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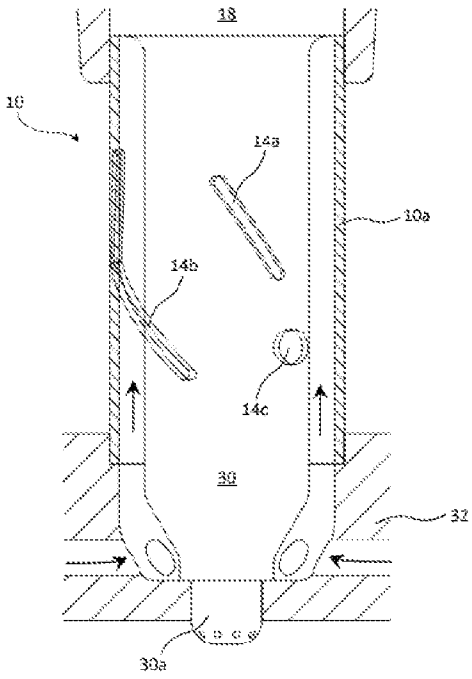
(54) Title **Cooling sleeve for a cylinder head**

(56) References Cited: US 2007228191 A1, US 2012037124 A1, US 2018142654 A1, US 3420215 A, US 2019017464 A1, US 2015211410 A1, US 6279516 B1, GB 762792 A

(57) Abstract

A cooling sleeve for a cylinder head (20) of an internal combustion engine, the cooling sleeve comprising a circular and cylindrical cooling sleeve (10) with a through running internal bore (12), said cooling sleeve (10) is enveloping a prechamber unit (30) in a water-jacket chamber (24) in the cylinder head (20), and said cooling sleeve (10) comprises a number of apertures (14a,14b,14c) permitting flow of coolant, for cooling exhaust ports (26) in said water-jacket chamber (24).



Field of the invention

The present invention relates to a cooling sleeve for a cylinder head of an internal combustion engine, the cooling sleeve comprising a circular and cylindrical cooling sleeve with a through running internal bore, and which is enveloping a prechamber unit in a water-jacket chamber in the cylinder head. The invention also relates to a cylinder head with a cooling sleeve.

Background of the invention

A cooling sleeve is a component designed to capture cooling water and redistribute it at strategically placed locations to increase the cooling efficiency of engine exhaust ports, without inducing unnecessary restrictions and pressure loss in the cooling water circuit.

The current design leaves the water flow free to move in any direction as it exits the flamedeck and enters the “main volume” of the cylinder head. The water comes up through the liner and via bores in the flamedeck before passing the prechamber nozzle and holder.

This leaves a lot of freedom of movement for the water and roughly half of it will be spent on “cooling” the intake ports, which does not need cooling. In fact heating them, as the intake air can be 55degC and the water 85degC.

Disclosure of the state of art

US2017167432 A1 disclose a water jacket for a cylinder head of an internal combustion engine, and includes a coolant chamber arranged to permit the flow of coolant within the water jacket and a coolant conduit positioned to permit the flow of coolant proximate to a recess for receiving an exhaust valve mounted to the cylinder head. The coolant conduit is in fluid communication with the coolant chamber, and the coolant conduit is shaped as a complex curve. A water jacket includes a pair of apertures arranged to receive a spark plug and a fuel injector. The apertures are separated by a separating member, and a coolant chamber is arranged to permit the flow of coolant about the apertures. The separating member includes a coolant channel in fluid communication with the coolant chamber so as to permit the flow of coolant between the apertures.

Further, GB583652 A, US3818878 A, GB1100511 A, and CN105464831 A relates to improved cylinder head cooling.

US 2007228191 A1 discloses a fluid-injecting system with a nozzle assembly which includes a housing defining an outlet cooling passage, an outlet control passage, at least one inlet supply passageway, and an injection orifice. The nozzle assembly also includes a shaft disposed within the housing and movable between a closed position and an open position. The fluid-injecting system further includes a first valve in fluid communication with the nozzle assembly configured to regulate the supply of a fluid through the at least one inlet passageway and a second valve in fluid communication with the nozzle assembly to regulate a flow of fluid through the outlet passageway.

US 2012037124 A1 relates to an internal combustion engine including an injector having an injector body including a nozzle assembly having an annular outer surface. A cylinder head includes an injector mounting bore to receive the injector, and a lower sealing portion. The engine also includes an engine coolant passage formed in the cylinder head to receive engine coolant to remove heat from the cylinder head. The engine coolant passage opens into, and is fluidly connected to, the mounting bore to cause coolant in the coolant passage to contact the annular outer surface of the nozzle assembly. A lower seal is positioned between the lower sealing portion and the nozzle assembly to form a fluid seal.

US 2018142654 A1 relates to an assembly of a cylinder head and a fuel injector with an injector tip for an internal combustion engine with at least one combustion chamber, wherein the fuel injector at the end facing a combustion chamber of the internal combustion engine is at least partially surrounded by a heat shield, wherein in the region of the heat shield a heat dissipation device is provided, through which heat can be dissipated from the combustion chamber of the internal combustion engine, wherein the heat shield surrounds the fuel injector as far as the injector tip, wherein the heat shield is designed as a tapering collar towards the injector tip and is integrated into an injector sleeve or into the cylinder head.

Reference is also made to US 3420215 A, US 2019017464 A1, US 2015211410 A1, US 6279516 B1, and GB 762792 A, showing different solutions for cooling ports or prechambers with and without cooling sleeves, and which are placed in a cylinder head of an engine.

Objects of the present invention

The cooling sleeve according to the invention is designed to trap cooling water coming up through the flamedeck of a cylinder head and pointing it in the direction for optimal cooling of exhaust ports.

Strategic holes/apertures in different shapes can be cut out of the cooling sleeve surface/wall to create a flow field that increases cooling on the exhaust ports.

The cooling sleeve can also be used to improve cooling of a prechamber unit in the cylinder head.

The cooling sleeve can completely close the domain between the flamedeck and a “main" volume in the cylinder head, except from the cutout apertures in the sleeve. Either the sleeve can be retrofitted to existing cylinder heads as a machined component or it can be included in the casting.

Mounting of the cooling sleeve can be done in numerous ways without affecting the function. For instance, a cooling sleeve can be threaded onto the prechamber unit of the engine, or a cooling sleeve can be installed in the cylinder head separate from the prechamber unit. Other methods could also be used.

The selected mounting method should lock the sleeve in its correct rotational direction, to ensure that the cutout apertures are oriented towards their desired targets.

Summary of the invention

The above objects are achieved with a cooling sleeve for a cylinder head of an internal combustion engine, the cooling sleeve comprising:

a circular and cylindrical cooling sleeve with a through running internal bore, said cooling sleeve is enveloping a prechamber unit in a water-jacket chamber in the cylinder head, and

said cooling sleeve comprises a number of apertures, said apertures being one or more slits or holes in an outer wall of the cooling sleeve, permitting flow of coolant, for cooling exhaust ports in said water-jacket chamber.

The apertures can be of different shapes to create a flow field of coolant, increasing cooling of said exhaust ports in the cylinder head.
At least one of the apertures can be a straight slit in an outer wall of the cooling sleeve.

At least one of the apertures can be an L-shaped or curved slit in an outer wall of the cooling sleeve.

At least one of the apertures can be a hole in an outer wall of the cooling sleeve.

The cooling sleeve can be in the shape of a piece of pipe.

The above objects are also achieved with a cylinder head of an internal combustion engine, comprising a water-jacket chamber with exhaust ports and a prechamber unit, the cylinder head further comprising:
a circular and cylindrical cooling sleeve with a through running internal bore, said sleeve is enveloping the prechamber unit in the water-jacket chamber in the cylinder head, wherein
the cooling sleeve comprises a number of apertures permitting flow of coolant, for cooling exhaust ports in said water-jacket chamber, and
said cooling sleeve is mounted with the apertures facing their desired target exhaust ports.

Said cooling sleeve can envelop the prechamber unit in the cylinder head, and run down to or into a flamedeck of the cylinder head.

Said cooling sleeve is designed to trap coolant coming up through the flamedeck and to direct the coolant in the direction of the exhaust ports in the water-jacket chamber.

A top part of said cooling sleeve can be engaged with a prechamber holder.

A top part of said cooling sleeve can be engaged with a cylinder head housing.

The apertures of the cooling sleeve can be of different shapes to create a flow field of coolant, increasing cooling of exhaust ports in the cylinder head.

At least one of the apertures of the cooling sleeve can be a straight slit in an outer wall of the sleeve, and/or wherein at least one of the apertures can be an L-shaped or curved slit in the outer wall of the sleeve, and/or wherein at least one of the apertures can be a hole in the outer wall of the sleeve.

Description of the figures

Embodiments of the present invention will now be described, by way of example only, with reference to the following figures, wherein:

Figure 1 shows a cross sectional view of a cylinder head with a cooling sleeve according to the invention.

Figure 2 shows a perspective and cross sectional view of a cylinder head with a cooling sleeve according to the invention.

Figure 3 shows a prechamber unit in the cylinder head surrounded by a cooling sleeve according to the invention.

Figure 4 shows a cooling sleeve according to the invention.

Figure 5 shows a cooling sleeve according to the invention.

Description of preferred embodiments of the invention

The present invention relates in the main to use in a cylinder head with a prechamber for a lean-burn gas engine, but the invention can also be used in other gas engines. In a lean-burn gas engine (Otto engine), the cylinder is filled with a homogenous, lean mixture of air and fuel gas. To achieve a steady and safe ignition of the charge, an ignition amplifier in the form of a prechamber is often used, where the charge is made richer in that the fuel gas is supplied through a separate prechamber gas valve, and where an ignition means in the form of for example a spark plug or pilot injection valve is located. The prechamber is a substantial contributor to the formation of NOx during the combustion. Furthermore, the prechamber is subjected to high thermal loads and requires much cooling. Reduced size and subsequent reduced amount of energy released in the prechamber also leads to a gain in the form of lower thermal load and reduced wear on the ignition means and prechamber gas valve.

When the prechamber is referred to in a technical context, it is meant the prechamber volume, i.e. the volume of the nozzle part independent of the construction/division. As a structural part, the whole unit can be defined as a prechamber unit, which in the main is comprised of a prechamber retainer (upper part) and a prechamber nozzle (lower part).

The prechamber unit 30 shown in the drawings may comprise an elongated body with several borings arranged side by side. A first boring can comprise a prechamber gas valve, for example in the form of a non-return valve such as a ball valve, and a second boring can comprise an ignition means, for example in the form of a spark plug, a pilot injection valve, or another similar ignition mechanism.

Figure 1 and 2 show the prechamber unit 30 installed in a cylinder head 20. The cylinder head 20 is designed as a conventional cylinder head for a combustion engine, as well known to a person skilled in the art, and it is therefore not disclosed in detail.

The prechamber unit 30 can be installed in the cylinder head 20 using a prechamber holder 18 screwed to or otherwise fastened to an upper part of a cylinder head housing 22. The prechamber unit 30 is normally installed in a vertical position, and runs from the prechamber holder 18 and into a flamedeck 32 in a lower part of the cylinder head housing 22. The cylinder head 20 is normally covered by a cylinder cover 28.

The prechamber unit 30 is installed in a "main" volume that can be referred to as a water-jacket chamber 24. One or more exhaust ports 26 runs from the engine and through said water-jacket chamber 24. Cooling water comes up through the liner and via bores in the flamedeck 32 (indicated by the arrows in fig. 2-3) before passing the prechamber nozzle 30a. In fig. 2 only the lower prechamber nozzle 30a is visible, as the rest of the prechamber unit 30 is enveloped or surrounded by a circular and cylindrical cooling sleeve 10 with a through running internal bore 12 enveloping the main body of the prechamber unit 30.

Mounting the cooling sleeve 10 as shown will trap the water coming up through the flamedeck 32 and direct the cooling water for optimal cooling of the exhaust ports 26 in the water-jacket chamber 24. The cooling sleeve 10 will thus close the domain between the flamedeck 32 and the water-jacket chamber 24, except from cutout apertures in the sleeve 10.

Fig. 3 shows in more detail the cooling sleeve 10 mounted between the prechamber holder 18 and the flamedeck 32. The upper part of the cooling sleeve 10 can be threaded engaged to the prechamber holder 18 or just inserted in the prechamber

holder 18 with a snug fit. The cooling sleeve 10 can optional be connected or engaged to the upper part of the cylinder head housing 22. The lower part of the cooling sleeve 10 can be connected or engaged to the flamedeck 32 in a similar manner.

As particularly shown in fig. 4 and 5 the cooling sleeve is designed as a circular and cylindrical sleeve 10 with a through running internal bore 12, and the wall 10a of the cooling sleeve 10 comprises a number of apertures 14a,14b,14c permitting flow of coolant, such as water, for cooling the exhaust ports 26 in said water-jacket chamber 24.

The cooling sleeve 10 can have one or several apertures, and possibly several apertures of similar type. For instance, at least one of the apertures 14a of the cooling sleeve 10 is a straight slit, and/or at least one of the apertures 14b is an L-shaped or curved slit, and/or at least one of the apertures 14c is a hole in the outer wall 10a of the sleeve 10. The number of apertures and design of the apertures may vary dependent on the cylinder head design.

Claims

1. A cooling sleeve for a cylinder head (20) of an internal combustion engine, the cooling sleeve comprising:

a circular and cylindrical cooling sleeve (10) with a through running internal bore (12), said cooling sleeve (10) is enveloping a prechamber unit (30) in a water-jacket chamber (24) in the cylinder head (20), characterized in that

the cooling sleeve (10) comprises a number of apertures (14a,14b,14c), said apertures (14a,14b,14c) being one or more slits or holes in an outer wall (10a) of the cooling sleeve (10), permitting flow of coolant, for cooling exhaust ports (26) in said water-jacket chamber (24).

2. Cooling sleeve according to claim 1, wherein said apertures (14a,14b,14c) are of different shapes to create a flow field of coolant, increasing cooling of said exhaust ports (26) in the cylinder head (20).

3. Cooling sleeve according to claim 1, wherein at least one of the apertures (14a) is a straight slit in the outer wall (10a) of the cooling sleeve (10).

4. Cooling sleeve according to claim 1, wherein at least one of the apertures (14b) is an L-shaped or curved slit in the outer wall (10a) of the cooling sleeve (10).

5. Cooling sleeve according to claim 1, wherein at least one of the apertures (14c) is a hole in the outer wall (10a) of the cooling sleeve (10).

6. Cooling sleeve according to claim 1, wherein said cooling sleeve (10) is shaped as a piece of pipe.

7. Cylinder head (20) of an internal combustion engine, comprising a water-jacket chamber (24) with exhaust ports (26) and a prechamber unit (30), the cylinder head (20) further comprising:

a circular and cylindrical cooling sleeve (10) with a through running internal bore (12), said cooling sleeve (10) is enveloping the prechamber unit (30) in the water-jacket chamber (24) in the cylinder head (20), wherein

the cooling sleeve (10) comprises a number of apertures (14a,14b,14c) permitting flow of coolant, for cooling exhaust ports (26) in said water-jacket chamber (24), characterized in that

said cooling sleeve (10) is mounted with the apertures (14a,14b,14c) facing their desired target exhaust ports (26).

8. Cylinder head (20) according to claim 7, wherein said cooling sleeve (10) envelop the prechamber unit (30) in the cylinder head (20), and runs down to or into a flamedeck (32) of the cylinder head (20).

9. Cylinder head (20) according to claim 8, wherein said cooling sleeve (10) is designed to trap coolant coming up through the flamedeck (32) and to direct the coolant in the direction of the exhaust ports (26) in the water-jacket chamber (24).

10. Cylinder head (20) according to claim 7, wherein a top part of said cooling sleeve (10) is engaged with a prechamber holder (18).

11. Cylinder head (20) according to claim 7, wherein a top part of said cooling sleeve (10) is engaged with a cylinder head housing (22).

12. Cylinder head (20) according to claim 7, wherein said apertures (14a,14b,14c) of the cooling sleeve (10) are of different shapes to create a flow field of coolant, increasing cooling of exhaust ports (26) in the cylinder head (20).

13. Cylinder head (20) according to claim 7, wherein at least one of the apertures (14a) of the cooling sleeve (10) is a straight slit in an outer wall (10a) of the cooling sleeve (10), and/or wherein at least one of the apertures (14b) is an L-shaped or curved slit in the outer wall (10a) of the cooling sleeve (10), and/or wherein at least one of the apertures (14c) is a hole in the outer wall (10a) of the cooling sleeve (10).

Patentkrav

1. Kjølehylse for et sylinderhode (20) til en forbrenningsmotor, der kjølehylsen omfatter:

en sirkulær og sylindrisk kjølehylse (10) med en gjennomløpende intern boring (12), der kjølehylsen omgir en forkammerenhet (30) i et kjølekappekammer (24) i sylinderhodet (20), karakterisert ved at

kjølehylsen (10) omfatter et antall åpninger (14a,14b,14c), der åpningene (14a,14b,14c) er en eller flere slisser eller hull i en ytre vegg (10a) til kjølehylsen (10) og som tillater strømning av kjølemiddel for kjøling av eksosporter (26) i nevnte kjølekappekammer (24).

2. Kjølehylse i samsvar med krav 1, karakterisert ved at nevnte åpninger (14a,14b,14c) er av ulike former for å frembringe et strømningsfelt av kjølemiddel som øker kjøling av nevnte eksosporter (26) i sylinderhodet (20).

3. Kjølehylse i samsvar med krav 1, karakterisert ved at minst en av åpningene (14a) er en rett sliss i den ytre veggen (10) til kjølehylsen (10).

4. Kjølehylse i samsvar med krav 1, karakterisert ved at minst en av åpningene (14b) er en L-formet eller buet sliss i den ytre veggen (10) til kjølehylsen (10).

5. Kjølehylse i samsvar med krav 1, karakterisert ved at minst en av åpningene (14c) er et hull i den ytre veggen (10) til kjølehylsen (10).

6. Kjølehylse i samsvar med krav 1, karakterisert ved at kjølehylsen (10) er utformet som et rørstykke.

7. Sylinderhode (20) til en forbrenningsmotor, omfattende et kjølekappekammer (24) med eksosporter (26) og en forkammerenhet (30), der sylinderhodet (20) videre omfatter:

en sirkulær og sylindrisk kjølehylse (10) med en gjennomløpende intern boring (12), der kjølehylsen omgir forkammerenheten (30) i kjølekappekammeret (24) i sylinderhodet (20), hvori

kjølehylsen (10) omfatter et antall åpninger (14a,14b,14c) som tillater strømning av kjølemiddel for kjøling av eksosportene (26) i kjølekappekammeret (24), karakterisert ved at

kjølehylsen (10) er montert med åpningene (14a,14b,14c) vendt mot deres målrettede eksosporter (26).

8. Sylinderhode (20) i samsvar med krav 7, karakterisert ved at kjølehylsen (10) omgir forkammerenheten (30) i sylinderhodet (20), og løper ned til eller innpå et flammedekk (32) til sylinderhodet (20).

9. Sylinderhode (20) i samsvar med krav 8, karakterisert ved at kjølehylsen (10) er innrettet til å fange kjølemiddel som kommer opp gjennom flammedekket (32) og til å lede kjølemiddelet i retning eksosportene (26) i kjølekappekammeret (24).

10. Sylinderhode (20) i samsvar med krav 7, karakterisert ved at en øvre del av kjølehylsen (10) er forbundet med en forkammerholder (18).

11. Sylinderhode (20) i samsvar med krav 7, karakterisert ved at en øvre del av kjølehylsen (10) er forbundet med et hus (22) til sylinderhodet.

12. Sylinderhode (20) i samsvar med krav 7, karakterisert ved at nevne åpninger (14a,14b,14c) er av ulike former for å danne et strømningsfelt av kjølemiddel som øker kjøling av eksosportene (26) i sylinderhodet (20).

13. Sylinderhode (20) i samsvar med krav 7, karakterisert ved at minst en av åpningene (14a) er en rett sliss i den ytre veggen (10) til kjølehylsen (10), og/eller at minst en av åpningene (14b) er en L-formet eller buet sliss i den ytre veggen (10) til kjølehylsen (10), og/eller at minst en av åpningene (14c) er et hull i den ytre veggen (10) til kjølehylsen (10).

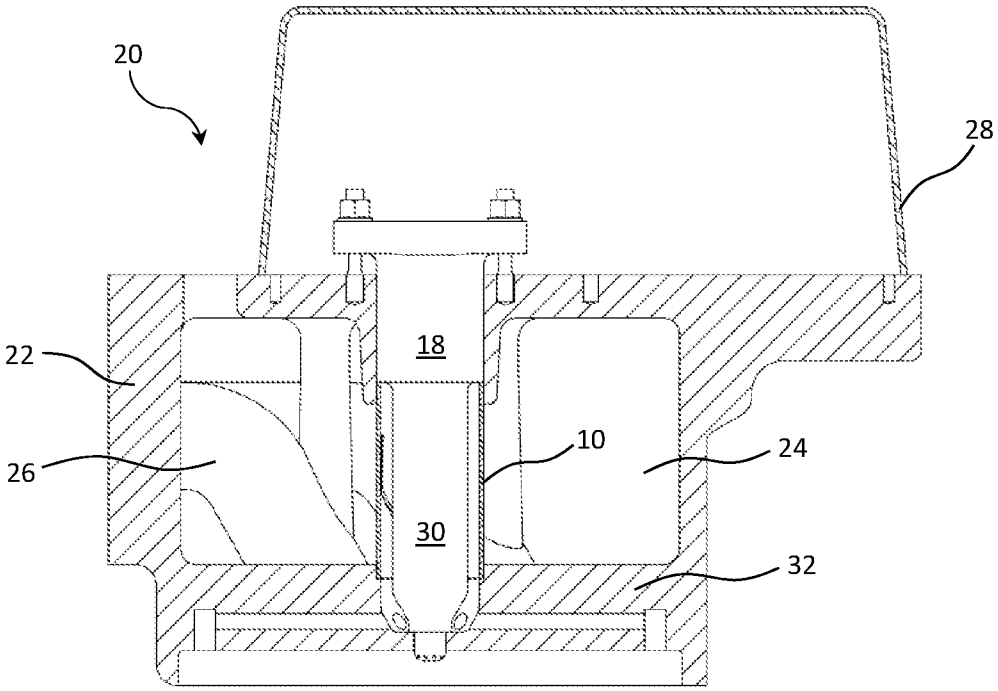


Fig. 1

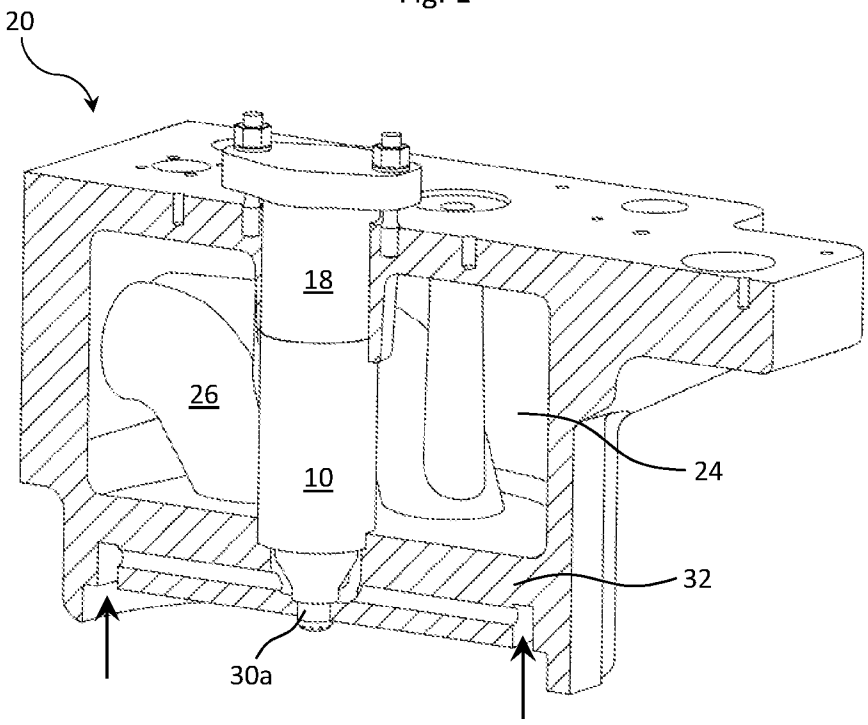


Fig. 2

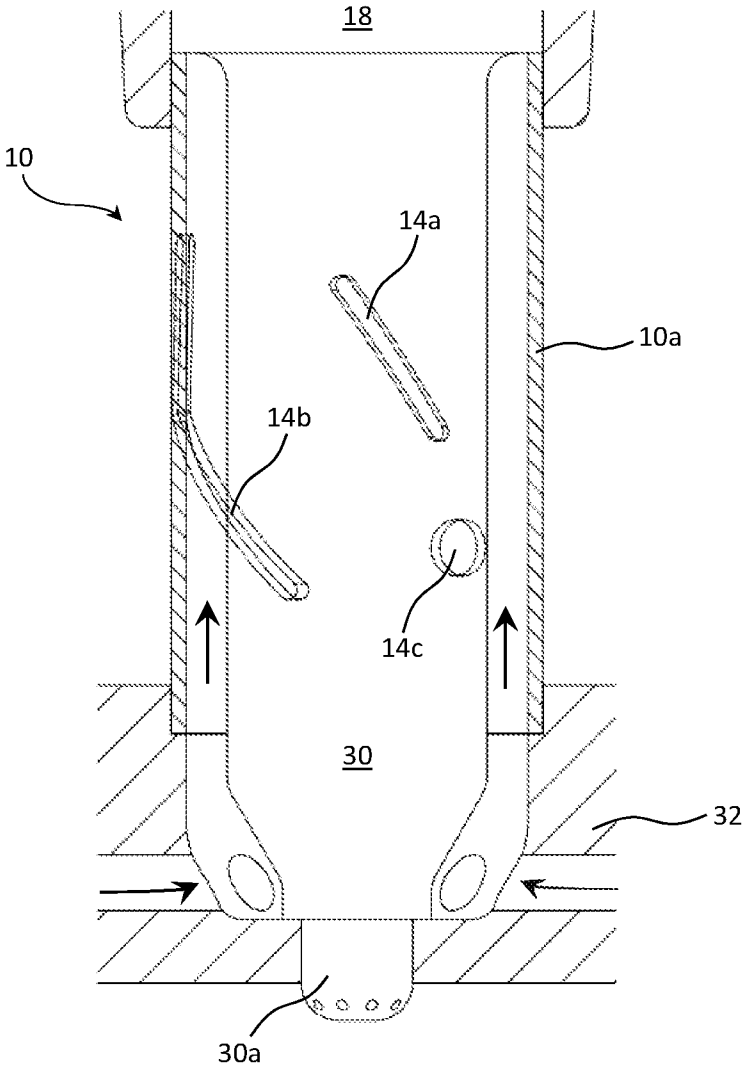


Fig. 3

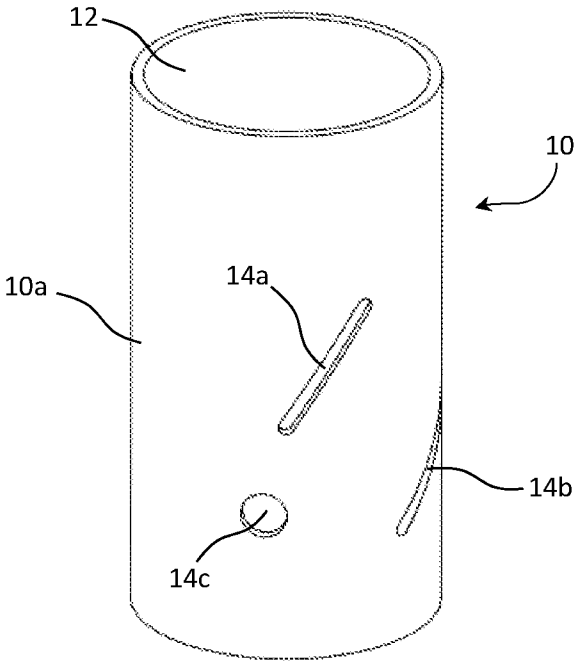


Fig. 4

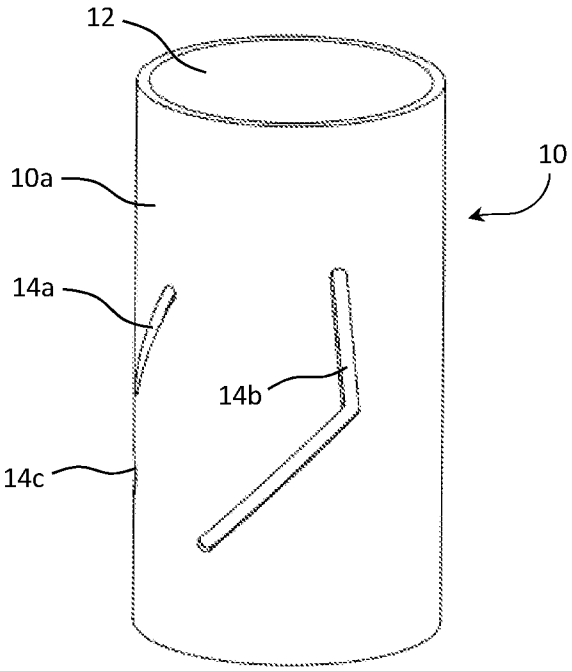


Fig. 5