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Description

The invention refers to a heat exchanger for primary and secondary fluids between which heat exchanger occurs, said exchanger comprising at least first, second and third tubes of successively larger diameters and coaxially disposed, the tubes being spaced apart by a pair of end manifolds to form annular fluid flow passages for said primary and secondary fluids between adjacent tubes, at least one of said manifolds having a generally conical portion and having first, second and third pairs of sealing elements which sealingly engage the inner surfaces of the first, second and third tubes respectively, circumferential flow passages located between the sealing elements of at least said second pair, said conical portion including first and second chambers formed therein for the primary and secondary fluids and wherein, in transverse section of said conical portion, the first and second chambers lie on opposite sides of a diametrical line, there being a third chamber located between the first and second chambers and said conical portion further including generally radial ducts extending to said circumferential flow passages on generally opposite sides thereof.

Such a heat exchanger is known from US—A—4 146 088. This heat exchanger is improved by the invention in that said third chamber has a member extending therethrough so as to divide the third chamber into three chambers: one central chamber within said member and circulating fluid inlet and outlet chambers on opposite sides of the central chamber and wherein said line passes through said circulating fluid inlet and outlet chambers and said central chamber, said radial ducts extending from respective circulating fluid inlet and outlet chambers, said manifold further including circulating fluid inlet and outlet ducts for fluid communication to the circulating fluid inlet and outlet chambers respectively whereby in use circulating fluid can pass through the circulating fluid inlet duct, to the circulating fluid inlet chamber, through one of the radial ducts to the circumferential passage and can flow through the passage and enter the other radial duct then flow through the circulating fluid outlet chamber and thence out of the circulating fluid outlet duct.

This heat exchanger proposed by the invention provides means for establishing flow of a purging fluid in the region between the O-ring or rings and the ends of the tubes. Such purging flow can firstly function as a coolant for cooling the O-rings and thereby making the exchanger more suitable for treatment of fluids at higher temperatures. Secondly, the purging fluid can be maintained at relatively higher pressure than the fluids flowing in the annular flow paths between adjacent fluids whereby if there is a leak between the O-rings and the ends of the tubes, the purging fluid will flow into such annular spaces and intermixing of the fluids being treated in the heat exchanger will not occur.

Alternatively, the purging fluid could be kept at relatively low pressure and a monitoring system provided to detect the presence of either or both of the heat exchanger fluids in the purging fluid. Thus, if one or other of the heat exchanger fluids is detected, that will be indicative of a broken or damaged O-ring seal. Also the purging fluid could sterilize the passage between the O-rings thus eliminating biological contamination in the event of a damaged seal.

The invention will now be more fully described with reference to the accompanying drawings in which:

Figure 1 is a longitudinal cross section through part of a heat exchanger constructed in accordance with the invention,

Figure 2 is a cross sectional view taken along the line 2—2 marked on Figure 1,

Figure 3 is a more detailed view of part of the exchanger, and

Figure 4 is a sectional view taken along the line 4—4 of Figure 3.

The heat exchanger of the invention comprises a pair of end manifolds 2 between which concentric heat conducting tubes 4 are disposed. The manifolds have a central bore 6 through which a long tension bolt 7 can pass therethrough and be used to clamp the tubes between the end manifolds. In the illustrated arrangement there are five tubes 4 each of which is preferably formed from stainless steel and may be provided with helical grooving (not shown) on its cylindrical wall so as to improve heat transfer properties. The spaces between adjacent tubes form annular fluid flow passages for the heat exchanger.

Both end manifolds 2 for the heat exchanger are the same and accordingly it is only necessary to describe the construction of one of the manifolds.

As best seen in Figures 1 and 3, each manifold comprises a generally conical body portion 8 integrally cast with tubular inlet/outlet spigots 10 and 12. The spigots 10 and 12 permit connection of fluid conduits to the end manifold by conventional means. The spigots 10 and 12 can be used interchangeably as inlet or outlet but in the description which follows it will be assumed that the spigot 10 is used as an inlet for a first heat transfer fluid and the spigot 12 is used as an outlet for the second heat transfer fluid. The body portion 8 includes inlet chamber 14 and an outlet chamber 16 in communication respectively with the spigots 10 and 12. The conical portion 8 further includes a central opening which is divided into separate chambers 18 and 19 by a tube 21, the ends of the tube 21 passing through the bore 6 and being welded thereto.

The outer surface of the body portion 8 of the manifold includes a series of generally cylindrical portions 20 which are spaced axially along the body portion and are adapted to be inserted within respective ends of the tubes 4, the cylindrical portions 20 being interconnected by tapering transition portions. Each cylindrical portion has formed therein two spaced grooves for re-

ceipt of O-rings 25 for forming positive seals with the inner surfaces of the tubes 4. A shoulder is formed at the end of each of the cylindrical portions 20 so as to form a seat against which the ends of the tubes 4 bear.

Fluid chambers 14 and 16 are connected to the annular fluid passages defined between adjacent tubes 4 by way of radial recesses 28 and 29 formed into the transition portions as best seen in Figure 1.

In accordance with the present invention means is provided to establish flow of a circulating or purging fluid between the respective pairs of O-rings 25. Grooves 30 are formed in the body portion 8 between the pairs of O-rings 25 so as to form circumferential flow passages for the purging fluid. As best seen in Figure 3, the manifold includes a purging fluid inlet duct 32 opens into the chamber 18 which has a number of generally radial inlet ducts 34 which communicate with respective grooves 30. On the opposite side of the body portion 8, there is formed a purging fluid outlet duct 36 which opens into the chamber 19 which has a number of generally radial return passages 38 from the grooves 30. As best seen in Figure 4 the purging fluid will then flow from the chamber 18 through the passages 34 then follow generally semi-circular paths along the grooves 30 and between the pairs of O-rings 25. The fluid will then flow into the return passages 38 to the return chamber 19.

In one application the purging fluid can be used as a coolant to cool the O-rings 25 to thereby enable the heat exchanger to be used with heat transfer fluids at relatively high temperatures. In a second application, the purging fluids may be circulated at a pressure which is higher than one or other of the pressures of the first and second heat transfer fluids so that should there be any leakage at the O-rings 25 the purging fluid will flow into the heat transfer passages between the tubes rather than intermixing of the heat transfer fluids.

Alternatively, the purging fluid may be circulated at relatively low pressure compared to the heat transfer fluids and monitoring apparatus provided to monitor the presence of one or other of the heat transfer fluids in the purging fluid so as to provide an effective means of detecting a broken or damaged O-ring. This arrangement is schematically illustrated in Figure 2 which shows a purging fluid supply 50 connected by a conduit 52 to the inlet duct 32 and a purging fluid analyser 54 connected by a conduit 56 to the outlet duct 36. The analyser monitors the presence of traces of one or both of the fluids flowing through the inlet 10 and outlet 12 of the exchanger. The supply and analyser could be operated continuously or periodically. There may be a return path for purging fluid from the analyser 54 to the supply 50.

Claims

1. A heat exchanger for primary and secondary fluids between which heat exchange occurs, said exchanger comprising at least first, second and third tubes (4) of successively larger diameters and coaxially disposed, the tubes (4) being spaced apart by a pair of end manifolds (2) to form annular fluid flow passages for said primary and secondary fluids between adjacent tubes (4), at least one of said manifolds (2) having a generally conical portion and having first, second and third pairs of sealing elements (25) which sealingly engage the inner surfaces of the first, second and third tubes respectively, circumferential flow passages (30) located between the sealing elements (25) of at least said second pair, said conical portion including first and second chambers (14) and (16) formed therein for the primary and secondary fluids and wherein, in transverse section of said conical portion, the first and second chambers (14) and (16) lie on opposite sides of a diametrical line, there being a third chamber (18) located between the first and second chambers and said conical portion further including generally radial ducts (34), (38) extending to said circumferential flow passages (30) on generally opposite sides thereof, characterised in that said third chamber has a tube (21) extending therethrough so as to divide the third chamber into three chambers: one central chamber within said tube (21) and circulating fluid inlet and outlet chambers (18, 19) on opposite sides of the central chamber and wherein said line passes through said circulating fluid inlet (18) and outlet chambers (19) and said central chamber, said radial ducts (34, 38) extending from respective circulating fluid inlet (18) and outlet chambers (19), said manifold (2) further including circulating fluid inlet and outlet ducts (32, 36) for fluid communication to the circulating fluid inlet and outlet chambers (18, 19) respectively whereby in use circulating fluid can pass through the circulating fluid inlet duct (32), to the circulating fluid inlet chamber (18), through one of the radial ducts (34, 38) to the circumferential passage (30) and can flow through the passage (30) and enter the other radial duct (38, 34) then flow through the circulating fluid outlet chamber (19) and thence out of the circulating fluid outlet duct (36).

2. A heat exchanger according to claim 1 characterised in that said tubes (4) have pairs of sealing elements (25) which sealingly engage the inner surfaces of the tubes (4) and wherein there are circumferential flow passages (30) between each pair of sealing elements (25).

3. A heat exchanger according to claim 1 or 2 characterised in that both of said end manifolds (2) are the same and wherein an elongate tension bolt (7) extends within the first tube and through said member (21) and maintains the ends of the tubes (4) seated against shoulders formed in the conical portions of the manifolds (2).

4. A heat exchanger as claimed in any one of claims 1 to 3 characterised in that said sealing elements (25) comprise O-rings and wherein circulating fluid supply means (50) is coupled by a conduit (52) to said circulating fluid inlet duct (32),

said supply means (50) being arranged in use to supply circulating fluid at a relatively low temperature so as to cool said O-rings.

Patentansprüche

1. Wärmetauscher für erste und zweite Fluide, zwischen denen ein Wärmeaustausch erfolgt, mit mindestens ersten, zweiten und dritten koaxial angeordneten Rohren (4) mit zunehmend größeren Durchmessern, die mit Hilfe eines Paares von Endverteilern (2) zur Bildung ringförmiger Fluid-Strömungsdurchgänge für die ersten und zweiten Fluide zwischen benachbarten Rohren (4) beabstandet sind, wobei mindestens einer der Endverteiler (2) einen im allgemeinen konischen Abschnitt und erste, zweite und dritte Paare von Abdichtelementen (25) aufweist, die abdichtend an den inneren Oberflächen des ersten bzw. zweiten bzw. dritten Rohres (4) angreifen, wobei umlaufende Strömungsdurchgänge (30) zwischen den Abdichtelementen (25) mindestens des zweiten Paares angeordnet sind, der konische Abschnitt darin eingeformte erste und zweite Kammern (14) und (16) für die ersten und zweiten Fluide aufweist und in einem Querschnitt des konischen Abschnittes die ersten und zweiten Kammern (14) und (16) auf gegenüberliegenden Seiten einer Durchmesserlinie liegen, eine dritte Kammer (18) zwischen der ersten und zweiten Kammer angeordnet ist und der konische Abschnitt weiterhin etwa radiale Leitungen (34, 38) aufweist, die sich zu den umlaufenden Flüssigkeitsdurchgängen (20) auf dessen im allgemeinen gegenüberliegenden Seiten erstrecken, dadurch gekennzeichnet, daß die dritte Kammer ein sich hierdurch zur Teilung der dritten Kammer in drei Kammern erstreckendes Rohr (21) aufweist, nämlich eine zentrale Kammer innerhalb des Rohres (21) sowie eine Einlaß- und eine Auslaßkammer (18, 19) für das zirkulierende Fluid auf gegenüberliegenden Seiten der zentralen Kammer, wobei die Linie durch die Einlaßkammer (18) und die Auslaßkammer (19) für zirkulierendes Fluid und die zentrale Kammer hindurchgeht, daß sich die radialen Leitungen (34, 38) von der Einlaß- bzw. Auslaßkammer (18, 19) für zirkulierendes Fluid erstrecken, der Verteiler (2) weiterhin Einlaß- und Auslaßleitungen (32, 36) für zirkulierendes Fluid zur Fluidverbindung mit der Einlaß- bzw. Auslaßkammer (18, 19) für zirkulierendes Fluid aufweist, wodurch im Gebrauch zirkulierendes Fluid durch die Zirkulationsfluid-Einlaßleitung (32) in die Fluid-Einlaßkammer (18), durch eine der radialen Leitungen (34, 38) in den umlaufenden Durchgang (30) gelangen und durch den Durchgang (30) fließen kann, in die andere radiale Leitung (38, 34) gelangen und dann durch die Zirkulationsfluid-Auslaßkammer (19) und von dort aus der Zirkulationsfluid-Auslaßleitung (36) fließen kann.

2. Wärmetauscher nach Anspruch 1, dadurch gekennzeichnet, daß die Rohre (4) Paare von abdichtenden Elementen (25) aufweisen, die abdichtend an den inneren Oberflächen der Rohre (4) angreifen, und wobei zwischen jedem Paar von abdichtenden Elementen (25) umlaufende Strömungsdurchgänge (30) vorhanden sind.

3. Wärmetauscher nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß beide der Endverteiler (2) gleich sind und sich ein langegestreckter Zugbolzen (7) innerhalb des ersten Rohres und durch das Element (21) erstreckt und die Enden der Rohre (4) gegen in den konischen Abschnitten der Verteiler (2) gebildete Schultern gesetzt hält.

4. Wärmetauscher nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Abdichtelemente (25) O-Ringe enthalten und eine Zirkulationsfluid-Versorgungseinrichtung (50) über eine Leitung (52) mit der Zirkulationsfluid-Einlaßleitung (32) verbunden ist, wobei die Versorgungseinrichtung (50) derart ausgebildet und angeordnet ist, daß sie im Gebrauch Zirkulationsfluid bei einer relativ niedrigen Temperatur zur Külung der O-Ringe liefert.

Revendications

1. Echangeur de chaleur pour des fluides primaire et secondaire entre lesquels un échange de chaleur apparaît, ledit échangeur comprenant au moins des premier, deuxième et troisième tubes (4) de diamètres augmentant progressivement et disposés coaxialement, les tubes (4) étant séparés par une paire de collecteurs d'extrémité (2) pour former des passages annulaires d'écoulement de fluide pour lesdits fluides primaire et secondaire entre des tubes (4) adjacents, au moins un desdits collecteurs (2) ayant une partie sensiblement conique et comprenant des première, deuxième et troisième paires d'éléments d'étanchéité (25) qui coopèrent de manière étanche avec les surfaces intérieures des premier, deuxième et troisième tubes respectivement, des passages d'écoulement circonférentiels (30) situés entre les éléments d'étanchéité (25) d'au moins ladite seconde paire, ladite partie conique comportant des première et seconde chambres (14) et (16) formées à l'intérieur de celle-ci pour les fluides primaire et secondaire et dans laquelle, en section transversale de ladite partie conique, les première et seconde chambres (14) et (16) reposent sur des côtés opposés d'une ligne diamétrale sur laquelle se trouve une troisième chambre (18) située entre les première et deuxième chambres et ladite partie conique comprenant en outre des conduits à peu près radiaux (34), (38) s'étendant jusqu'aux passages d'écoulement circonférentiels (30) sur des côtés à peu près opposés de ceux-ci, caractérisé en ce que ladite troisième chambre comprend un tube (21) s'étendant à travers elle de manière à diviser la troisième chambre en trois chambres: une chambre centrale à l'intérieur du tube (21) et des chambres (18, 19) d'entrée et de sortie de fluide de circulation sur des côtés opposés de la chambre centrale et dans laquelle ladite ligne passe à travers les chambres d'entrée (18) et de sortie (19) de fluide de circulation et la chambre centrale, les conduits radiaux (34, 38) s'étendant à partir des chambres d'entrée (18) et de

sortie (19) de fluide de circulation respectives, le collecteur (2) comprenant en outre des conduits (32, 36) d'entrée et de sortie de fluide de circulation destinés à une communication de fluide avec les chambres d'entrée et de sortie de fluide de circulation (18, 19) respectivement, en utilisation, du fluide de circulation pouvant passer à travers le conduit d'entrée de fluide circulation (32), jusqu'à la chambre d'entrée de fluide de circulation (18), à travers un des conduits radiaux (34, 38) jusqu'au passage circonférentiel (30) et s'écouler à travers le passage (30) et entrer dans l'autre conduit radial (38, 34) et s'écouler ensuite à travers la chambre de sortie de fluide de circulation (19) et enfin hors du conduit de sortie de fluide de circulation (36).

2. Echangeur de chaleur selon la revendication 1, caractérisé en ce que les tubes (4) comportent des paires d'éléments d'étanchéité (25) qui coopèrent de manière étanche avec les surfaces intérieures des tubes (4) et dans lequel des passages d'écoulement circonférentiels (30) sont situés entre chaque paire d'éléments d'étanchéité (25).

3. Echangeur de chaleur selon l'une des revendications 1 ou 2, caractérisé en ce que les deux collecteurs d'extrémité (2) sont identiques et dans lequel un boulon de tension allongé (7) s'étend à l'intérieur du premier tube et à travers ledit tube (21) et maintient les extrémités des tubes (4) en appui contre des épaulements formés dans les parties coniques des collecteurs (2).

4. Echangeur de chaleur selon l'une quelconque des revendications 1 à 3, caractérisé en ce que les éléments d'étanchéité (25) sont constitués par des anneaux toriques et dans lequel des moyens d'alimentation en fluide de circulation (50) sont couplés par une conduite (52) audit conduit d'entrée de fluide de circulation (32), lesdits moyens d'alimentation (50) étant agencés, en utilisation, pour fournir du fluide circulation à une température relativement basse de manière à refroidir lesdits anneaux toriques.

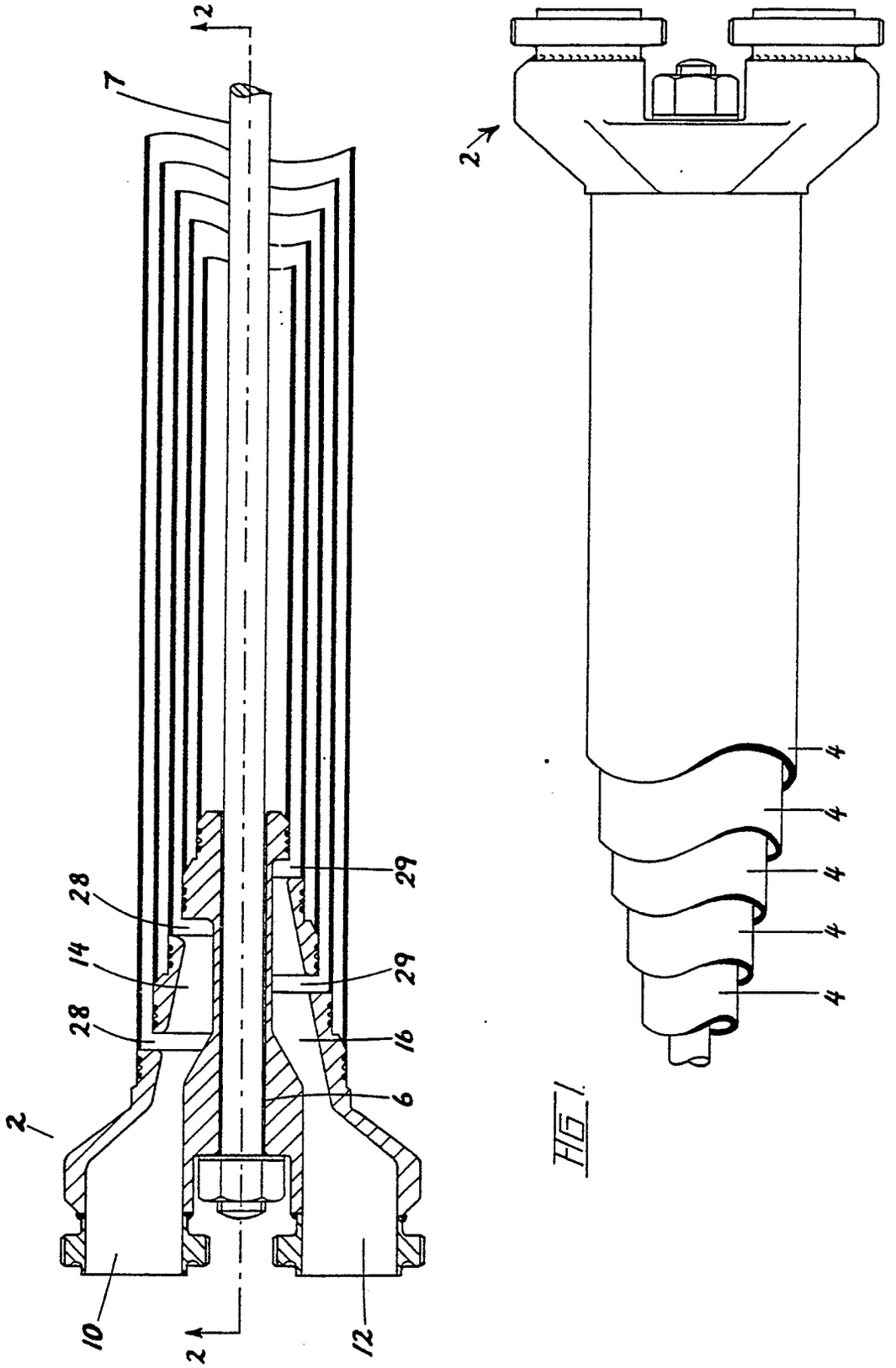

FIG 1.

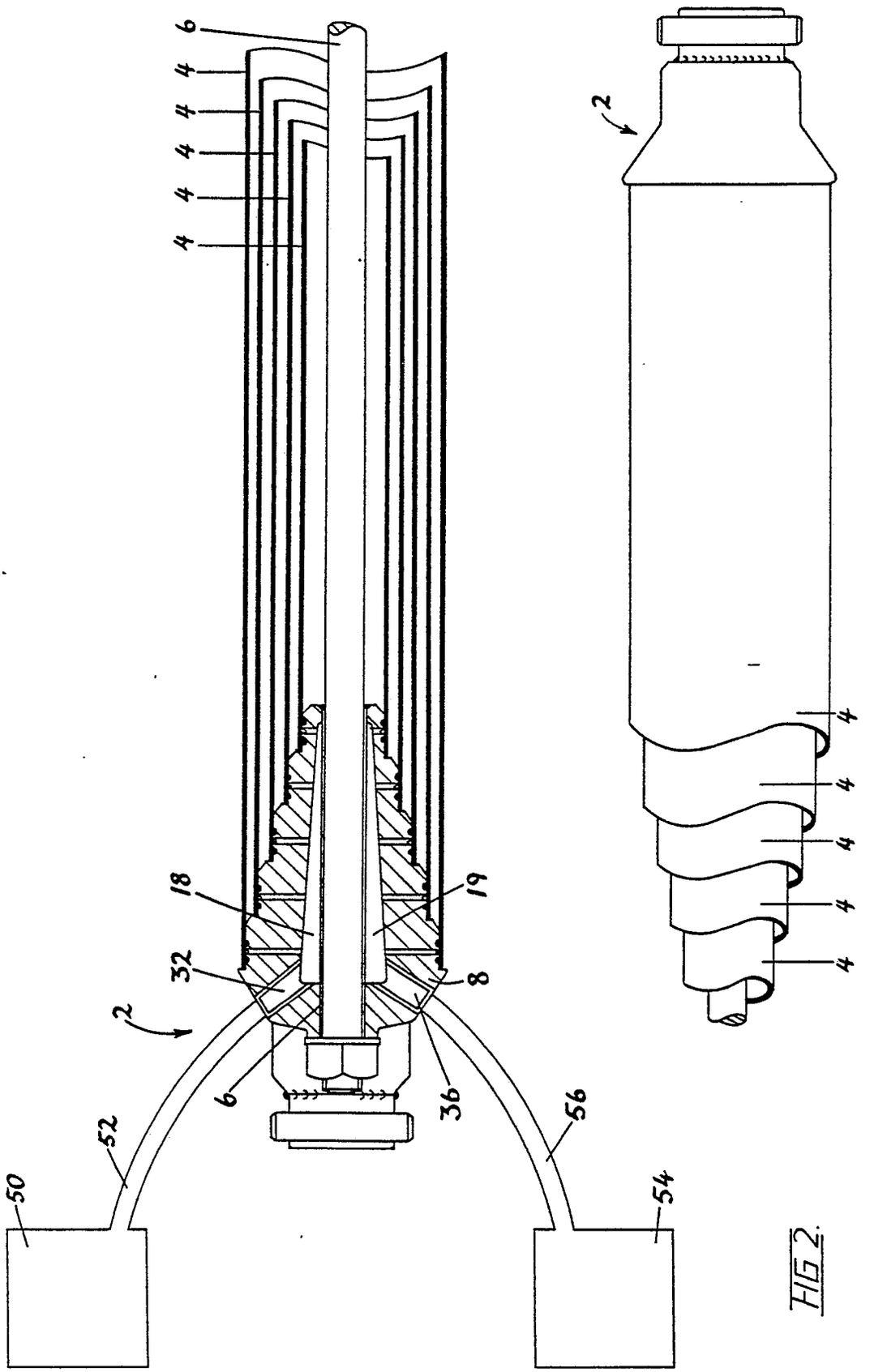

FIG 2.

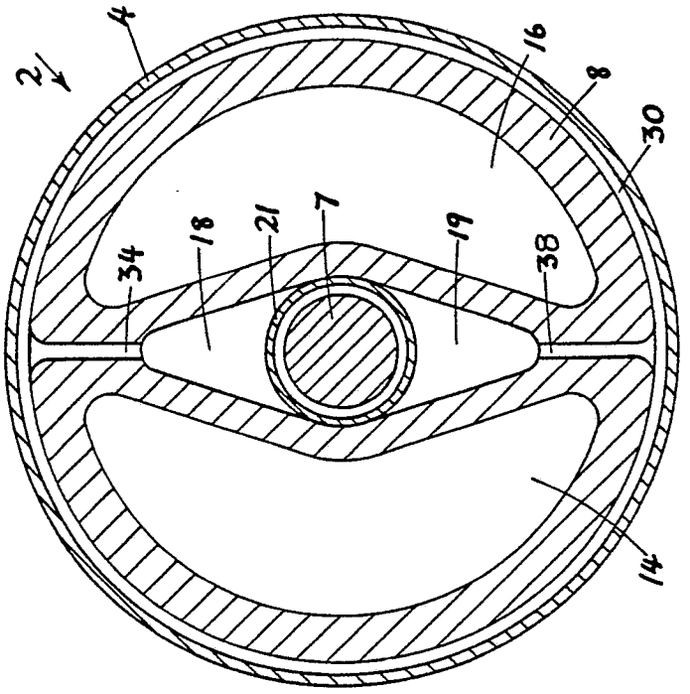
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FIG 4

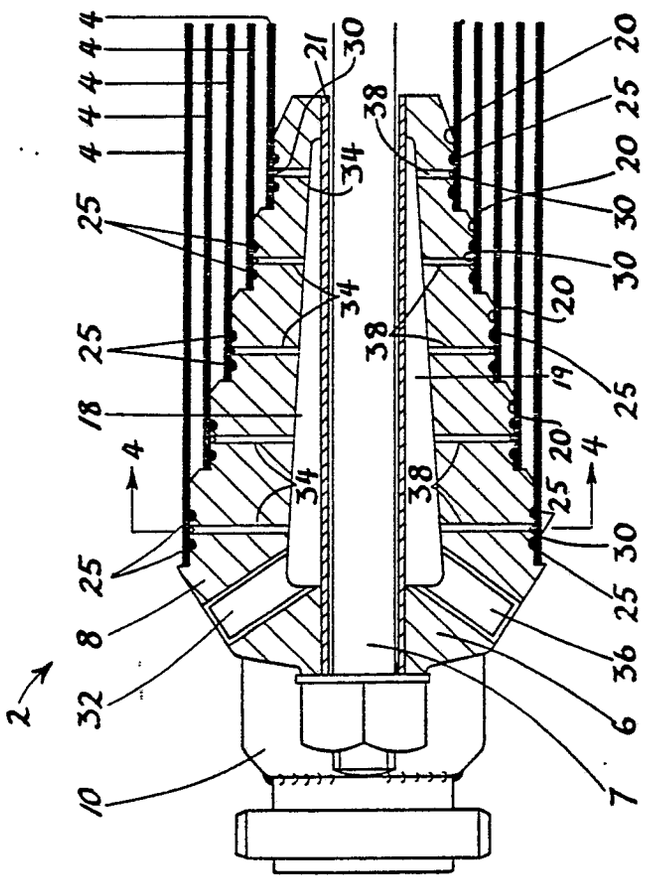
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FIG 3