NALSAR PROXIMATE EDUCATION
NALSAR UNIVERSITY OF LAW, HYDERABAD
P.G.DIPLOMA IN PATENTS LAW

2016-17
Supplementary Exams (November, 2017)

Paper II – Practical

(Exploitation of Patents – Drafting, Specification & Patent Writing)

Time: 2 ½ hours. **TOTAL MARKS: 100**

INSTRUCTIONS TO CANDIDATES

1. **The question paper to be interpreted as given and no clarification can be sought from the invigilator.**

2. **Answers in illegible handwriting will not be taken into consideration.**

Attempt any one – either A or B

You are required to draft a complete specification of the given disclosure with

a. Assigning a Title for the Invention
b. Background for the invention
c. Summary of the Invention,
d. Abstract of the Invention and
e. A brief description.

60 Marks

(Detailed description/figures should not be written/ drawn as it is already given in the disclosure. Failure to respect instruction may carry negative marking)

Draft a Main Claim and Nine dependent Claims. **40 Marks**

Option A

Venkatesh is a professional taxi driver with 25 years of driving experience. He is a favorite driver for many customers and they regularly book him for his professional conduct and expert driving ability. With severe competition and many new entrants in the field of taxi services he decided to buy his own Etios Car and also joined the Uber services. The Uber taxi services operate on an interactive Internet based taxi service where the desiring taxi driver can enroll after being vetted for their driving skills, conduct and professional behavior. The taxi hailing service also has a rating system in their app where the customers rate the service of the trip at the end of the trip. Venkatesh with a track record of many years of driving without an accident was consistently getting a good rating, which kept him as a top driver among those who have enrolled into the Uber taxi services.

However one rainy day when Venkatesh picked up a family from the Hyderabad Airport to be dropped at Shamirpet had a near miss experience in the ORR. Though he was carefully driving and watching the vehicles in the road, he nearly missed observing a speeding taxi at the back of the vehicle and with some luck he swerved the car and avoided the accident. However the passengers felt that he was careless and rated poor in the rating system and also send a written complaint to the company, which asked an explanation about his driving that day. He could not really explain what went wrong and apologized but was a blot on his service.

Later he analysed what could have gone wrong and came to a conclusion that at a point he bent little forward to adjust his seating position to observe some object on the road and at that point the near miss accident happened. He did look in the rear view mirror in front of him in the car but did not notice the vehicle, which came at the back in a good speed.

He narrated this to one of his regular passenger named Samir Roy who manufactures accessories to cars and other vehicles who is also a graduate of IIT Hyderabad. Samir Roy listened to this and later tried to find out how this could have happened and concluded that the rear view mirror is a fixed one and if one moves forward or adjusts the seat there is a possibility to miss out the view of the vehicle at the back. Roy thought he has to find a solution, as this could be a common factor among drivers especially of Cars and Trucks. This problem could lead to fatal accidents.

Roy who has an R& D lab worked on this and after a year came at with a solution. He made a prototype of a rear view mirror by fitting a camera, which will capture the face and eye position of the driver and feed into a system, which then will constantly track the position. In case of the face /eye position is not captured it will automatically adjust the mirror to give the driver the correct rear view reflection. Having tested this in his car he approaches you with this disclosure document and contracts you to file a Patent for this. The description is as follows:

Described herein is an intelligent ***rear view mirror*** system configured to adjust to a user's height and seating position automatically, or without user interaction. In some embodiments, a camera mounted on the ***rear view mirror*** system captures an image that includes the user and uses one or more computer vision techniques to identify the user's eye. Once identified, the ***rear view mirror*** may be rotated from a default position to a position that enables the user to view objects through the rear window of a vehicle. In some embodiments, the default position in the ***rear view mirror*** system may be pre-programmed by a manufacturer of the ***rear view mirror*** system. For example the manufacturer may set the center of a rear window as a default position, such that the ***rear view mirror*** system can identify the mirror's position with respect to the default position.

In some embodiments, the ***rear view mirror*** system may comprise a semi-transparent reflective surface and an opaque reflective surface, with a space between the two. In some embodiments, the semi-transparent reflective surface may be a one-way mirror or tinted glass. In some embodiments, the mirror may comprise a prismatic wedge mirror. In some embodiments, the ***rear view mirror*** system may comprise a single opaque reflective surface. In some embodiments, a camera configured to capture digital input may be positioned so that the camera's line of sight is perpendicular to the semi-transparent reflective surface. In some embodiments, the ***rear view mirror*** system may include multiple cameras. For example, the ***rear view mirror*** system may include two cameras, each configured to capture different image information. In some embodiments, the camera may be positioned behind the first reflective surface. In some embodiments, the camera may be mounted on a ***rear view mirror*** housing.

In some embodiments, the ***rear view mirror*** system may be in communication with a server or other service provider computer located outside of the vehicle in which the ***rear view mirror*** system is installed. The service provider computer may be configured to perform one or more calculations related to the automatic adjustment of the ***rear view mirror*** system. In some embodiments, the vehicle itself may include a processing device configured to perform one or more calculations related to the automatic adjustment of the ***rear view mirror*** system.

In some embodiments, the ***rear view mirror*** system may be placed into a "follow" mode, in which a camera will continue to (or periodically) capture digital image information related to the user and may adjust the ***rear view mirror*** position each time the user's position information is updated. In some embodiments, the ***rear view mirror*** system may automatically return to a default position upon being knocked out of place. This may enable the camera of the ***rear view mirror*** system to re-acquire image information for the user.

FIG. 1 depicts an example ***rear view mirror*** system that may be implemented in accordance with at least some embodiments. FIG. 1 is broken up into FIG. 1A and FIG. 1B in order to better illustrate some features of the disclosure.

FIG. 1A depicts a side-view cutout of an example ***rear view mirror*** system. Depicted in FIG. 1A, is a mirror unit 102 positioned within a mirror housing 104. The mirror unit 102 is held within the mirror housing 104 so that it is capable of rotating about an axis that runs the length of the mirror housing 104. For example, the mirror unit may be held to the mirror housing 104 by use of pins or studs 106. Additionally, a tilt actuation device 108 may be coupled with the mirror unit to cause it to rotate along a range of motion 110. Range of motion 110, as depicted, is a rotation about an axis running parallel to, or along the length of, the ***rear view mirror*** unit. In other words, the mirror unit itself is tilted up or down through range of motion 110. For example, the mirror unit may be adjusted along this range of motion 110 to account for a driver's height. In some embodiments, the entire mirror housing may be rotated along range of motion 110 using the tilt actuation device 106. The mirror unit itself will be described in greater detail with respect to FIG. 3 below.

FIG. 1B depicts a top-down view of an example ***rear view mirror*** system. As depicted, the ***rear view mirror*** system may be connected to a vehicle via an arm 112. The mirror housing 104 may be rotatable along a second range of motion 114 around the arm 112. Furthermore, a second tilt actuation device may be used to rotate the mirror housing 104 in this way. The second tilt actuation device may be located within the mirror housing 104, or it may be located at the end of the arm distal to the mirror housing 104. The second tilt actuation device may be configured to rotate the mirror housing along range of motion 114 so that a reflective surface 116 is facing a particular direction. The second tilt actuation device may also be configured to hold the mirror housing 104 in a particular position. In some embodiments, tilt actuation device 108 and the second tilt actuation device may be different type of actuation devices.

FIG. 2 depicts system or architecture in which techniques for processing image information may be implemented in accordance with the disclosure. In some examples, a vehicle 202 may include a processor device 204. In some embodiments, the processor device 204 may be configured to communicate with a service provider computer 206 via a network 208, or via other network connections. The processor device 204 or the service provider computer 206 may be configured to process an image received from a camera associated with the ***rear view mirror*** system and provide instructions for adjusting a mirror position.

The processor device 204 may be any type of computing device capable of performing the described functions. The processor device 204 may include one or more processors 210 capable of processing input from one or more input sensors 212. As is known in the art, there are a variety of input sensors 212 capable of detecting input related to a user or vehicle conditions, such as accelerometers, cameras, microphones, etc. The input obtained by the input sensors may be from a variety of data input types, including, but not limited to, audio data, visual data, or biometric data. Programmatic code for an application or module utilized in the implementation of at least some embodiments may be stored and executed from the memory 214 of processor device 204. The processor device 204 may include a module for processing image information to determine a viewer position (image processing module 216) and/or a module for providing movement instructions to a mirror unit (mirror adjustment module 218).

FIG. 3 depicts an example mirror unit that may be implemented in accordance with at least some embodiments. The mirror unit illustrated in FIG. 3 may be an example mirror unit 106 as depicted in FIG. 1. FIG. 3 is broken up into FIG. 3A, FIG. 3B, FIG. 3C, and FIG. 3D in order to better illustrate some features of the disclosure.

FIGS. 3A and 3B depict an illustration of mirror darkening techniques that may be implemented in a ***rear view mirror*** system to reduce headlight glare. FIG. 3A depicts an auto-darkening ***rear view mirror*** in a "night" position, utilized when the use of vehicle headlights is likely. As depicted, the mirror unit may be configured with a prismatic wedge mirror 302, or a mirror having a first reflective surface 304 and a second reflective surface 306 positioned at an angle. It should be noted that the angle between the first reflective surface 304 and the second reflective surface 306, as well as the resulting "tilt" between the "day" position and the "night" position, might be greatly exaggerated in FIG. 3 in order to better illustrate the principles of this disclosure. It should also be noted that the prismatic wedge mirror might be positioned such that it tapers in any direction. In this illustration, the first reflective surface 304 is a semi-transparent reflective surface, which allows most light to pass through it and reflects a small percentage of the light directed at the mirror unit. The second reflective surface 306 is a highly reflective surface (e.g., a silvered surface) that reflects the majority of the light directed to the mirror unit.

When in the "night" position, the mirror unit is tilted such that light from the first reflective surface 304 is directed at the driver. As depicted, with the use of a "night" position, the majority of the reflected incoming light is directed away from the driver. This prevents the driver from being blinded by headlight glare from the rear window.

FIG. 3B depicts an auto-darkening ***rear view mirror*** in a "day position," utilized when the use of vehicle headlights is unlikely. When in the "day" position, the mirror unit is tilted such that light from the second reflective surface 306 is directed at the driver. As depicted, with the use of a "day" position, the majority of the reflected incoming light is directed toward the driver, allowing him or her to see through the rear window.

In some embodiments, a ***rear view mirror*** system may include one or more photo detectors, such as a photovoltaic diode, to detect a light threshold. The ***rear view mirror*** system may be configured to switch between a "day" position and a "night" position automatically based on feedback from the photo detectors. For example, the ***rear view mirror*** system may include a photovoltaic diode that receives light from headlights directed at the ***rear view mirror*** system. If the received light is above a predetermined threshold, then the ***rear view mirror*** system may enter night mode. In another example, a photovoltaic diode may be used to determine if an illumination level outside the vehicle is above a predetermined threshold value. In this example, the ***rear view mirror*** system may be placed in a day position if the illumination level outside the vehicle is above the predetermined threshold value.

FIG. 3C depicts a first camera configured to automatically adjust to a user's position under "night" conditions. As depicted in FIG. 3C, camera 308 may be positioned such that the camera 308 line of sight is perpendicular to the first reflective surface 304. In some embodiments, the camera 308 may be embedded in the second reflective surface 306. In some embodiments, the camera 308 may be embedded in a surface of the mirror unit other than the second reflective surface. Camera 308 may be a pinhole camera. In some embodiments, camera 308 may include a wide-angle lens, (i.e., a lens with a focal length shorter than that of a normal lens) capable of capturing an extended image. In some embodiments, camera 308 may be a night vision or type of camera suited to capture images in low light level conditions.

FIG. 3D depicts a second camera configured to automatically adjust to a user's position under "day" conditions. As depicted in FIG. 3D, camera 310 may be positioned such that the camera 310 line of sight is perpendicular to the second reflective surface 306. Similar to camera 308, the camera 310 may be embedded in the second reflective surface 306. Camera 310 may also be a pinhole camera, and may include a wide-angle lens capable of capturing an extended image. Because camera 308 is positioned perpendicular to the first reflective surface 304 and camera 310 is positioned perpendicular to the second reflective surface 306, the angle between camera 308 and camera 310 should be equal to the angle of the prismatic wedge mirror 302.

It should be noted that the mirror unit might be configured to rotate the ***rear view mirror*** around a horizontal axis (up and down) and/or around a vertical axis (from side to side). In some embodiments, the actuation device that is configured to rotate the mirror unit around a horizontal axis may also be configured to place the mirror unit into either a "day" position or a "night" position. In some embodiments, the ***rear view mirror*** system may utilize separate actuation devices for the rotation of the mirror unit and switching between positions. For example, a first actuation device may be located within the mirror housing and may be used to rotate between the "day" and "night" position. In this example, a second actuation device may rotate the entire mirror housing in accordance with the described disclosure. In some embodiments, the mirror unit may be "flipped," or manually moved, to either position. As the mirror unit is changed from a "day" position to a "night" position, the active camera may change from camera device 310 to camera device 308 (image information may be received from camera 308 instead of camera 310) and vice versa.

In some embodiments, when the ***rear view mirror*** system switches from "night" position to "day" position, the ***rear view mirror*** system may also switch to receiving image information from camera 310 instead of from camera 308, and vice versa. In some embodiments, camera 308 may also be camera 310. For example, a single camera may be configured to rotate positions between that of 308 and 310 based on feedback received from a photovoltaic diode.

FIG. 4 depicts an illustration of camera/mirroring positioning that may be implemented in accordance with at least some embodiments of the current disclosure. In FIG. 4, a camera 402 is positioned such that a line of sight 404 of the camera 402 is perpendicular to a reflective surface 406. Camera 402 may be an example camera 308 of FIG. 3, or it may be an example camera 310 of FIG. 3. The reflective surface 406 may be an example first reflective surface 304 of FIG. 3, or an example second reflective surface 306 of FIG. 3.

Depicted in FIG. 4 is an object position 408 and a viewer position 410. In accordance with at least some embodiments, the ***rear view mirror*** system may determine an angle 412 between the object 408 and the viewer 410. In some embodiments, the ***rear view mirror*** system may calculate a distance between the object position 408 and the viewer position 410 on an image captured by camera 402. The calculated distance may correlate to an angle 412. The ***rear view mirror*** system may adjust the position of the camera 402 and the reflective surface 406 (e.g., by causing a rotation of a mirror unit) so that the line of sight 404 is positioned halfway between the object position 408 and the viewer position 410 (where a distance d from the line of sight 404 to the default location 408 is equal to the distance from the line of sight 404 to the viewer location 410). Accordingly, an incident angle .THETA..sub.I is created that is equal to a reflected angle .THETA..sub.R and the viewer 410 is able to see the object 408 in the reflective surface 406.

FIG. 5 depicts example rear view images that may be captured and used to adjust to an appropriate mirror position in accordance with at least some embodiments. In FIG. 5, a first image 502 is captured. The center of image 502, referred to as the focus 504, is depicted as being aligned with a default position 506. In some embodiments, the default position 506 may be the center of a rear window 508 of a vehicle. The default position 506 may be stored in memory, such that all measurements are made with respect to the default position 506. In some embodiments, the default position 506 may represent an origin point of a coordinate system utilized by the ***rear view mirror*** system. In accordance with at least some embodiments of the ***rear view mirror*** system, the mirror may return to a default state (e.g., where the reflective surface and camera are pointed at a default position) if the mirror is knocked out of place, or if the vehicle is turned off.

FIG. 6 depicts an example of a ***rear view mirror*** system that is configured to automatically adjust to user movement in accordance with at least some embodiments. In some embodiments, the ***rear view mirror*** 602 may be adjusted to a user's position upon detecting a repositioning event (e.g., a startup of the car's engine, buckling of a safety belt, closing of a door, etc.). In accordance with at least some embodiments, the ***rear view mirror*** 602 may be placed into a "follow" mode, such that it continuously readjusted to connect a user's line of sight with a rear window. For example, the camera may continuously feed user position data to a processing device (e.g., by providing video data, or still image data on a periodic basis). Upon detecting that a user's view position has changed from a first position 604 to a second position 606, the mirror 602 may be subjected to a repositioning 608 that is calculated to result in the user maintaining eye contact with the rear window.

FIG. 7 depicts an illustrative flow chart demonstrating an example adjustment to a ***rear view mirror*** in accordance with at least some embodiments. The process 700 is illustrated as a logical flow diagram, each operation of which represents a sequence of operations that can be implemented in hardware, computer instructions, or a combination thereof. In the context of computer instructions, the operations represent computer-executable instructions stored on one or more computer-readable storage media that, when executed by one or more processors, perform the recited operations. Generally, computer-executable instructions include routines, programs, objects, components, data structures, and the like that perform particular functions or implement particular data types. The order in which the operations are described is not intended to be construed as a limitation, and any number of the described operations can be omitted or combined in any order and/or in parallel to implement this process and any other processes described herein.

An image-processing module may process the received image information in order to identify an eye pattern at 706. In some embodiments, the image-processing module may reside in the memory of a processing device located within the vehicle itself. In some embodiments, the ***rear view mirror*** system may be in communication with a service provider computer that stores and executes the image-processing module. In some embodiments, visual patterns in the received image information may be compared to known eye pattern structures in order to identify an eye pattern. In some embodiments, the ***rear view mirror*** system may be "trained" with a particular user's eye. For example, the first time that a new driver attempts to drive a vehicle, he or she may be asked to provide a close-up image of his or her eye. In this example, the service provider computer may add a pattern related to the user's eye to a pattern recognition database.

Once an eye pattern has been identified, the location of the eye pattern may be determined at 708. In some embodiments, the image information may be associated with a grid, or coordinate, system. The coordinates may be associated with a degree of rotation. In some embodiments, the location of the eye pattern may be identified with respect to a default location. For example, the eye pattern location may be identified with respect to the center of the rear window.

FIGURES – Option A

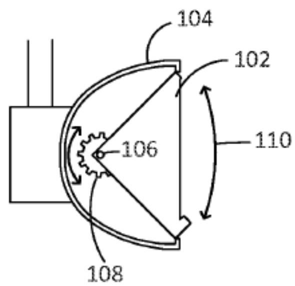


Fig.1A

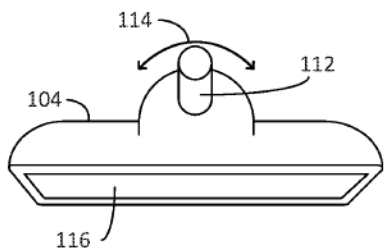


Fig.1B

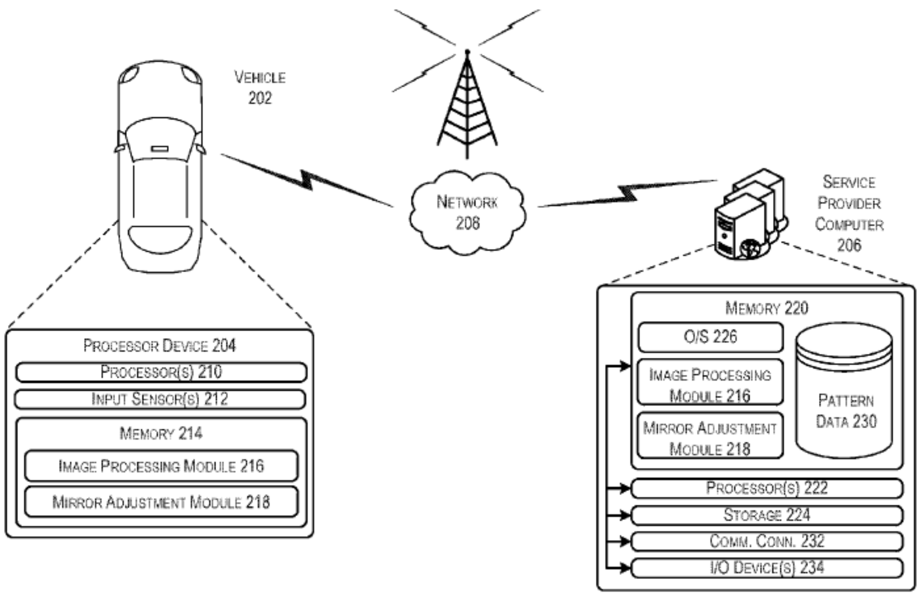


FIG. 2

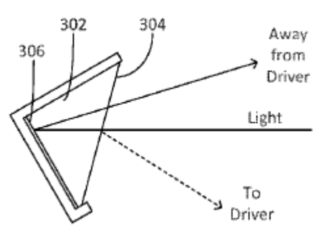


FIG. 3A

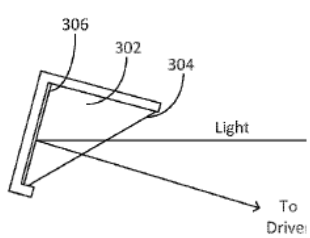


FIG. 3B

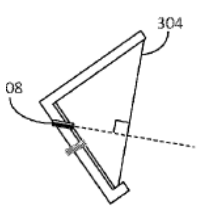


FIG. 3C

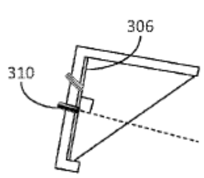


FIG. 3D

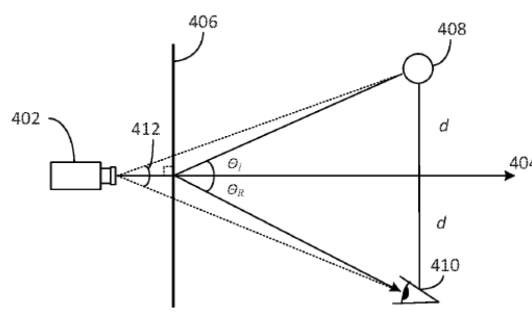


Fig.4

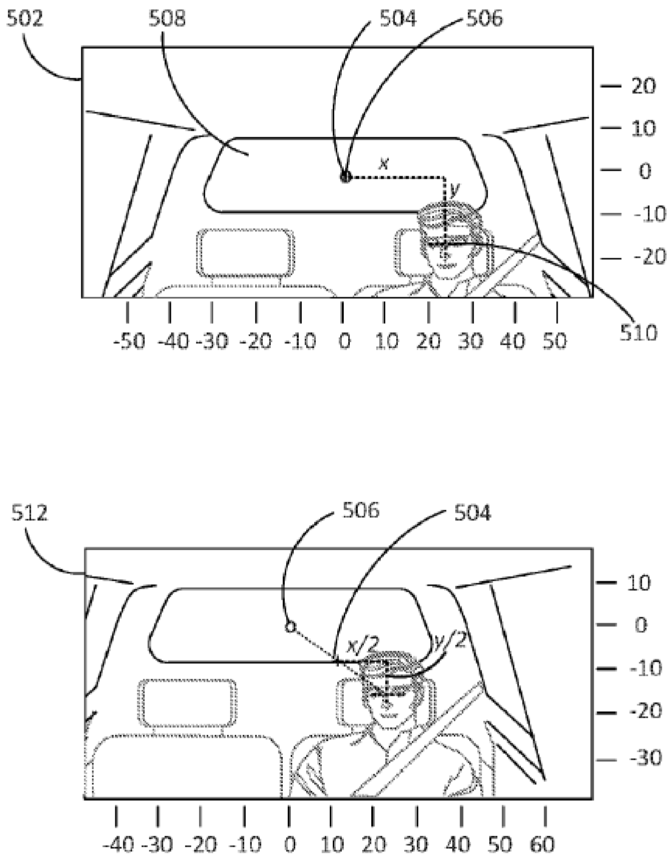


Fig.5

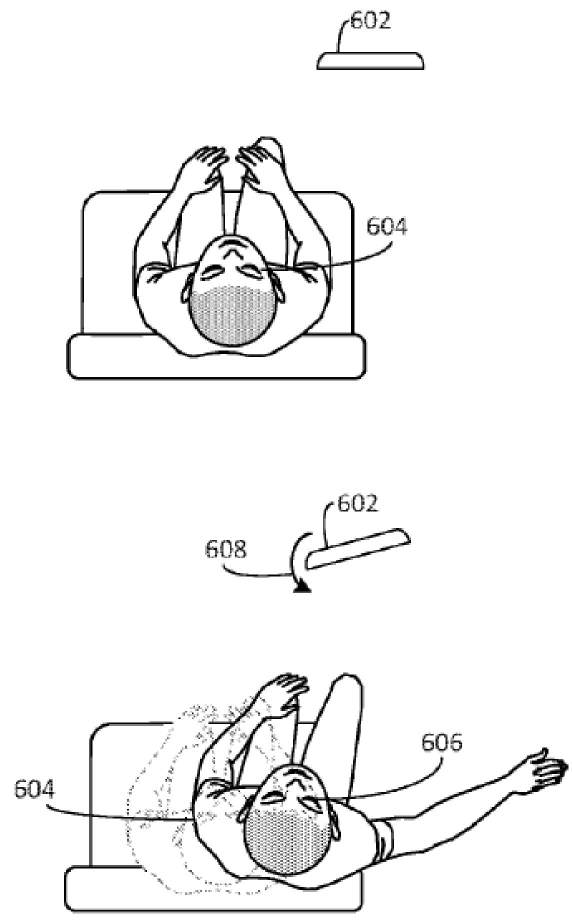


Fig.6

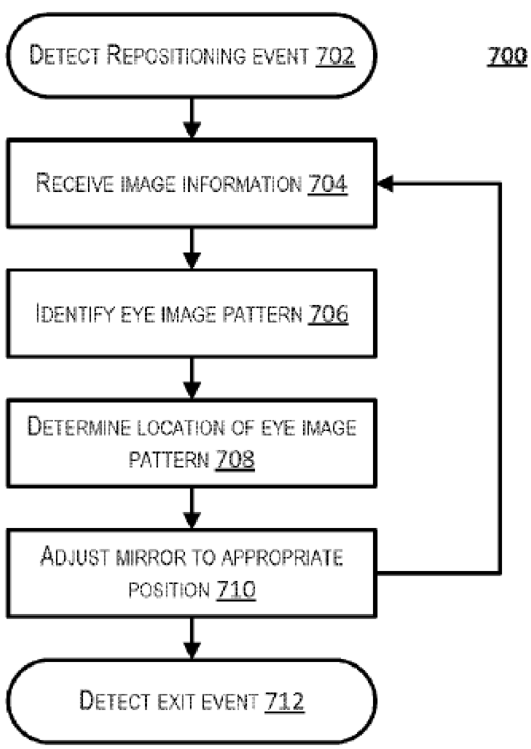


Fig.7

Option B

Xue Hong is an R & D scientist working in the field of Polyethylene production. Hong had come across the problem of Poppet Valves used in hyper compressors, which are not reliable due to the wear of the poppet valves in high-pressure polymerization units. Hong wanted to solve the problem of reliability and has come out with this invention and approaches you to file a patent. Her disclosure is follows:

High-pressure ethylene compression, especially at pressures of between 130 MPa and 350 MPa, is commonly employed in high-pressure polyethylene production. So called "hypercompressors" are used to achieve such high pressures, the fluid ethylene becoming a "supercritical fluid" at such pressures. Poppet valves are commonly used on such hypercompressors. The hypercompressor reliability is typically the largest source of unreliability in the high-pressure polymerization unit. In particular, the poppet valve life is one of the largest sources of unreliability of the hypercompressor. This unreliability is mainly due to wear of the poppet valves.

Furthermore, and perhaps leading to such high unreliability, hypercompressor valve poppets often do not open and close during operation as desired. The forces that are created by the supercritical fluid flow through the valve act upon the poppet during operation, which causes the poppet to behave undesirably. The force, which causes the undesirable behavior, is an axial force created by a local low-pressure zone between the seat and poppet sealing surfaces. Increasing the flow rate also increases the closing force on the poppet so that the poppet does not move to the open position with increasing flow rate.

What is needed is a means by which high pressure polymerization processes can be run more reliably with less down time and less expense in replacing poppet valves in the hypercompressor. The inventors have solved this and other problems in the design of a novel seat, preferably a replaceable seat, with a radial restriction between the poppet and the seat, which is incorporated into a typical poppet valve design. The radial restriction is a novel concept to enable the poppet position during operation to be a function of the fluid flow conditions through the valve. This solves the problem of unwanted poppet behavior due to the forces created by fluid flow between the poppet and seat sealing surfaces. The replaceable feature enables the introduction of the seat with the novel radial restriction profile in existing valve bodies, and simplified replacement of the valve.

DETAILED DESCRIPTION OF THE INVENTION

An aspect of the invention is directed to a valve, more particularly a valve for use in high-pressure devices such as a compressor, and most particularly a hypercompressor valve for use in a high-pressure polymerization reactor containing supercritical fluids. The valve is a poppet valve in one embodiment and comprises a seat that creates a flow restriction of the operating fluid at and around the outside diameter of the head of the poppet as the fluid flows adjacent to the seat, and in a particular embodiment, between the seat and the poppet. Each of the seat and poppet has at least one corresponding mating surface that creates a seal in the closed configuration of the valve. In the open configuration--any point between completely closed and up to and including fully open--there is at least one surface on each of the seat and poppet whose profile creates the flow restriction, altering the velocity of fluid as it passes through the open valve. This flow restriction, axisymmetric flow restriction zone in one embodiment, is slightly more of a restriction than the restriction created between the poppet head and inside valve surface alone. The radial flow restriction creates a local high fluid velocity zone, which creates a greater difference in pressure between the upstream and downstream sides of the poppet. In addition, the local low-pressure zone that normally exists between the poppet and inside valve surface (without the added seat) is disrupted. Since the restriction is radial (at the outside diameter of the poppet), the fluid forces on the poppet from this restriction are radially balanced.

More particularly, described herein is a valve comprising a valve body having a poppet valve chamber; a seat having a seat inside surface, the seat located within the poppet valve chamber; and a poppet having a poppet head surface, the poppet being located within the poppet valve chamber and capable of making contact with at least a portion of the seat inside surface; and further comprising a velocity increasing means to provide a local high fluid velocity zone at least adjacent to the poppet sealing surface and the seat sealing surface. In one embodiment, the velocity increasing means comprises a "flow restriction zone" defined by the profile of the seat inside surface and the poppet head surface. These surfaces can take on any profile, the profile only limited in design in its capacity to create the flow restriction zone: a local high fluid velocity zone created by the movement of fluid through the flow restriction. In the closed position of the valve, the poppet head surface and seat inside surface create a seal that stops fluid flow there through.

Advantageously, the geometry that creates the flow restriction--the profile of the poppet head surface relative to the profile of the seat inside surface--is such that it is a variable restriction; in one embodiment the movement of the poppet itself as it opens and closes along the axis of symmetry changes the velocity within the flow restriction. The profile of the radial restriction that is formed adjacent to the seat is such that the amount of restriction changes as the poppet moves in the range of poppet travel between the closed position and the fully open position. Thus, the poppet position is dependent upon the flow rate of fluid through the valve and the amount of restriction between the poppet head and seat. The profile of the radial restriction can be manipulated to achieve the desired poppet position at a given fluid flow rate. In particular, the radial restriction is manipulated by adjusting the geometry, (angle and/or surface area and/or diameter) of the seat inside surface and poppet head surface.

In certain embodiments, the seat is removable. A replaceable seat is introduced to the valve to enable the addition or adjustment of the radial restriction without having to purchase new valve bodies. By "replaceable," what is meant is that the seat is not affixed within the valve, as by welding, bolting, adhesive bonding or any other means. The replaceable seat is novel in that it possesses a conical sealing surface that seals against the inner valve body surface, which distributes the stress in the valve body resulting from the contact force in a way to minimize stress concentration and enhance fatigue life. An additional feature of the replaceable seat is that refurbishment of the whole valve for reuse is simplified by replacing the seat (the wear item) instead of machining a deeper seat profile in the valve body. This feature greatly increases the number of times a valve body can be reused. Thus, the replaceable seat design decreases maintenance cost.

One embodiment of the invention will be described with respect to the FIGS. 1-5. First referring to FIG. 1 is a valve body 101 having at least one poppet valve chamber 103. Contained and seated within the poppet valve chamber 103 is a seat 109, preferably located and seated against valve inside surface 105. In one embodiment, the valve inside surface 105 is conical in shape, mating with the outer-seat surface 137 and creating a fluid seal when the poppet is in the closed position, as in FIG. 2c. In a preferred embodiment, the seat 109 is replaceable.

For ease of reference, the poppet valve chamber 103 is referenced as possessing an axis 107, which forms an axis of symmetry through the cylindrically-shaped chamber 103. The poppet is located coaxially within the poppet valve chamber 103. The seat 109 comprises a seat inside surface 151 (FIG. 4). The seat inside surface is preferably axisymmetric about the seat, and in one embodiment comprises at least one seat sealing surface 111 and at least one flow restriction surface 113. In a preferred embodiment, there is only one seat sealing surface 111 and one flow restriction surface 113. In one embodiment, the seat 109 comprises a seat sealing surface 111 and a flow restriction surface 113 (FIGS. 1 and 4) that are distinct from one another, meaning that they each may have a different angle or shape relative to axis 107 and/or one another. At least one surface, the seat sealing surface 111 in a preferred embodiment, forms a fluid seal with the poppet when the poppet is in the closed position as in FIG. 2c.

The poppet 115 comprises a poppet head surface 153, preferably axisymmetric about the poppet. The poppet head surface comprises a poppet sealing surface 119 and a second poppet surface 149 in a particular embodiment. In one embodiment, the poppet 115 comprises a poppet sealing surface 119 and a second poppet surface 149 that are distinct from one another, meaning that they each may have a different angle or shape relative to axis 107 (FIG. 2) and/or each other. In one embodiment, the seat sealing surface 111 faces the poppet 115 having a poppet sealing surface 119. In one embodiment, the poppet sealing surface 119 forms a fluid seal with the seat, preferably with the seat sealing surface 111, when the poppet is in the closed position as in FIG. 2c.

The poppet sealing surface 119 makes at least partial contact, discontinuous around the circumference in one embodiment, and continuous contact in another embodiment, with at least the seat sealing surface 111 such that when the valve is in a closed position a poppet-seat interface 143 (FIG. 2c) is created. Upon opening (the poppet travels upward or away from orifice 135), a flow restriction zone 121 is created generally between the seat inside surface 151 and the poppet head surface 153. In the embodiment in FIGS. 1-5, the restriction is created by the intersection of poppet sealing surface 119 and the second poppet surface 149, those surfaces being at distinct angles from one another relative to the axis 107, thus creating a "pinch" point or narrowed zone between the seat and poppet. Fluid rushing past the poppet is then "pinched", which generates a high fluid velocity zone. This high fluid velocity zone can be manipulated by the geometry (cross-sectional shape) of the flow restriction zone, which in turn is adjusted by the design of at least the flow restriction surface 113, the poppet sealing surface 119, or the second poppet surface 149, or a combination of each.

The valve and its components can be made using any material (e.g., metal, alloy, ceramic, combination thereof) that can withstand the working pressures of a hypercompressor. The components of the valve assembly are made from high strength steel or ceramic in one embodiment, preferably high strength steel. In certain embodiments, the valve body is made of high strength steel, and the seat, compression sleeve and poppet are made of ceramic or high strength steel, preferably high strength steel.

Referring still to the Figures, fluid, supercritical fluid in one embodiment, flows down a valve channel as in flow A and into the valve chamber 103 through orifice 135 as in flow C. The flow of fluid then enters the poppet valve chamber 103 at the upstream end 125 (FIGS. 1 and 2b) of the poppet valve chamber 103, and through the chamber when the valve is in the open position (as in FIG. 2b) and out of the poppet valve chamber 103 as fluid flow B out the downstream end 127 of the poppet valve chamber. The seat 109 is generally an axisymmetric shape that fits at the upstream end 125 of poppet valve chamber 103 of a valve body 101. The seat 109 has an outer-seat surface 137 in one embodiment that contacts the mating valve inside surface 105 at the upstream end 125 of the poppet valve chamber 103. The outer-seat surface 137 (FIG. 3) may be lapped to the inside valve surface 105 to enhance a metal to metal seal at the valve-seat interface 147 (FIG. 5). The poppet 115 located downstream of the seat 109 has a poppet head 123 that acts against the replaceable seat 109 to create the poppet-seat interface 143 (FIG. 2c). In one embodiment, the seat 109 has a seat sealing surface 111 that mates against at least the poppet sealing surface 119 to form a poppet-seat interface 143 when the poppet valve is in the closed position (FIG. 2c). These surfaces 111 and 119, creating the poppet-seat interface 143 when the poppet valve is in the closed position, form an angle .beta. (FIG. 2) with respect to the axis 107 within the range of from 20 to 90.degree. in one embodiment, and from 25 to 85.degree. in another embodiment, and from 30 to 80.degree. to the axis in one embodiment, and from 35 to 75.degree. in another embodiment, and from 45 to 75.degree. in yet another embodiment, wherein any upper limit can be combined with any lower limit to create a desirable range.

Further, a valve-seat interface 147 (FIG. 5) is located at the outer-seat surface 137 contacting the valve inside surface 105, the valve-seat interface 147 also being at an angle .beta.', wherein .beta.' may be the same or different angle from .beta.. The angle .beta.' with respect to the axis 107 is within the range of from 20 to 90.degree. in one embodiment, and from 20 to 85.degree. in another embodiment, and from 30 to 80.degree. to the axis in one embodiment, and from 35 to 75.degree. in another embodiment, and from 45 to 75.degree. in yet another embodiment. The valve-seat interface 147 serves as a sealing interface to prevent higher pressure fluid located at the downstream end of the valve and in the chamber from communicating to the upstream end of the valve 125 when the valve is in the closed position. The force created from the differential pressure downstream and upstream of the valve while the valve is in the closed position acts against the seat 109 which reinforces the fluid sealing properties of the valve-seat interface 147. This force creates stress in the valve body 101. This stress is distributed from the valve surface 105 into the valve body 101. The valve-seat interface 147 can be optimized by adjustments in the angle .beta.' of the conical inside valve surface 105 and the surface 137 thereby preventing undesirable stress concentrations within the valve body 101 in the vicinity of the seat.

The seat 109 is held in position at least in part by a compression sleeve 117 (FIGS. 1, 3 and 5) that contacts a shoulder 139 (FIG. 4) on the downstream end of the seat 109. The upstream end of the compression sleeve 117 contacts this shoulder 139 adjacent to the outside diameter of the seat 109. The compression force of the compression sleeve 117 is achieved, in one embodiment, by an axial interference fit within the poppet valve chamber 103, thereby achieving a force acting parallel to axis 107 to hold the seat in position.

As mentioned, there is a flow restriction zone 121 created between the poppet head 123 and the seat 109 at least adjacent to the surface 113 in one embodiment, and also adjacent to second poppet surface 149 in another embodiment. This flow restriction zone 121 is, in one aspect of the invention, advantageous to the proper function of the poppet 115 performance. The flow restriction zone 121 is such that the greatest restriction of fluid through the valve (smallest cross section area of flow) occurs at this flow restriction zone 121, between at least the flow restriction surface 113 and the poppet sealing surface 119 during most of the poppet range of travel. In a particular embodiment, the flow restriction zone 121 is also adjacent to second poppet surface 149 (FIG. 2a). A flow restriction surface 113, which is substantially conical in one embodiment of the seat 109, defines the outer profile of flow restriction zone 121 while the edge (or edge feature) defined by the intersection of poppet sealing surface 119 and second poppet surface 149 of the poppet head 123 defines in part the inner profile of flow restriction zone 121. The shape of the flow restriction surface 113 is such that as the poppet 115 travels to the fully open position (FIG. 2a), the open area increases and, thus, the restriction of the radial flow restriction zone 121 is reduced. The opposite occurs as the poppet 115 travels to the fully closed position (FIG. 2c). The cutaway view of one embodiment of the valve in FIG. 2b highlights how the fluid flow C channels into the valve chamber 103 through orifice 135 and around the poppet head 123 and out through the downstream end 127.

Note that for simplicity of illustration, the valve body as shown (e.g., FIG. 5) in the illustrated embodiment is without any form or material, which would encompass or surround the full length of the compression sleeve 117. The valve body 101 would, in a preferable embodiment, extend outward to encompass at least the full length of the compression sleeve 117. Thus, the inside wall of the poppet valve chamber 103 extends, in a preferred embodiment, the length of the compression sleeve 117, intimately contacting the outer sleeve surface 133 (FIG. 3), while the inside sleeve surface 131 makes up the full length of the poppet valve chamber 103.

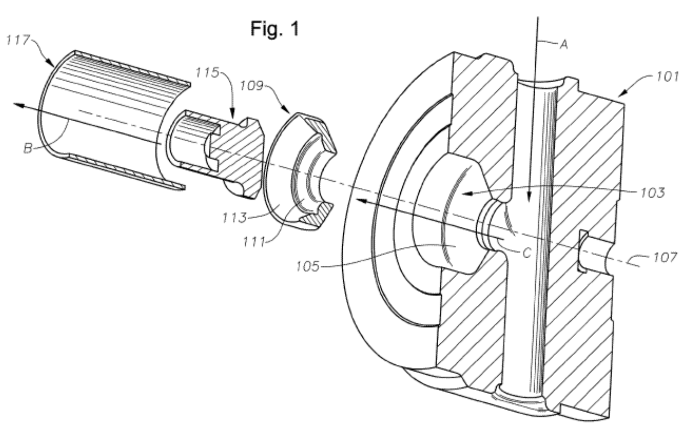
In certain embodiments, the seat 109 possesses a pressure balancing means 141, shown more fully in one embodiment in FIG. 4, to communicate fluid between at least the outside seat surface 145 of the seat 109 to the inside surface made up at least by seat sealing surface 111 and flow restriction surface 113, and in one embodiment the groove 129 there between, of the seat 109 to prevent unwanted differential pressure forces acting upon the seat. The pressure balancing means 141 may be in the form of a groove in one embodiment, or a hole running through the thickness of seat 109 in another embodiment, or other shape.

Generally, when a normally fluid inert hydrocarbon is used to provide the reaction medium, the polymerization reaction may be carried out at lower pressures than required when the polymerization medium consists essentially of a fluidized monomer, ethylene in a particular embodiment. When present, inert hydrocarbon compounds, which may be used as a polymerization diluent to provide the polymerization medium, include aliphatic, cycloaliphatic, and aromatic hydrocarbons having from six to twenty carbon atoms.

In a preferable embodiment, the seat is removable from the valve body, meaning that it is not permanently fixed to the valve body but can be removed and/or replaced by a new seat or a refurbished seat. The only criteria is that conical surface 137 that creates the sealing interface 147 should be nearly the same or identical to the seat being replaced for the same valve body, as the sealing interface will be determined at least in part by the shape of the inside valve surface 105 that will typically remain fixed.

In a particular embodiment, the flow restriction zone has a flow path cross sectional area that is less than the flow path cross sectional area between the poppet sealing surface and the seat sealing surface for a given position of the poppet in an open position. This occurs in one embodiment when the poppet head surface is discontinuous such that there is an edge or "pinch point" created by the poppet head, this pinch point, and the facing seat inside surface, creates the flow restriction zone. In a more particular embodiment, the seat inside surface comprises two discontinuous surfaces--a seat sealing surface and a flow restriction surface, the flow restriction surface participating in the creation of the flow restriction zone as the poppet travels to the fully open position. In yet a more particular embodiment, the geometry of the poppet head (which can comprise one surface, or two or more surfaces at different angles from one another) and the seat inside surface (which can comprise one surface, or two or more surfaces at different angles from one another) is such that the fluid-velocity enhancement of the flow restriction zone is stronger when the poppet is near the closed position, and small or negligible when the poppet is in the fully open position.

FIGURE- Option B



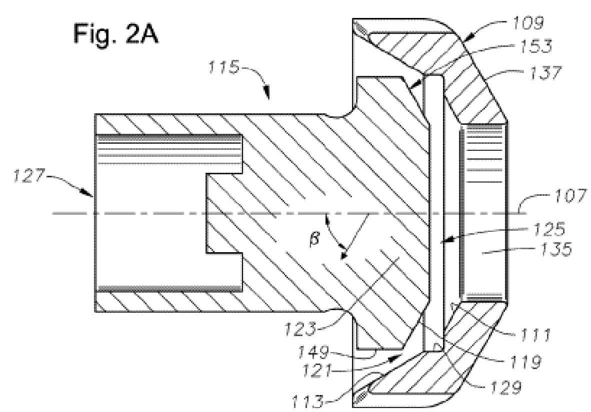


Fig. 2B

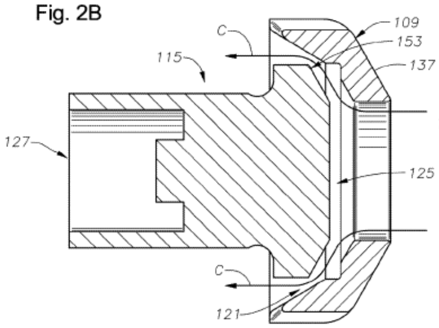


Fig. 2C

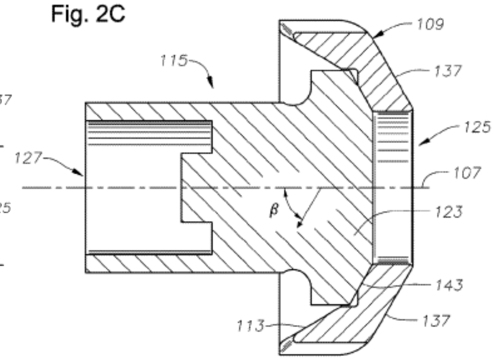


Fig. 4

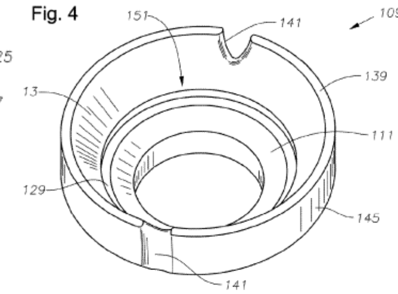
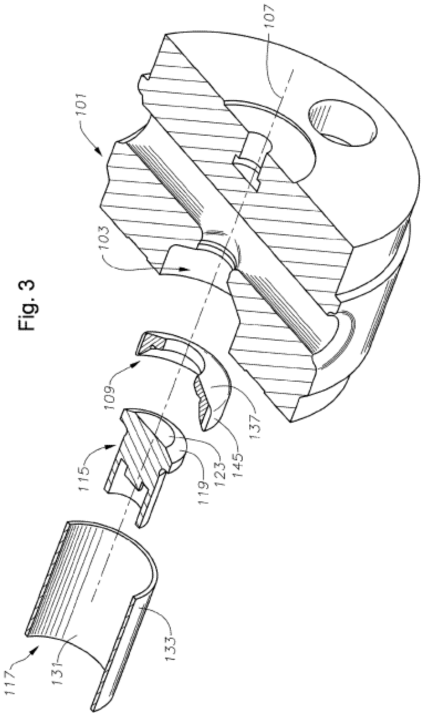


Fig. 3



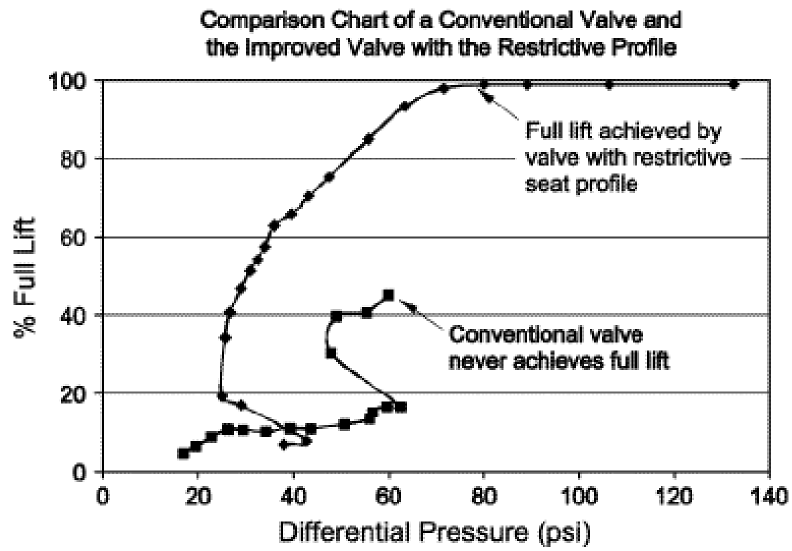
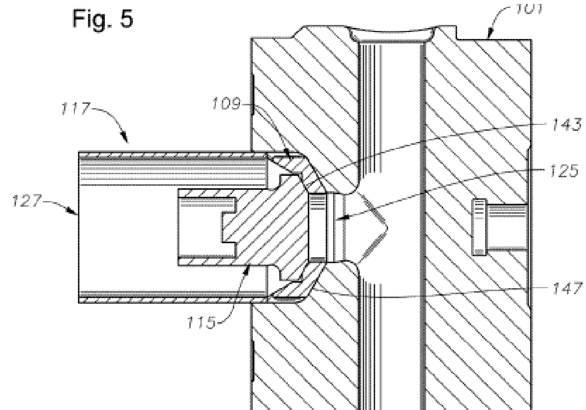


Fig. 6

Fig. 5



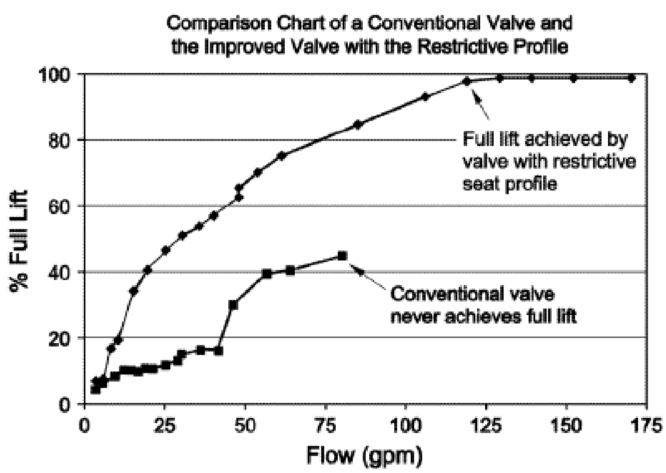


Fig. 7