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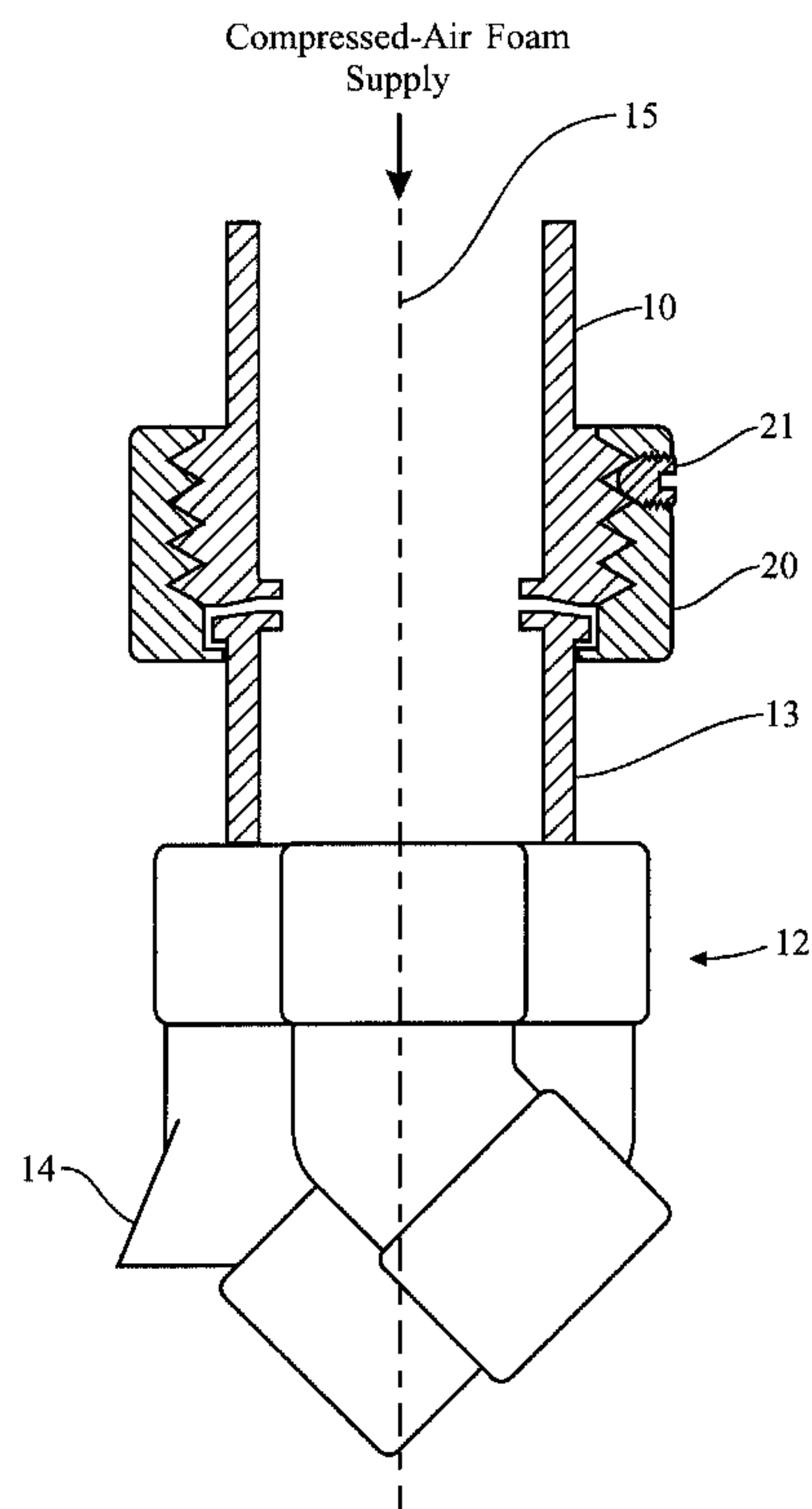
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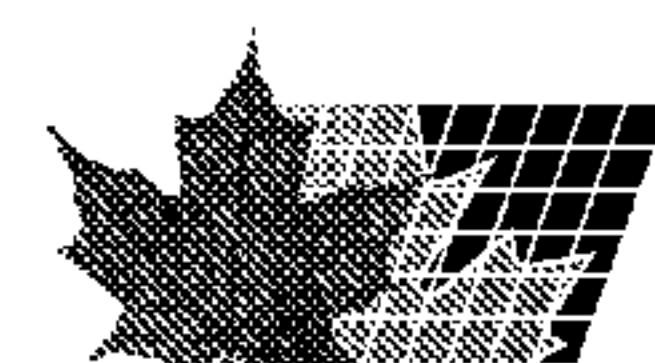
(54) Titre : LANCE A MOUSSE

(54) Title: FOAM NOZZLE



(57) Abrégé/Abstract:

A compressed-air foam (CAF) nozzle has a stationary barrel and a distributor assembly with typically three outlets which are angled and skewed against each other. The distributor assembly is rotatably connected to the barrel and rotates when a stream of fluid is passed through the nozzle. The nozzle enables the delivery of a CAF stream at a relatively wide delivery angle without significantly collapsing the bubble structure of the foam.



ABSTRACT OF THE DISCLOSURE

5 A compressed-air foam (CAF) nozzle has a stationary barrel
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FOAM NOZZLE

5 This invention relates to foam nozzles, and more particularly, to a nozzle for producing a stream of compressed-air(or compressed-gas) foam capable of controlling or extinguishing a fire in the path of the foam stream.

10 Foam solution consists of water mixed with a foam concentrate. The volume of solution is expanded by the addition of air and mechanical energy to form a bubble structure resembling shaving cream. The foam suffocates and cools the fire and protects adjacent structures from radiant
15 exposure.

Foam can be generated using an aspirating nozzle which entrains air into the solution and agitates the mixture producing bubbles of non-uniform size. With an
20 aspirating system, the foam is formed at the nozzle using the energy of the solution stream.

Foam can also be generated by injecting the air under pressure into the solution stream. The solution and air
25 mixture is scrubbed by the hose (or pipe) to form foam or uniform bubble size. The energy used in this system comes from the solution stream and the air injection stream. This system creates "Compressed-Air Foam" which delivers the foam with a greater force than the "Aspirated" systems.

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There are two major problems associated with using compressed-air foam (CAF) in a fixed piping fire suppression system:

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- The distribution of CAF to allow a broad area of coverage without collapsing the

bubble structure thus reducing the expansion ratio.

- Broadening the area of distribution without losing much of the beneficial forward momentum associated with CAF. This momentum is necessary to penetrate the strong fire plume dynamics and blanket the fuel source.

Presently, CAF is delivered as a manually-operated hose stream. It has been demonstrated to be effective in wildland and structural fire fighting applications. The nozzles in use are of a smooth bore design, releasing a "rope" of foam with high forward momentum. Widening the delivery angle with conventional nozzles collapses the bubble structure and degenerates the foam turning it back into solution and air.

A fixed fire suppression system using CAF has not been developed due to the difficulty in distributing and delivering the expanded foam. Foam systems using aspirating nozzles are in wide use, however, their effectiveness is limited due to several factors:

- a) The work required to generate the foam comes from the solution flow which reduces the delivered momentum.
- b) The foam generated is not as stable and consistent as CAF, and the expansion ratios are not as high, limiting its ability to adhere to vertical surfaces.
- c) The air used to expand the solution comes from a fire environment and is

contaminated with smoke and soot which degrades the foam and, in some nozzles, plugs the screen which generates the foam.

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- d) The concentration of foaming agent in solution must be at least 2 times greater than a CAF system which greatly increases the operating costs.

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According to the invention, there is provided a nozzle for generating an expanding stream of air-compressed foam, the nozzle comprising:

a barrel section defining a passageway therein,

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a distributor assembly connected rotatably to the barrel section for rotation essentially about the longitudinal axis of the barrel section, the assembly having from two to four outlets, the assembly and the outlets defining passageways in register with the passageway of the barrel section. The longitudinal axis of at least one of the outlets is disposed at an angle to the longitudinal axis of the barrel section and skewed relative to the other outlets so as to cause, upon a forced flow of a fluid through the barrel section and the outlets, a rotational movement of the distributor assembly relative to the barrel section.

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The cross-sectional area of the passageway of the barrel section should approximately match the sum of the cross-sectional area of the passageways of the outlets.

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In the drawings which illustrate the invention in more details,

Fig. 1 is a schematic representation of the nozzle of the invention,

Fig. 2 is a longitudinal, partly cross-sectional view of the nozzle, and

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Fig. 3 is plan view from the top of Fig. 2, of the distributor assembly.

The nozzle as shown in Fig. 1 and 2 has a barrel which is adapted to be connected to a source of air-compressed foam for delivering a stream of the foam to the distributor assembly 12. The assembly 12 has a cylindrical section 13 and three tubular outlets 14, 16 and 18 which are angled at 45° relative to the vertical direction (longitudinal axis 15 of the cylindrical section 13) and skewed by 120° against each other as best shown in Fig. 3. One of the outlets 14 is truncated to enable, in operation, a distribution of a stream of foam close to the longitudinal axis of the section 13 while the other outlets direct their respective foam streams in an annular zone which is wider than the zone covered by the stream of the outlet 14 (a greater delivery angle). As shown in Fig. 2, the distributor assembly is coupled to the barrel 10 by means of a loose-fit bearing which consists of a coupling 20 which is threaded onto the barrel 10 and retained thereon by means of a set screw 21 and has a flange 22 which engages a lip 24 on the cylindrical section 13 of the distributor assembly 12 in a manner to enable a rotation of the distributor assembly 12 relative to the barrel 10.

As seen in Fig. 3, the tubular outlets 14, 16 and 18 have upper sections 24 which adjoin each other at the upstream end where they are attached to the cylindrical section 13. The space between and around the points of contact of the upper sections is filled, e.g. by brazing. certain portions 26 of the cross-sectional areas of the tubular outlets 14, 16, 18 extend beyond the periphery of the tubular section 13 and may optionally be closed. This is, however, not necessary as it does not impair the operation of the nozzle if the portions 26 are left open.

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In operation, a CAF foam stream is delivered through a stationary piping system through the stationary barrel 10 and through the three angled outlets. The skewed arrangement of the outlets causes a turbine action of the distributor assembly which is facilitated by the loose-fit bearing. The force exerted by the foam exiting the nozzle causes the distributor assembly to spin (clockwise in the arrangement of Fig. 3). The three rotating streams form a solid cone which distributes the foam uniformly over a broad area (typically 7m² when the nozzle is located near the ceiling of a typical room). Two of these distributors direct foam into the outer area and the third is truncated to fill the inner area. Because the foam stream is only redirected, the bubble structure is not damaged and much of the forward momentum is preserved.

It is the gentle redirection of the foam and its rotary action which makes this nozzle unique. It has been tested as part of a fixed piping fire suppression system in single and multiple head configurations and proven effective on Class B liquid fuel fires and Class A combustible fires.

The following is a list of the design limitations of the nozzle:

A) The combined cross sectional areas of the outlets should not be less than the cross sectional area of the foam delivery tube nor should it be larger than 2 times the cross sectional area of the delivery tube.

B) The number of foam outlets can be as few as 2 but no greater than 4. A single outlet would still function, however the vibration stresses from the imbalance are undesirable. Outlet numbers greater than 4 can rob the system of rotational power and can make the nozzle

unreliable. Two or three outlets provide reliable operation and can produce a uniform coverage (3 outlets) to protect floor areas or a wide hollow coverage (2 outlets) to protect walls.

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C) For the three-outlet nozzle the delivery angle of two outlets is 45 degrees from vertical. The third outlet delivers foam from 0 to 45 degrees. This produces a solid 90 degree cone of foam. Delivery angles significantly greater than 45 degrees would function but the uniform distribution would suffer. Delivery angles significantly less than 45 degrees would rob rotational power and make the nozzle unreliable. For these reasons a 10 degree tolerance should be considered to be maximum.

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D) For a 2 outlet nozzle any delivery angle from 45 to 90 degrees will function since the area of coverage is intentionally hollow. A 90 degree angle, from vertical, will deliver foam horizontally to cover the upper portion of the surrounding walls. The foam will then flow under gravity down the surface to protect the lower portion. Delivery angles significantly less than 45 degrees would rob rotational power and make the nozzle unreliable.

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E) The foam outlet skew angle of 120 degrees on the three-outlet nozzle can not be physically greater than 120 degrees and angles less than 110 degrees will reduce the rotational power and affect the reliability of operation.

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F) A 2 outlet nozzle can have a skew angle up to 180 degrees.

What Is Claimed Is:

1. A foam generating nozzle, the nozzle comprising:
 a barrel section having a longitudinal axis
 defining a passageway therein,
 a distributor assembly connected rotatably to the
 barrel section for rotation about the longitudinal
 axis of the barrel section,
 the assembly having a number of outlets, each of
 these outlets having a longitudinal axis and defining
 a passageway in register with the passageway of the
 barrel section,
 wherein the longitudinal axis of at least one of
 the outlets is disposed at an angle to the
 longitudinal axis of the barrel section and skewed
 relative to the other outlets so as to cause, upon a
 forced flow of a fluid through the barrel section and
 the outlets, a rotational movement of the distributor
 assembly relative to the barrel section.
2. A foam generating nozzle, the nozzle comprising:
 a barrel section having a longitudinal axis
 defining a passageway therein,
 a distributor assembly connected rotatably to the
 barrel section for rotation about the longitudinal
 axis of the barrel section,
 the assembly having a cylindrical section
 defining a second passageway coaxial with the
 passageway of the barrel section,
 the assembly having a number of outlets, each
 having a longitudinal axis, and defining passageways
 in register with the second passageway,
 wherein the longitudinal axis of at least one of
 the outlets is disposed at an angle to the
 longitudinal axis of the cylindrical section and
 skewed relative to the other outlets so as to cause,
 upon a forced flow of a fluid through the cylindrical

section and the outlets, a rotational movement of the distributor assembly relative to the barrel section.

3. The nozzle as defined in claim 1 or 2 wherein said outlets are tubular.
4. The nozzle as defined in claim 1, 2 or 3 wherein the combined cross-sectional area of the outlets is approximately equal to the cross-sectional area of the passageway of the barrel.
5. The nozzle as defined in claim 1, 2 or 3 wherein the combined cross-sectional area of the outlets is not less than the cross-sectional area of the passageway of the barrel and not larger than twice the cross-sectional area of the delivery tube.
6. The nozzle as defined in claim 1, 2 or 3 wherein the outlets are angles at 45° relative to the longitudinal axis of the cylindrical section.
7. The nozzle as defined in claim 6 wherein the outlets are skewed by an angle of 120° against each other.
8. The nozzle as defined in claim 1, 2 or 3 wherein the outlets is truncated to distribute stream of foam close to the longitudinal axis of the cylindrical section.
9. The nozzle as defined in claim 1, 2 or 3 wherein the distributor assembly is coupled to the barrel by means of an adjustable loose-fit bearing.

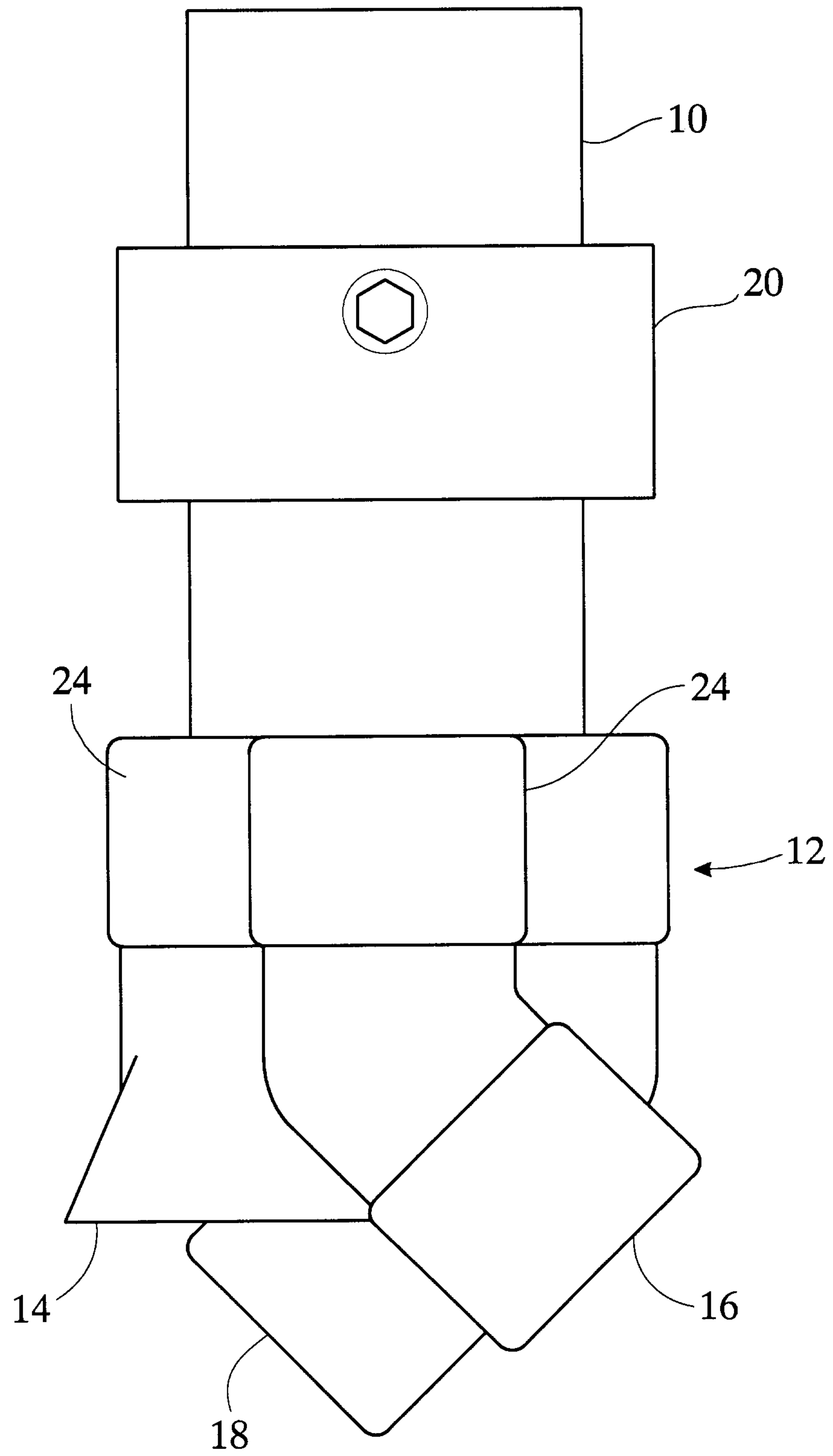


Fig. 1

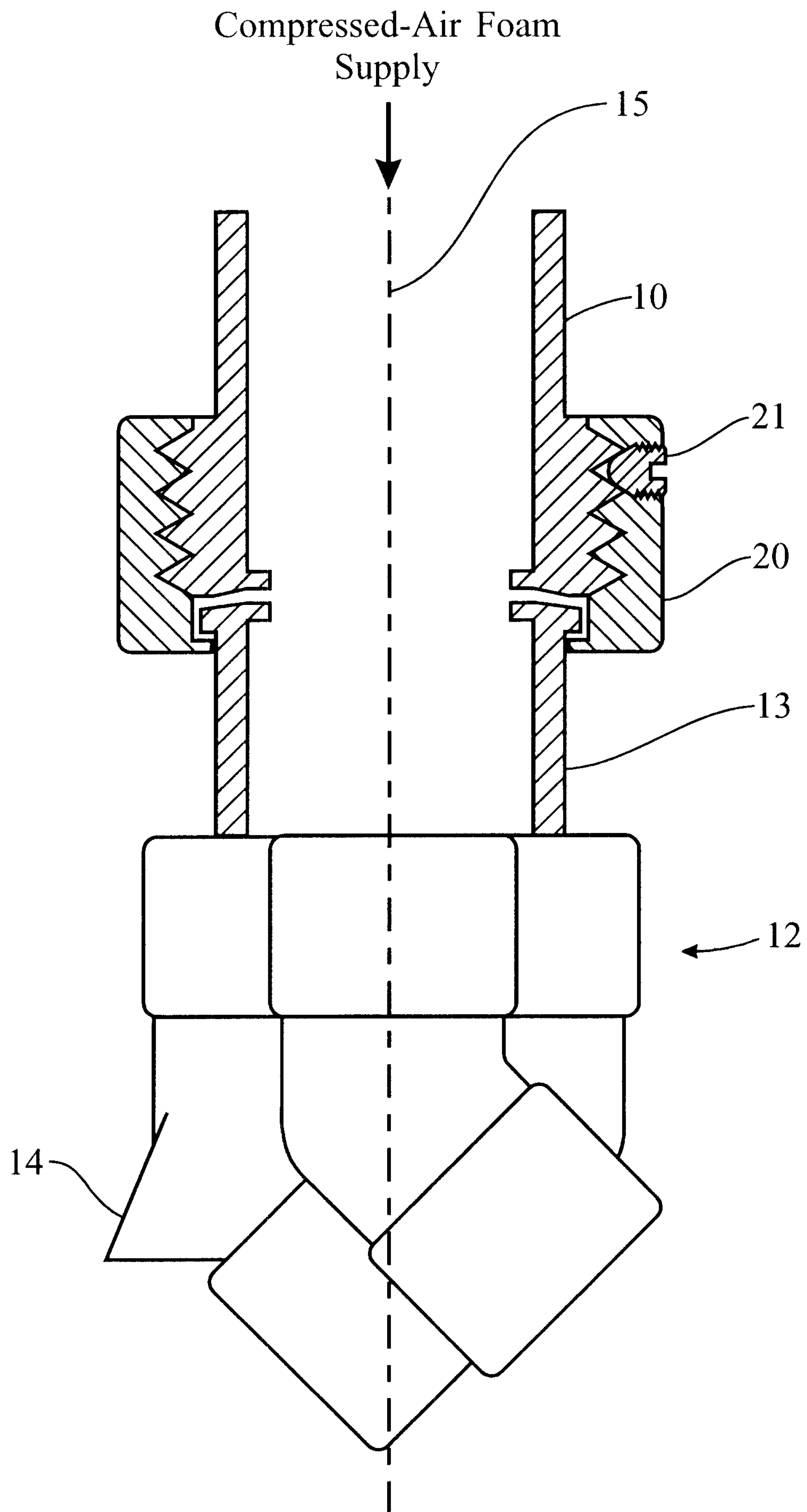


Fig. 2

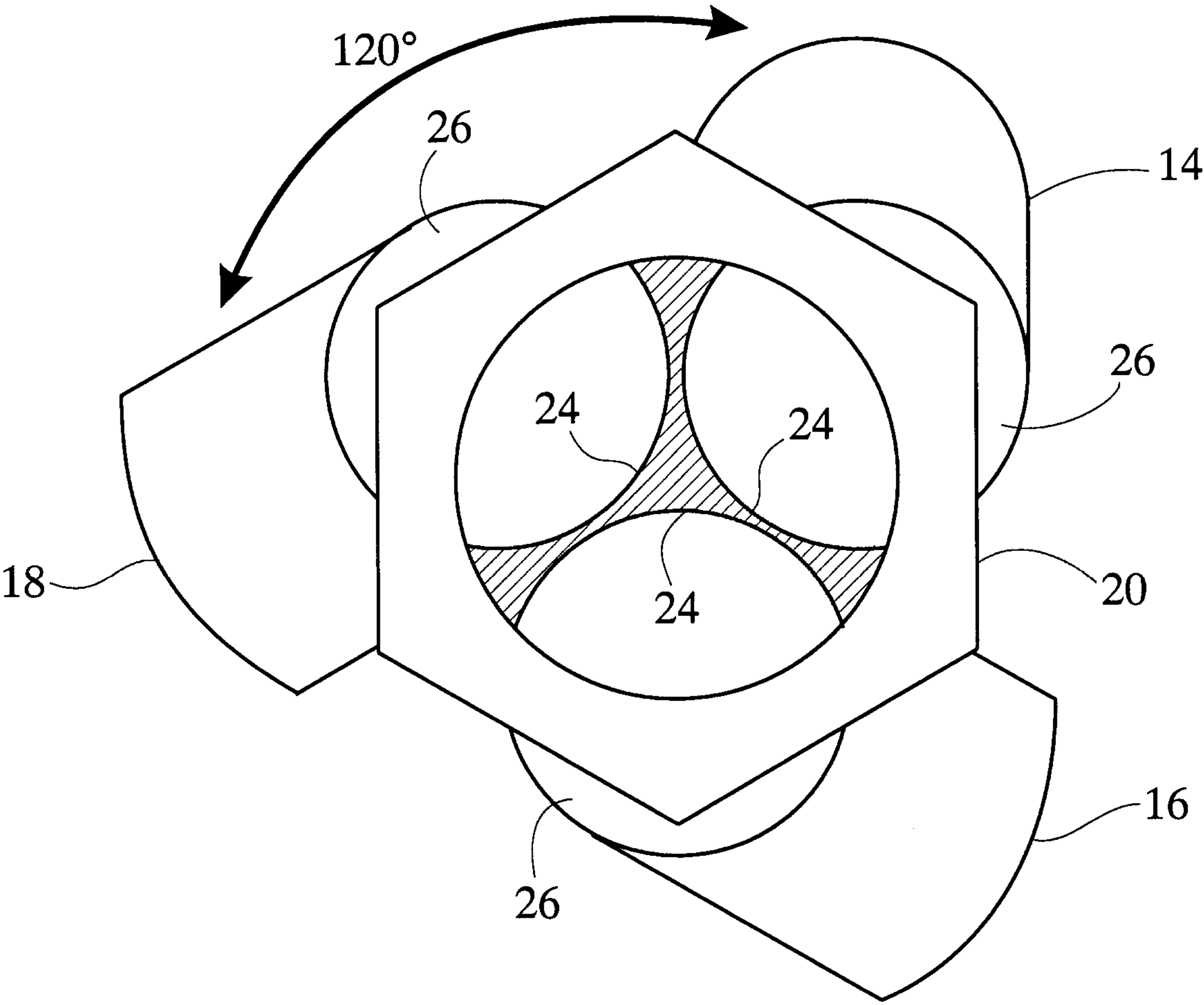


Fig. 3

Compressed-Air Foam
Supply

