

[54] **GAS EJECTING DEVICE INCLUDING
ROTARY COMPONENTS FOR
COOLING EXTRUDED TUBING**

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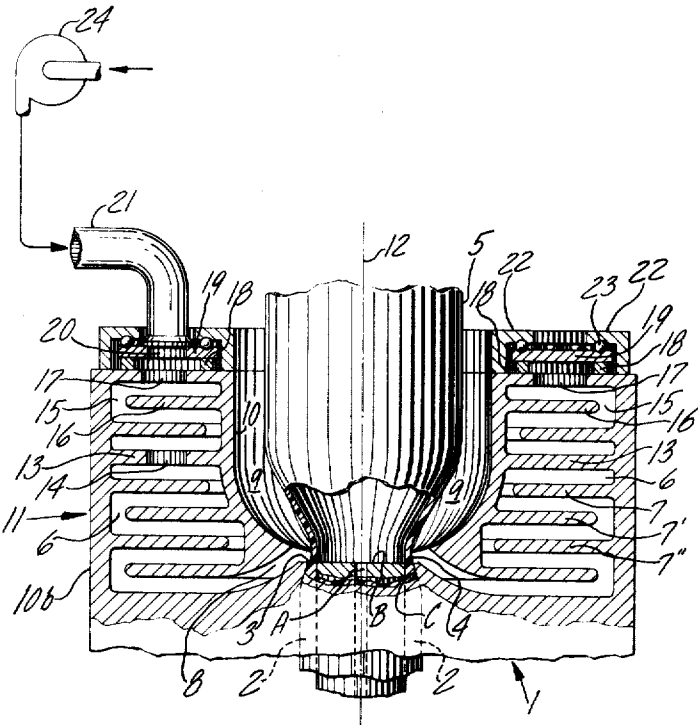
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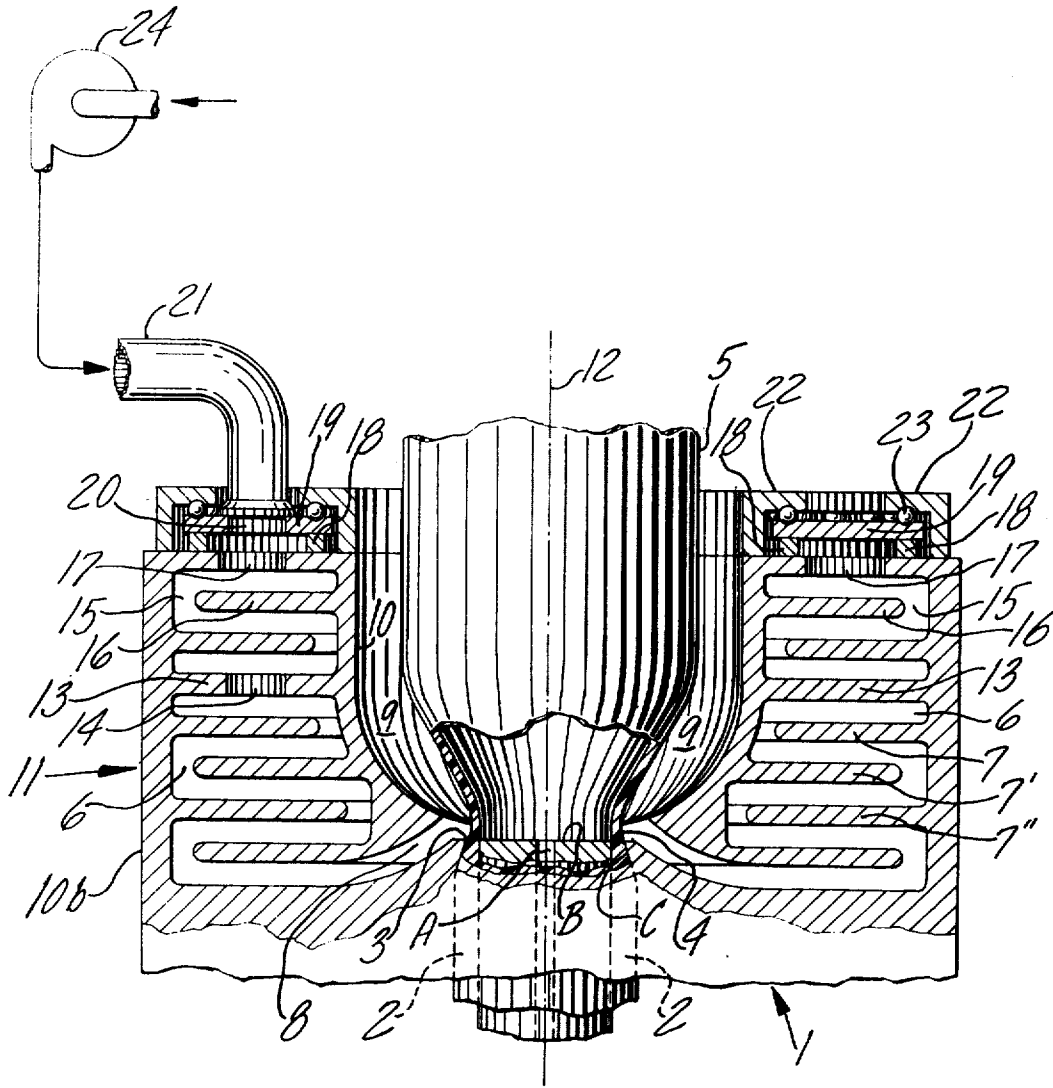
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[57] **ABSTRACT**

A device for applying cooling gas in an annular stream to the exterior of a tubing of plastic material as it issues from an extruding machine. The device is of generally annular configuration with stream-forming components thereof in sealed rotatable relation with other components of fixed position through which a cooling gas enters the device. The apparatus is interiorly baffled in an essentially radial direction to establish a radially and axially extending zigzag passageway for movement of the gas therethrough. The apparatus is otherwise constructed to establish uniform conditions in the cooling gas and a distribution of any thickness variation resulting from non-uniform cooling along the length of a roll of collected film.

4 Claims, 1 Drawing Figure





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GAS EJECTING DEVICE INCLUDING ROTARY COMPONENTS FOR COOLING EXTRUDED TUBING

DESCRIPTION

Apparatus related to that disclosed below is described in commonly assigned U.S. Pat. application Ser. No. 881,538 which has the purpose of uniformly feeding a cooling gas, especially air, to the outlet orifice of apparatus, such as a film-blowing die, a hose extruder, or an extrusion press. This earlier device is supplied by at least one blower connected by ducts to a relatively large annular space within the device in concentric relation with the film blowhead or die. Interiorly of the device, the annular space is contiguous with, and discharges into, a chamber distinguished by deflecting walls arranged transversely to the working direction of the film discharging die. Through this arrangement, substantially even distribution of the cooling gas received inwardly along one side of the device is attained around the circumference of the film discharging orifice. This effect is achieved largely because of the special arrangement of the transverse walls which result in the serial arrangement of several quieting chambers through which the cooling gas must successively pass. Since the volume of each chamber varies greatly in accordance with the radius from the working axis, there occurs considerable expansion or compression of the gas in flowing first in one radial direction and then the other by which mixing and equalizing to conditions of uniform temperature and movement of the gas around the circumference of the device are promoted.

Further research with cooling apparatus of this nature has resulted in the finding that there remains variation of density of the cooling gas along the circumference of the gas stream discharged by the earlier device. This condition apparently arises from the fact that the cooling gas is always introduced into the device unevenly along one side of the apparatus. Since the feed opening, even in film blowing devices of which the die or a component thereof rotates around its working axis always remains in the same place, there are unevennesses in the thickness of the film produced which, although very slight, cause accumulated imperfection at the same place along the length of the roll during the windup thereof.

To prevent this effect, it is known from another prior device that the cooling gas may be fed at several points to a cooling ring and to let the points of feeding rotate together with a film blowing die. It is disclosed that this construction is permitted by a plate or the like connected with the feeding die on which several small blowers are arranged together with their electric drive motors.

Devices of this prior art type have the disadvantage that the fans arranged on the rotating plate require a relatively great amount of space, so that the volume, especially the diameter of the unit, required is excessive. Also it is often difficult to regulate commercial fans of small capacity to discharge exactly the same required amount of air per time unit. Moreover, commercial fans of small capacity can overcome only a relatively low counter-pressure, usually up to about 100 mm water column. The apparatus described by the above-mentioned patent application for equalizing of the cooling air to be fed to the discharge region of the film blowing die has a number of labyrinth-forming deflecting walls arranged progressively to provide thorough mixing and equalization of the cooling gas. Such a device on the other hand necessitates the use of fans which can overcome higher counter-pressure up to about 500 mm water column or over. Consequently, the earlier devices now referred to some structural difficulties and disadvantages of cost.

Hence, the problem exists of modifying apparatus such as hereinabove disclosed so that, insofar as possible, a single stationary fan of any desired capacity can be used, and so that variations in film thickness caused by feeding the cooling gas from one side of the apparatus will not be noticeable in the finished roll of film. Solution of this problem is achieved in accordance with the invention by apparatus comprising a housing formed generally annularly and concentrically with

respect to the axis of a film blowing die in which air or other cooling gas passes along the labyrinthine passageway extending axially and back and forth in a radial direction by a series of axially transverse walls of the housing joined alternately to the spaced outer and inner walls thereof. The apparatus is distinguished by the following features:

- a. The housing is arranged and constructed for rotation relative to gas feeding components;
- b. a stationary closure plate is provided as one of the gas feeding components which has at least one passage for discharging gas into the housing;
- c. the portion of the housing adjacent the stationary plate has a region for receiving cooling gas into the housing extending substantially along an entire circumference concentric to the axis of the film blowing die.
- d. In preferred embodiments, further features are:
 1. The housing comprises an intermediate baffle or wall separating the other labyrinth-forming baffles in two groups, each group within one of two different chambers, with one or more openings through the intermediate baffle of substantially less total cross section than other portions of the labyrinthine passageways comprising the chambers;
 2. the housing is connected solidly with at least the outer rotating component of the film blowing die.

By inclusion of an annular intermediate wall or baffle within the housing intermediately within the series of baffles, the housing is divided interiorly into two chambers which are separated completely from each other except for one or more openings through the intermediate wall which are of small capacity as compared with the annular openings between the radially inner or outer ends of other baffles of the chambers in spaced relation with either the inner and outer walls. The result gained is that the outlet opening of the equalizing chamber, i.e., the chamber which discharges the cooling gas against the film revolves around the axis of the die. If it happens that the cooling air is discharged in such a manner against the film issuing from the die to cause a slight decrease in the thickness of the film then, because of the revolving housing and the openings through the intermediate wall moving therewith, the places on the issuing film so marked also change location along the circumference of the film whereby any variations in thickness are shifted relative to the width of the finally split film and consequently are distributed along the width of a stationary windup device for the film. In this way, the undesired effect of differences in thickness of the film adding up at one place on the roll would consequently form bulges or depressions is prevented.

An apparatus according to the invention will be described below in detail with reference to the drawing comprising a single FIGURE in the form of a schematic longitudinal section through the cooling housing.

The apparatus comprises a film blowhead or die 1 shown partly in frontal view and partly in section. The broken lines 2 indicate that the feed channel for the melted plastic which is to be evenly delivered to and issued from the die orifice 3 in a way which need not be described in detail herein. The plastic film tube 4 emerges from the orifice 3 and is expanded by air or other gas introduced into the film by way of means such as a bore A extending centrally of the interior die component B, in a conventional manner.

For exterior cooling of the film tube, a cooling gas, preferably air, is blown onto the outside of the tube. Distribution of this gaseous coolant evenly over the circumference of the tube is the problem of the present invention.

As in the device disclosed in the earlier application referred to above, the improvement described herein resides in a chamber 6 in which at least one, but preferably several, baffles or deflecting walls 7, 7', 7'', etc. are arranged. In this way, the chamber 6 is divided into several chamber sections arranged in succession through which the cooling gas successively passes and then leaves the chamber 6 through an annular orifice 8 to flow in an even circumferentially applied stream into a space 9 between the film tube 5 and the inner wall 10 of the

apparatus 11. As a further difference of the apparatus disclosed herein with respect to that disclosed in the earlier application, the housing in its entirety is shown fixedly connected with the outer rotating component C of the blowhead 1. While the housing is shown integral with component C, it may be of separate construction and fixedly attached to the rotating die component interiorly of the housing 11.

The chamber 6 is completely closed by an annular wall or baffle 13 except for at least one opening 14 therethrough through which the gaseous coolant enters chamber 16 from chamber 15. The wall 13 is shown in the present embodiment as an integral portion of the housing 11. Consequently, during operation, the opening 14 revolves together with the blowhead 1 and continually changes its position in relation to a takeup reel or core (not shown) for the sheet of film produced from the tube 5.

As indicated above, the chamber 15 occurs in upstream relation with the chamber 6 and the wall 13 and contains one or more annular deflecting walls or baffles 16 arranged transversely therein to the working direction of the film-extruding blowhead to cause the gaseous coolant passing therethrough and distributed throughout the entire circular region defined by the housing surrounding the blowhead axis 12 to travel in a circular but radially zigzag path extending lengthwise of the axis.

The annular chamber 15 has a generally annular gap or opening 17 in the end wall remote from the extrusion orifice extending over the whole circumference of the chamber for admitting the gaseous coolant. The annular opening 17 is covered by an assembly comprising a sealing means such as a pair of annular, radially-spaced sealing elements 18 resting on top or end surfaces of the axially extending inner wall 10 and outer wall 10b, and an annular closure plate 19 engaging the upper surface of the sealing rings 18. The closure plate 19 has at least one aperture 20, of which there may be several arranged as evenly as possible around its circumference, each being connected with a stationary feed line leading to one or more blowers 24. Multiple blowers are required only in the operation of very large units. Normally, the apparatus requires only applying cooling air from a single blower providing that it may be distributed evenly over the circumference of the tube of film.

In the embodiment shown, the closure plate 19 is confined firmly against the sealing element 18 in sliding relation therewith by a pair of radially spaced annular flanges 22 joined solidly with the end surfaces of the walls of the housing 11. The flanges have ledge portions as shown overhanging portions of the closure plate which function along with the indicated portions of the closure plate as races of a ball bearing between which are confined balls 23. The flanges preferably extend over the entire circumference of the device so that it is possible through them to effect a uniform pressure of the clo-

sure plate against the sealing elements along the entire circumference of the housing.

What is claimed is:

1. Apparatus for feeding an annular stream of cooling gas into concentric relation with a path traversed by plastic tubing in passing in the operating direction of the apparatus away from a circular extrusion orifice of the apparatus, said orifice having an axis generally centered along said path comprising:

housing means providing axially-extending outer and inner walls in generally outward spaced concentric relatively fixed relation with said path; and baffle means arranged between said walls to define a passageway which substantially encircles said inner wall and zigzags radially between said axial walls, extends from an end wall in axially remote relation with a surface containing said extrusion orifice, and terminates in a circular discharge orifice for said stream of cooling gas adjacent said extrusion orifice;

said remote end wall having an opening extending along a circle concentric to said axis; an annular closure plate and annular sealing means disposed between said plate and said remote end wall for enclosing said opening;

means joining the plate and said walls for rotation of the walls relative to the plate about said axis; and

duct means connecting with said plate in registry with at least one aperture therethrough providing a passageway into said apparatus for a cooling gas.

2. The apparatus of claim 1 wherein:

said baffle means comprises an annular radial wall extending between and joined with said outer and inner walls and disposed in axially intermediate relation with said remote end wall and said discharge orifice;

said annular wall dividing said passageway into two chambers and having at least one opening joining said chambers, said opening defining a portion of said passageway of reduced cross section through which the flow of gas is concentrated as it flows from one chamber to the other.

3. The apparatus of claim 1 comprising:

outer and inner die members supported in relatively rotatable relationship and defining said extrusion orifice, said outer die member being joined in fixed relation with said walls.

4. The apparatus of claim 1 wherein:

said means for joining the annular plate and said walls comprises a pair of radially spaced annular flanges providing ledge portions overhanging portions of said closure plate; and

said apparatus comprises anti-friction means interposed between the ledge portions and the plate, said anti-friction means being of a thickness which maintains engagement of the plate with said sealing means.

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