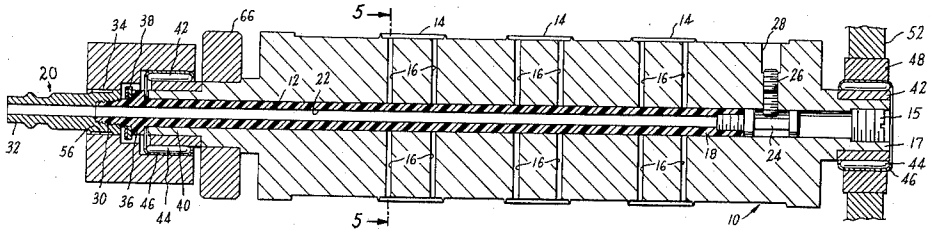
Primary Examiner—Andrew R. Juhasz

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[57] **ABSTRACT**

A rotary air eject die-cutting assembly utilizes an air delivery manifold having a cylindrical core portion that is fabricated of a relatively resiliently deformable material and is closely seated within the cavity of a journaled die-cutting roll. The roll has a cutting element of closed configuration on its outside surface and an aperture that extends between the cutting element and the cavity. The core portion has an interior passageway and a generally radially extending port that is positioned for registry with the aperture of the roll, permitting air to flow through the passageway and the port, and out of the aperture, upon registry of the aperture and port. This occurs intermittently as the roll rotates about the core portion which is secured in a substantially fixed position, and enables pressurized air to eject scrap that would other wise tend to build up within the cutting element. Use of a resiliently deformable core portion eliminates the need for added support and bearing members within the roll cavity; it simplifies the assembly and enhances its useful life.

10 Claims, 6 Drawing Figures



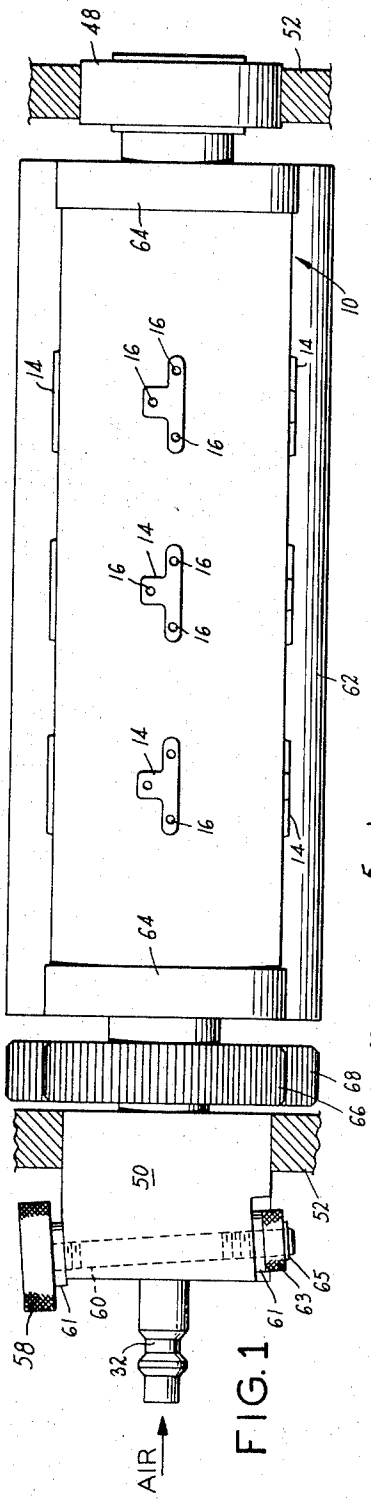


FIG. 1

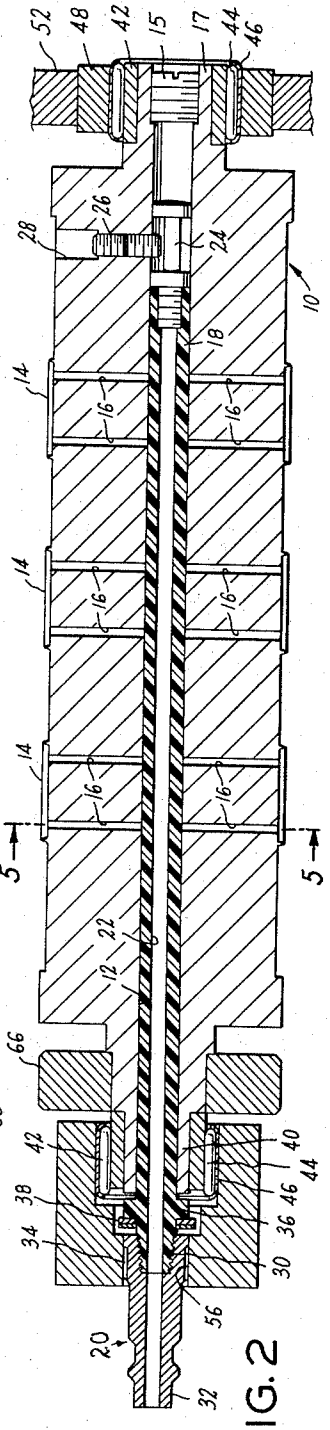


FIG. 2

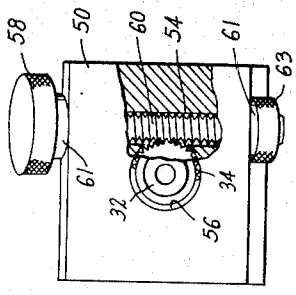


FIG. 3

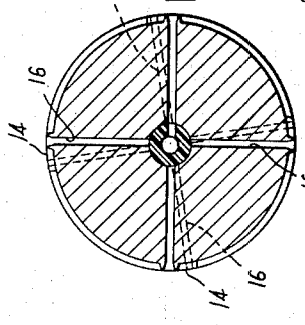


FIG. 5

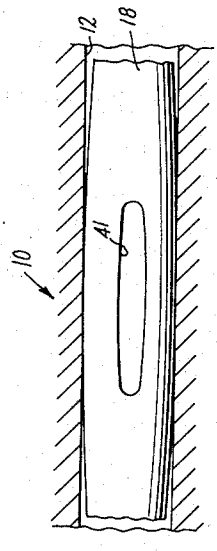


FIG. 6

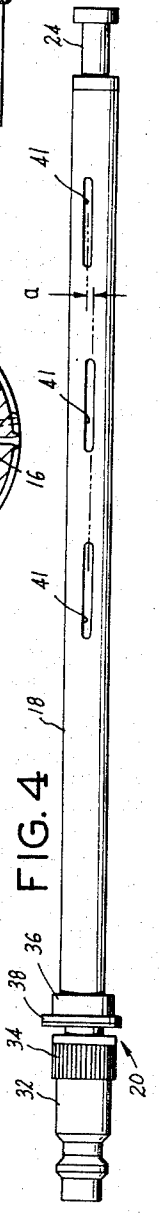


FIG. 4

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ROTARY AIR EJECT DIE-CUTTING ASSEMBLY

BACKGROUND OF THE INVENTION

It is now common practice to produce labels, tags, tickets and the like by die-cutting them from traveling web stock, utilizing a roll having a die or cutting element of appropriate configuration on its outer surface. In many instances, it is desirable to cut holes or slots of various configurations with such a roll to provide openings in the finished article for receiving fasteners or for other purposes. However, producing the opening in such a manner involves serious problems, which arise primarily as a result of the accumulation of scrap material within the die element and/or the inefficient removal of the scrap from the web.

As will be readily appreciated, by cutting through the entire thickness of the web stock the scrap can be readily removed therefrom, and frictional engagement within the die will normally suffice to consistently effect the desired separation. However, in the absence of some provision for ejecting the scrap from the die, accumulations therein will quickly render the roll ineffective and may often cause severe damage, such as bursting of dies thereon; these problems tend to be particularly acute when the web stock is printed or has an adhesive coating thereon.

In an effort to avoid such problems, it is now fairly common practice to employ hollow die-cutting rolls having apertures extending from the cavity therein to locations on the surface thereof. The apertures open within the confines of the cutting elements, and air charged into the roll cavity is used to eject the lodged pieces of scrap therefrom. Although this approach has been somewhat effective, and is certainly better than providing no ejection means whatsoever, it nevertheless suffers from a number of serious deficiencies.

Since the apertures in the roll are always open to the atmosphere, air flows continuously therethrough. This seriously diminishes the effectiveness of the system for a number of reasons, especially when there are numerous apertures in the roll. First of all, it requires that the air be injected in unduly large volumes and under unduly high pressures. Secondly, in such a system there is little impact of air upon the scrap pieces, as would most effectively dislodge them. In an effort to decrease air loss and pressure drop, the trend has been to reduce the diameter of the apertures, but such an expedient entails its own limitations. More particularly, the use of smaller holes diminishes the force acting upon each of the scrap pieces, which obviously tends to defeat the original objective of using an air eject system. As far as is known, no attempt has been made to improve the efficiency of discharge of the scrap by reliance upon an air impact effect.

The type of open system described is also disadvantageous in failing to provide any means for control of the direction or instant of discharge, which causes haphazard release of scrap and blowing of previously ejected pieces about the vicinity of the die-cutting operation. The pieces of scrap tend to foul gears and other parts of the press, and often adhere to the rolls and thereby interfere with die-cutting. Furthermore, prior art systems are often subject to frequent disrepair, and tend to require undue attention to ensure reasonably consistent and efficient operation.

Accordingly, it is an object of the present invention to provide a novel rotary air eject die-cutting assembly in which the effectiveness of pressure applied for the ejection of scrap particles is relatively high, and in which operation is substantially improved, as compared with prior art air eject devices.

It is also an object of the invention to provide such an assembly wherein the direction of discharge is controlled, and which is virtually trouble-free in operation.

Another object is to provide an assembly having the foregoing advantages and features, which is of relatively simple and inexpensive construction and which may be employed with existing equipment with little or no alteration thereto.

Still another object of the invention is to provide an assembly wherein added support and bearing members for the manifold core portion are unnecessary, and which exhibits an increased useful life by virtue of diminished wear of its components parts.

A further objective is to provide such an assembly wherein the effectiveness of the air ejection is maximized and the air loss is minimized by the attainment of improved sealing action between the roll and the manifold core portion seated therein.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects of the invention can be readily attained in a rotary air eject die-cutting assembly comprising a die-cutting roll adapted for journaling in a press and having a cylindrical cavity extending axially inwardly from one end thereof. The roll has a cutting element of closed configuration on its outside surface with at least one aperture extending from the cavity to a location on the outside surface within the confines of the cutting element. The aperture enables air flow between the cavity and the cutting element, and comprises substantially the only outlet for air therefrom. The assembly also includes an air delivery manifold which has a core member with a self-supporting, relatively resiliently deformable cylindrical portion inserted axially into the cavity of the roll from the "one" end thereof for relative rotation therebetween. The core portion is substantially free of added support and bearing members within the roll cavity; it is dimensioned and configured to seat therein with its outer surface in close proximity to the inside surface of the roll defining the corresponding portion of the cavity. The core portion also has an axially extending passageway therein with an outlet comprising at least one generally radially extending port opening at a point on the outer surface thereof in a location for registry with the one aperture of the roll. The manifold has an inlet communicating with the passageway of the core portion and is substantially closed to air flow except through the inlet thereinto and the outlet therefrom, and it includes coupling means adjacent the inlet for engagement with a source of pressurized air to enable delivery thereof into the passageway. A support member for the manifold is adapted for mounting in a stationary position on the die-cutting press, and has means for securing the core portion in a substantially fixed position thereon. Rotation of the roll on the press about the core portion causes intermittent registry of the one aperture and the one port, permitting air to flow from the source thereof outwardly through the port in a radial direction.

In the preferred embodiment, the material of the core portion also possesses a relatively low coefficient of friction, affording thereto inherent lubricity; for example, it may be comprised of a fluoroplastic resin. Desirably, the core member is integrally formed of the same material as the core portion and has an enlargement adjacent the one end of the roll and outwardly thereof. The enlargement serves to restrain axial movement of the roll in one direction, and provides a thrust surface against which the one end thereof may abut. Most desirably, the port of the core portion is elongated in a generally axial direction, so that the force of air acting against the longer edges of the port tends to increase the separation therebetween. This urges the adjacent outside surface of the core portion more tightly against the corresponding area of the inside surface of the roll, which in turn enhances significantly the sealing action thereat.

Generally, the roll will have a second cutting element on its outside surface with a second aperture extending from the cavity to a location therewithin. The two apertures in such a roll may open at generally circumferentially aligned points on the inside surface thereof for sequential registry with the port of the core portion during rotation of the roll thereabout. Alternatively, or in addition to apertures having openings so disposed, the roll may be provided with apertures opening at axially spaced points on the inside surface thereof. In such instances, the outlet of the core portion will include at least a second port that opens on the outside surface thereof independently of the first port at a point spaced axially therefrom for cooperation with an axially spaced opening of the roll.

Preferably, the core portion will provide ports that open at points that are not only axially spaced from one another, but that are also circumferentially displaced about the core portion within an arc of less than about 45°. Such a core may cooperate with a roll having apertures that open at points disposed at a circumferential displacement that is different from that of the pointsof opening of the ports, as a result of which the first and second apertures will register with the first and second ports of the core portion at different times during the rotation of the roll. Most desirably, a multiplicity of ports will be provided in the core portion, and such ports will open at points that are disposed along a helical path extending within the 45° arc. The roll employed therewith will have a multiplicity of apertures that open at axially spaced points along a path of different configuration, for sequential alignment with the ports of the core portion.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of a rotary air eject die-cutting assembly embodying the present invention;

FIG. 2 is a longitudinal sectional view of the assembly of FIG. 1;

FIG. 3 is an end view thereof with a portion of the bearing block broken away to show the angular adjustment mechanism;

FIG. 4 is an elevational view of the manifold employed in the assembly;

FIG. 5 is a cross-sectional view of the assembly taken along line 5 — 5 of FIG. 2; and

FIG. 6 is a fragmentary longitudinal sectional view of a section of the core portion adjacent a port thereof and of the corresponding section of the roll, showing the enhanced contact afforded thereat by virtue of the relative resiliency of the core portion; the scale is greatly enlarged.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now in detail to the appended drawing, therein illustrated is a rotary air-eject die-cutting assembly embodying the present invention and consisting of a die-cutting roll, generally designated by the numeral **10**, having a bore **12** extending axially therethrough and a multiplicity of cutting elements or dies **14** of closed configuration on the outside surface thereof. The dies **14** are spaced about the roll **10** in aligned axial rows and circumferential columns, and designed to cut openings having the configuration shown, such as to provide a button hole in a tag for attachment to clothing. A multiplicity of radial apertures **16** extend from the bore **12** to the outside surface of roll **10** at locations within the confines of each of the dies **14**. The inner ends of the apertures **16** are aligned in axial rows and circumferential columns corresponding to the dies **14**, and a set of three apertures **16** is associated with each die **14** for optimum ejection effectiveness, consistent with the die configuration. A plug **15** is threadably engaged in one end **17** of the shaft portion of the roll **10** to provide an air seal for the bore **12** thereat.

Seated within the bore **12** of the roll **10** is the cylindrical core portion **18** of an air distribution manifold, generally designated by the numeral **20** and most clearly illustrated in FIG. **4**. The core portion **18** is fabricated of a relatively resiliently deformable synthetic resin, and has an axial passageway **22** extending therethrough and closed at its inner end by a dumbbell-shaped plug **24**, which is threadably engaged therein. A set screw **26** is threadably engaged in a radial aperture **28** of the roll **10** and projects between the ends of the plug **24**; the function of the screw **26** is to cooperate with the plug **24** to prevent inadvertent dissasembly of the manifold **20** from the roll **10** when the assembly is dismounted from the die cutting press on which it is used.

The outer end **30** of the core portion **18** is externally threaded, and engages thereon a hose coupling nipple **32** that is of conventional design, except for the splined portion **34** that extends circumferentially thereabout. An annular enlargement **36** is provided on the core portion **18** and serves, in cooperation with the thrust washers **38**, as an abutment element of the adjacent end **40** of the roll **10**.

Three axially extending elongated ports or slots **41** are formed through the wall of the core portion **18** of the manifold **20** to provide air flow communication with the passageway **22** therein. The ports **41** are spaced along a helical path on the core portion **18**, and the arc *a* of circumferential displacement thereof is less than about 45°. As will be appreciated, the ports **41** are axially spaced so that the sets of apertures **16** associated with each circumferential column of dies **14** register intermittently with one of them, as the roll **10** rotates about the core portion **18**.

Press fit upon each of the ends **17**, **40** of the shaft portions of the roll **10** is a bearing assembly consisting

of an inner race **42**, a multiplicity of needle bearings **44**, and an outer case **46**. The bearing assemblies are received in bearing blocks **48, 50** which are stationarily supported on frame portions **52** of the press, to journal the roll **10** thereon. The bearing block **50** has formed in its upper portion an angularly disposed aperture **54** intersecting tangentially with the axial passageway **56** therethrough. The adjustment screw **58** has its threaded shaft **60** inserted in the aperture **54** and in meshing engagement with the splined portion **34** of the hose coupling nipple **32**. The washers **61** permit nonlocking adjustment of the screw **58** and it will be evident that turning the screw **58** in the aperture **54** will cause the manifold **20** to pivot within the block **50**, altering the radial direction in which air injected into the passageway **22** of the core portion **18** will discharge from the ports **41** thereof. The lock nut **63**, maintained on the shaft **60** by the snap ring **65**, is tightened to secure the screw **58** in the position necessary to maintain the selected angular attitude of the core portion **18**. The illustrated adjustment mechanism may be modified or replaced by equivalent means, if so desired.

To protect the dies against undue wear by contact with the surface of the anvil roll **62** that is cooperatively journaled below the cutting roll **10**, bearers **64** are provided on the ends thereof as is now common practice. A driven gear **66** is fixed upon the end **40** of the shaft portion of the cutting roll **10**, and it meshes with the drive gear **68** that is fixed on a common shaft with the anvil roll **62**.

In operation, the web stock (not shown) passes between the nip of the rolls **10, 62** as they are driven in opposite directions (by means also not shown), with the dies **14** cutting scrap pieces from the web. Simultaneously, air under pressure (e.g., line pressures of about 80 psi are commonly available) is injected into the manifold **20** through the nipple **32**, with the core portion **18** maintained at a set angular attitude. Due to the close fitting relationship and the relative resiliency of the core portion **18** (as will be more fully discussed hereinafter) substantially no air flows through the manifold **20** when none of the ports **41** is aligned with an aperture **16**, thus conserving air and maintaining the pressure thereof at a high value. As the cutting roll **10** rotates about the stationary core portion **18**, each set of apertures **16** comes into registry with the port **41** that is axially aligned therewith, permitting air to flow therethrough so as to eject any scrap piece that may be lodged in the associated die **14**. Due to the helical arrangement of the ports **41**, at any given instant air flow is substantially limited to one of the dies **14**, with the dies **14** that are axially aligned therewith in a single row receiving air sequentially thereafter. This flow pattern occurs in each row of dies **14** as the apertures **16** associated therewith are presented for registry with the ports **41** during rotation of the roll **10**.

The arc *a*, representing the portion of the circumference covered by the helical path on which the ports **41** are arranged, is preferably less than 45°, and should be as small as possible consistent with a desirable level of independence of air flow through the dies **14**. This is to minimize the space in which air and scrap pieces discharge from the assembly so as to prevent scattering, to facilitate collection of the pieces, and/or to utilize the air stream most effectively. Frequently, the optimal direction of air flow (which will depend upon the relationship of the die-cutting and anvil rolls **10, 62**, the travel of the web stock relative thereto, and upon other factors) is determined most effectively by trial and error. Accordingly the adjustability of the manifold **20** of the illustrated assembly affords considerable advantages, since changes in attitude may be readily made, even during operation.

FIG. **6** of the illustrated embodiment is an exaggerated representation of the separation or bowing of the longer edges of the ports **41**, that occurs when none of them is in registry with an aperture **16**. Although the core portion **18** is desirably formed of a relatively high modulus synthetic resinous material, the elongation of the ports **41** coupled with the degree of resiliency afforded by the core portion **18** permits slight flexing and cross-sectional enlargement to occur thereat. Accordingly, when all ports **41** are out of registry, the internal air pressure acts against the edges of the ports **41** and the associated wall sections to urge them more tightly against the corresponding surface areas of the roll **10** defining the bore **12** therein; this is depicted in FIG. **6**, and results in a well sealed assembly without need for auxiliary sealing elements or the like. Upon registry with an aperture, air flows therethrough (ejecting any lodged scrap piece) and also in a very small volume along the length of the core portion **18** between its surface and the wall of the bore **12** to serve a bearing function. This effect, coupled with the "foregiveness" or resilient deformability of the core portion **18**, eliminates the need for added bearing elements within the bore **12** of the roll **10**; it also simplified production of the assembly and enhances the useful life thereof.

Preferably, the core portion **18** of the manifold **20** is fabricated from a material that possesses a relatively low coefficient of friction, in addition to resilient deformability. Although a considerable variety of other materials may be employed, exemplary synthetic resins include the long chain polyamides, the polyethylene terephthalate polyesters and (most desirably) the fluoroplastics such as fluorinated ethylene propylene, polytetrafluoroethylene, polychlorotrifluoroethylene, polyvinylidene fluoride and the like; both filled (or reinforced) and unfilled resins may be utilized.

Thus, it can be seen that the present invention provides a novel rotary air eject die-cutting assembly in which the effectiveness of pressure applied for the ejection of scrap particles is relatively high, and in which operation is substantially improved, as compared with prior art air eject devices. The direction of discharge is controlled, added support and bearing members for the manifold core portion are unnecessary, and the effectiveness of air ejection is maximized and the air loss is minimized by the attainment of improved sealing action between the roll and the manifold core portion seated therein. In addition to the foregoing advantages and features, the assembly is relatively simple and inexpensive to construct, is virtually trouble free in operation, exhibits an increased useful life by virtue of diminished wear of its component parts, and may be employed with existing equipment with little or no alteration thereto.

Having thus described the invention, we claim:

1. A rotary air eject die-cutting assembly comprising: a die-cutting roll adapted for journaling in a die cutting press and having a cylindrical cavity extending axially inwardly from one end thereof and cutting elements of closed configuration on its outside surface with at least one aperture extending from said cavity to a location on said outside surface within the confines of said cutting element, said aperture enabling air flow between said cavity and said cutting element and comprising substantially the only outlet for air from said roll; an air delivery manifold having a core member with a self-supporting relatively resiliently deformable cylindrical portion inserted axially into said cavity of said roll from said one end thereof, for relative rotation therebetween, said core portion being substantially free of added support and bearing members within said roll cavity and being dimensioned and configured to seat therein with its outer surface in close proximity to the inside surface of said roll defining the corresponding portion of said cavity, said core portion having an axially extending passageway therein with an outlet comprising at least one generally radially extending port opening at a point on said outer surface thereof in a location for registry with said one aperture of said roll, said manifold having an inlet communicating with said passageway of said core portion and being substantially closed to the flow of air except through said inlet and outlet, and including coupling means adjacent said inlet for engagement with a source of pressurized air for delivery of air into said passageway; and a support member for said manifold adapted for mounting in a stationary position on the press and having means for securing said core portion in a substantially fixed position thereon, so that rotation of said roll on the press about said core portion causes intermittant registry of said one aperture and said one port, permitting air to flow from the source thereof outwardly through said one port in a radial direction.

2. The assembly of claim 1 wherein the material of said core portion also posses a relatively low coefficient of friction, affording to said core portion inherent lubricity.

3. The assembly of claim 2 wherein said core member is integrally formed of said material and has an enlargement adjacent said one end of said roll and outwardly thereof, said enlargement restraining axial movement of said roll in one direction and providing a thrust surface against which said one end thereof may abut.

4. The assembly of claim 2 wherein said material of said core portion comprises a fluoroplastic resin.

5. The assembly of claim 1 wherein said port of said core portion is elongated in a generally axial direction, so that the force of air acting against the longer edges defining said port tends to increase the separation between said edges and urge the adjacent outside surface of said core portion more tightly against the corresponding area of said inside surface of said roll to enhance the sealing action thereat.

6. The assembly of claim 5 wherein said roll has a second of said cutting elements on said outside surface thereof and said only outlet therefrom includes a second of said apertures so extending to a location therewithin, with said one and second apertures opening at generally circumferentially aligned points on said inside surface of said roll for sequential registry with said one port of said core portion during rotation of said roll thereabout.

7. The assembly of claim 5 wherein said roll has a second of said cutting elements on said outside surface thereof and said only outlet therefrom includes a second of said apertures so extending to a location therewithin, with said one and second apertures opening at axially spaced points on said inside surface of said roll, and wherein said outlet of said core portion includes at least a second of said ports said second port opening independently of said first port on said outer surface of said core portion at a point spaced axially therefrom, for intermittent registry with said second aperture of said roll.

8. The assembly of claim 7 wherein said one and second ports of said core portion open at points that are circumferentially displaced on said outer surface thereof within an arc of less than about 45°, and wherein said points of opening of said apertures are disposed on said inner surface of said roll at a circumferential displacement different from that of said points of opening of said ports, so that said one and second apertures register with said one and second ports at different times during rotation of said roll.

9. The assembly of claim 8 wherein said roll has at least an additional of said cutting elements and at least an additional of said apertures providing said only outlet therefrom and so extending to a location therewithin, said additional aperture opening at a point on said inside surface that is generally circumferentially aligned with said point of opening of said one aperture for sequential registry of said one and additional apertures with said one port of said core portion.

10. The assembly of claim 7 wherein said roll has at least an additional of said cutting elements and at least an additional of said apertures providing said only outlet therefrom and so extending to a location therewithin, said additional aperture opening at a point on said inside surface that is generally circumferentially aligned with said point of opening of said one aperture for sequential registry of said one and additional apertures with said one port of said core portion.

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