

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*

PIVOTABLE ACTUATOR MOUNTING STUD

Background

[0001] The present invention relates to embodiments of an apparatus to mount an actuator assembly to an air disc brake caliper for an air brake equipped vehicle.

[0002] Air disc brakes convert air pressure into braking force. When the driver applies the vehicle brake pedal, air enters the service brake chamber of an actuator assembly through a supply port. The pressure expands a diaphragm, moving a pressure plate and a pushrod of the actuator assembly forward. When the actuator assembly is mounted to an air disc brake assembly, the pushrod acts against an internal lever of the air disc brake, resulting in movement of the inner brake pad toward the rotor. Further movement of the bridge inside the air disc brake forces the caliper away from the rotor, pulling the outer brake pad into the rotor. Proper alignment of the actuator assembly with respect to the caliper body of the air disc brake is necessary to ensure that the push rod correctly acts on the lever. A very precise angle may need to be maintained between the axis of the caliper and the axis of the actuator when mounting.

[0003] Some actuator assemblies have at least one fixed bolt for attachment to the caliper. A special tool is used to affix a nut to the bolt when the actuator is set flush with a face of the caliper. In some configurations, the tool is unable to surround the nut for proper installation due to the angle of insertion of the bolt into the caliper and interference with the body of the caliper. If the actuator is not flush with the caliper, there may be reduced function or loss of function of the air disc brake assembly. Therefore, there is a need for an

improved method and apparatus for mounting an actuator assembly to a caliper in a braking assembly.

Summary

[0004] Various embodiments of an actuator assembly comprise an actuator housing having a service portion and at least one mounting stud attached to the service portion. The at least one mounting stud is pivotable with respect to the actuator housing.

[0005] In accordance with another aspect, various braking assemblies for an air disc brake comprise an actuator assembly having a service portion; at least one mounting stud attached to the service portion, and an air disc brake caliper having a bore for receiving the at least one mounting stud. The mounting stud is pivotable with respect to the service portion for installation on the air disc brake caliper.

Brief Description of the Drawings

[0006] In the accompanying drawings which are incorporated in and constitute a part of the specification, embodiments of the invention are illustrated, which, together with a general description of the invention given above, and the detailed description given below, serve to exemplify the embodiments of this invention.

[0007] **FIGURE 1** illustrates a cross section of a prior art actuator assembly and air disc brake assembly.

[0008] **FIGURE 2** illustrates the actuator assembly having two pivotable mounting studs as installed on the actuator assembly.

[0009] **FIGURE 3** illustrates a cross section of the actuator assembly of Figure 2 showing one of the pivotable mounting studs.

[0010] **FIGURE 4** illustrates the threaded portion and receiving portion of a pivotable mounting stud.

[0011] **FIGURE 5** illustrates a cross section of the actuator assembly as mounted to an air disc brake assembly according to one example of the present invention.

Detailed Description

[0012] **FIGURE 1** illustrates a cross section of an actuator assembly **12** as mounted on an air disc brake caliper **16** as part of a prior art brake assembly **10**. The actuator assembly **12** may be an Endurasure™ spring brake chamber, available from Bendix Spicer Foundation Brake LLC of Elyria Ohio. The caliper **16** may be part of an ADB22X™ air disc brake, also available from Bendix Spicer Foundation Brake LLC. The actuator assembly **12** includes at least one fixed fastener **14**. The fastener **14** may be welded or otherwise permanently affixed to the housing of the actuator assembly **12**. The fastener **14** is generally a threaded bolt affixed parallel to the central axis of the actuator assembly **12**.

[0013] An angle, **theta**, is established so that the push rod (not shown) of the actuator assembly **12** acts upon a lever **15** inside the air disc brake caliper **16**. A face **13** of the caliper **16** is generally at the angle **theta** with respect to the axis of the brake assembly **10** to accept the actuator assembly **12**. The angle **theta** is typically between zero degrees and twelve degrees to provide clearance for other wheel end components. The fastener **14** of the actuator assembly **12** is positioned through a bore **17** that exits at the face **13** of the caliper

16. The bore **17** is drilled into the caliper **16** at the angle required for the proper mounting of the actuator assembly **12** and normal to the face **13** of the caliper **16**. A nut **18** is required to be threaded onto the fastener **14** to hold the actuator assembly **12** in place on the caliper **16**. In general, a tool **19** is used to fasten the nut **18** to the fastener **14**. The tool **19** may not fit properly over the fastener **14** and interfere with the caliper **16** due to the angle of the bore **17**.

[0014] **FIGURE 2** illustrates an actuator assembly **21** having two mounting studs **22a, 22b** according to an example of this invention. The actuator assembly **21** has a service side housing **23** and a parking side housing **25**. Some actuators may only have a service side housing. The two mounting studs **22a, 22b** are affixed to the service side housing **23**.

[0015] **FIGURE 3** illustrates a cross section of the actuator assembly **21** showing mounting stud **22a**. Mounting stud **22a** comprises a threaded portion **26** and a receiving portion **24**. The receiving portion **24** is welded or otherwise affixed to the interior of the service side housing **23** adjacent to an aperture **29**. The threaded portion **26** is placed through the aperture **29** into the receiving portion **24**. A snap ring **36** is placed over the head of the threaded portion **26** so that it remains in the receiving portion **24**. The structure of the threaded portion **26** and receiving portion **24** are such that the threaded portion **26** can pivot in one plane with respect to the receiving portion **24**.

[0016] Therefore, an actuator assembly comprises an actuator housing having a service portion and at least one mounting stud attached to the service portion. The at least one mounting stud is pivotable with respect to the actuator housing.

[0017] **FIGURE 4** illustrates the threaded portion **26** and receiving portion **24** as two separate pieces. The threaded portion **26** includes a ball portion **30** at one end. In one

example, the threaded portion **26** is about 5/8" diameter. The ball portion **30** is also about 5/8" diameter. The ball portion **30** may have flats **32** to restrict the rotation of the threaded portion **26** once it is installed in the receiving portion **24**.

[0018] The receiving portion **24** includes a socket **34**. The socket **34** may also have flat portion **35** to mate with the flats **32** of the threaded portion **26**. In this manner, the threaded portion **26** will not rotate but rather be able to pivot in a single plane once installed. The angle of the pivot is controlled by the geometry of the mounting stud with respect to the features of the actuator assembly.

[0019] Alternatively, a pin can be placed axially through a hole in the threaded portion and the receiving portion to hold threaded portion in the receiving portion while allowing the threaded portion to pivot.

[0020] The materials of the receiving portion **24** and threaded portion **26** are metallic, such as stainless steel. The materials can be the same in order to facilitate movement between the receiving portion **24** and threaded portion **26**.

[0021] **FIGURE 5** illustrates a brake assembly **20** having the actuator assembly **21** of the present invention. The actuator assembly **21** mates with a caliper **27** of an air disc brake to form the brake assembly **20**.

[0022] The actuator assembly **21** includes mounting stud **22a**. The threaded portion **26** of mounting stud **22a** is positioned through a bore **28** in the caliper **27**. The angle at which the bore **28** is drilled is no longer required to be normal to the angled mounting face of the caliper **27**. The bore **28** is drilled parallel to the axis of the caliper **27**. The tool **19** fits over the threaded portion **26** without interfering with the caliper **27** in order to fasten the nut

18 onto the threaded portion **26**. As the nut **18** is threaded, the actuator assembly **21** is pulled flush to the face of the caliper **27** at the required angle **theta**.

[0023] With the actuator assembly **21** having the pivotable mounting studs **22a**, **22b**, nearly any angle **theta** between 0 degrees and 45 degrees can be contemplated. One application may include angles between 0 and 20 degrees. The restrictions are based on the angled mounting face of the caliper **27** and the envelope in which the entire brake assembly **20** must fit in on a vehicle.

[0024] Therefore, various braking assemblies for an air disc brake comprise an actuator assembly having a service portion; at least one mounting stud attached to the service portion, and an air disc brake caliper having a bore for receiving the at least one mounting stud. The mounting stud is pivotable with respect to the service portion for installation on the air disc brake caliper.

[0025] A brake assembly having the features of the present invention is easier to assembly since there is more space to maneuver the tool to attach the nut. Additional envelope space is provided in the caliper for inner mechanisms since the bore hole can be parallel to the caliper axis. Another advantage is that actuators with traditional non-pivoting fasteners would not fit on the calipers with the different mounting bore angle.

[0026] While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention, in its broader aspects, is not limited to the specific details,

the representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.

We claim:

1. An actuator assembly comprising:
an actuator housing having a service portion; and
at least one mounting stud attached to the service portion, wherein the at least one mounting stud is pivotable with respect to the actuator housing.
2. The actuator assembly as in claim 1, wherein the at least one mounting stud pivots in a plane parallel to an axis of the actuator housing.
3. The actuator assembly as in claim 1, wherein the at least one mounting stud is capable of pivoting between zero and about twenty degrees with respect to the actuator housing.
4. The actuator assembly as in claim 1, wherein the mounting stud comprises a threaded portion and a receiving portion, the threaded portion pivotable with respect to the receiving portion.
5. The actuator assembly as in claim 4, wherein the threaded portion includes a rounded head for insertion into the receiving portion.
6. The actuator assembly as in claim 4, further comprising a snap ring for holding the threaded portion in the receiving portion.
7. The actuator assembly as in claim 4, further comprising a pin for holding the threaded portion in the receiving portion.
8. A braking assembly for an air disc brake equipped vehicle comprising:
an actuator assembly having a service portion;

at least one mounting stud attached to the service portion, the mounting stud being pivotable with respect to the service portion; and

an air disc brake caliper having a bore for receiving the at least one mounting stud.

9. The braking assembly as in claim 8, wherein the bore is parallel to the centerline of the air disc brake caliper.

10. The braking assembly as in claim 8, wherein the mating of the actuator assembly with the air disc brake caliper forms an air tight seal.

11. The braking assembly as in claim 8, wherein the actuator assembly is mounted between a zero degree and about twenty degree angle to the brake caliper.

12. The braking assembly as in claim 8, wherein the at least one mounting stud includes a threaded portion and a receiving portion.

13. The braking assembly as in claim 12, wherein the threaded portion of the mounting stud mates with a nut through a bore in an associated air disc brake caliper.

14. The braking assembly as in claim 13, wherein the air disc brake caliper is sized to receive a tool to install the nut on the threaded portion wherein the tool does not interfere with the caliper housing.

15. An actuator assembly comprising:

an actuator housing having a service portion; and

at least one mounting stud attached to the service portion, the mounting stud having a means to pivot with respect to the actuator housing.

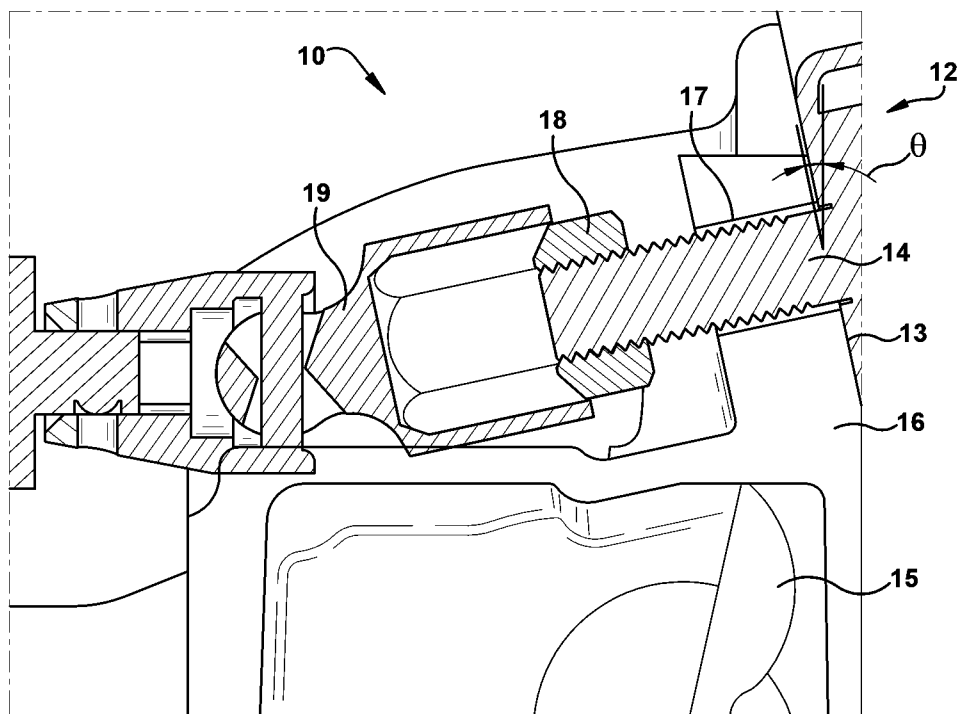


Fig. 1
Prior Art

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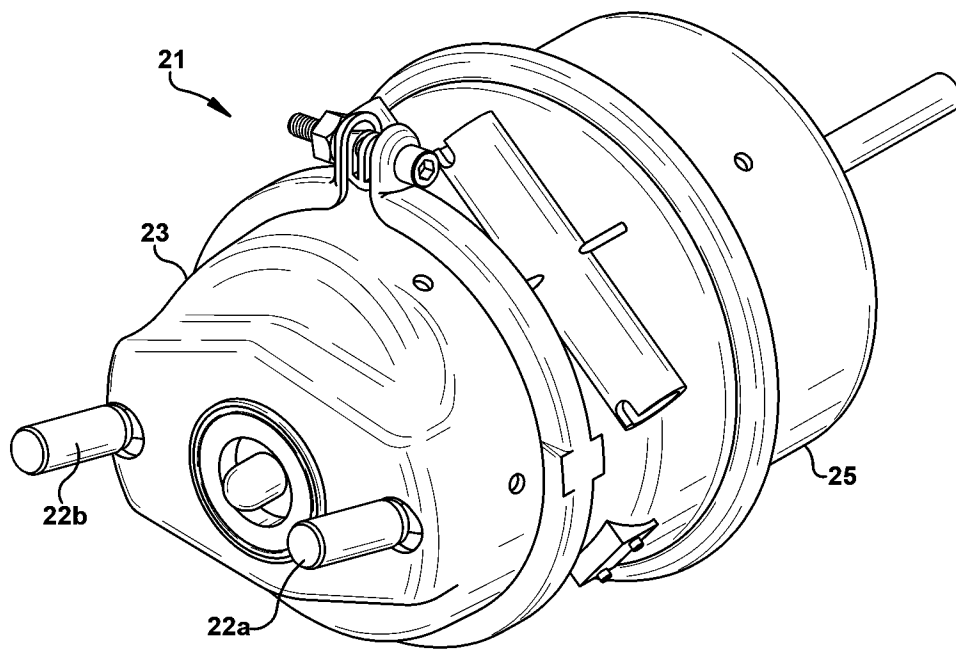
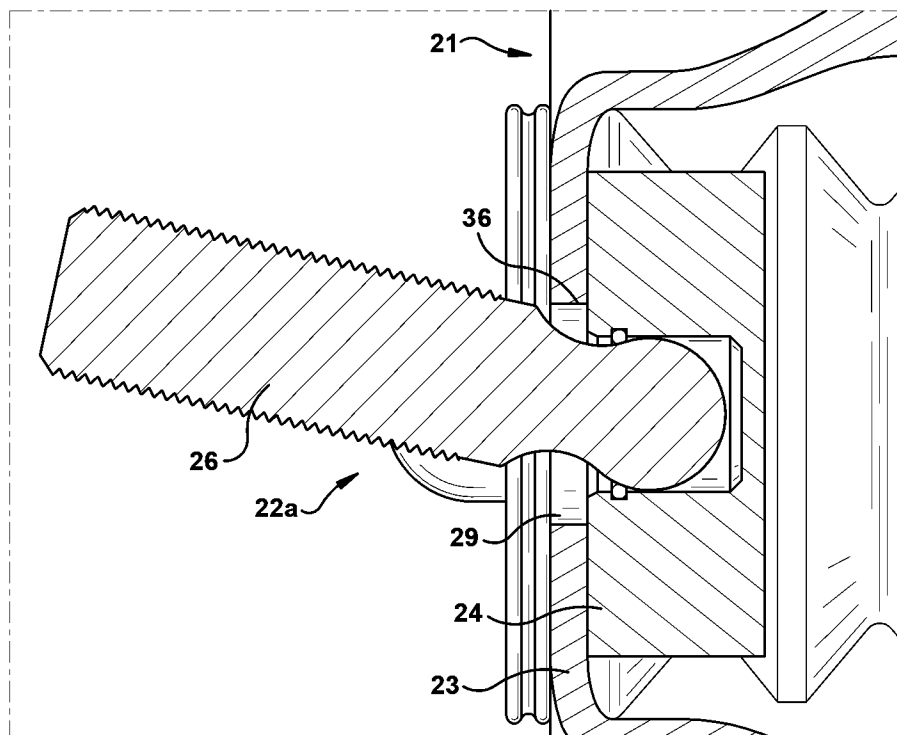
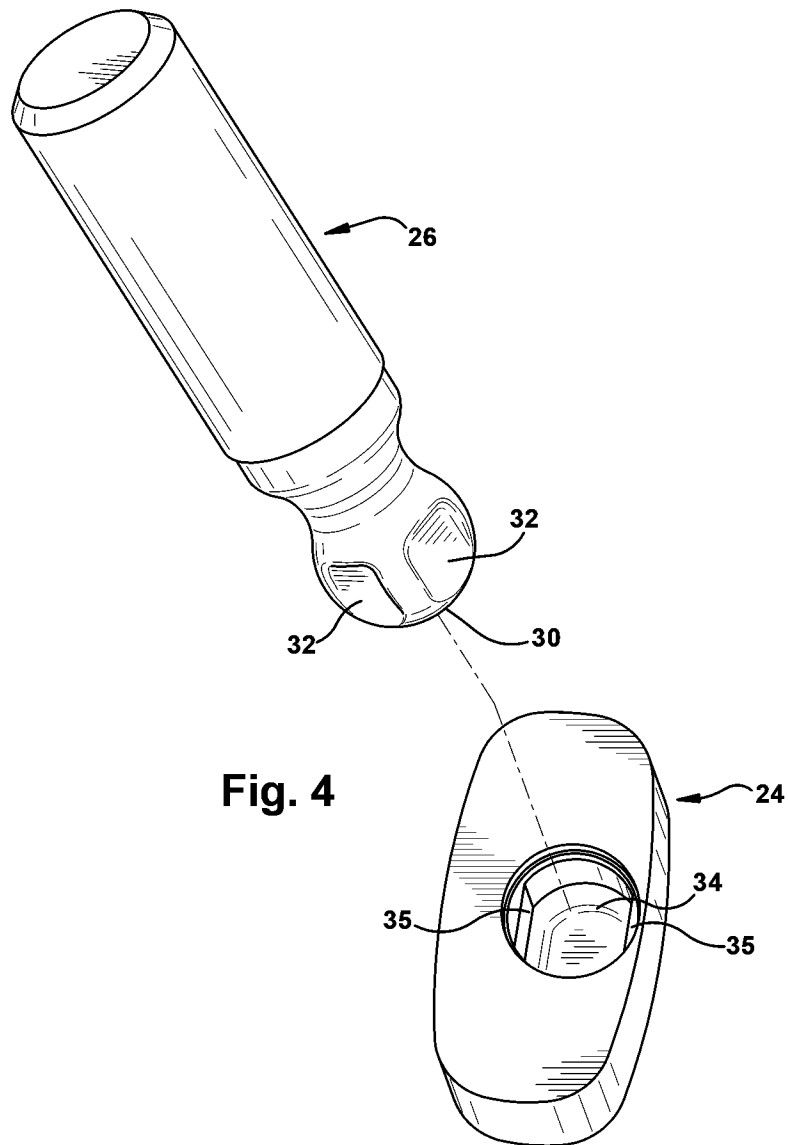


Fig. 2

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**Fig. 3**

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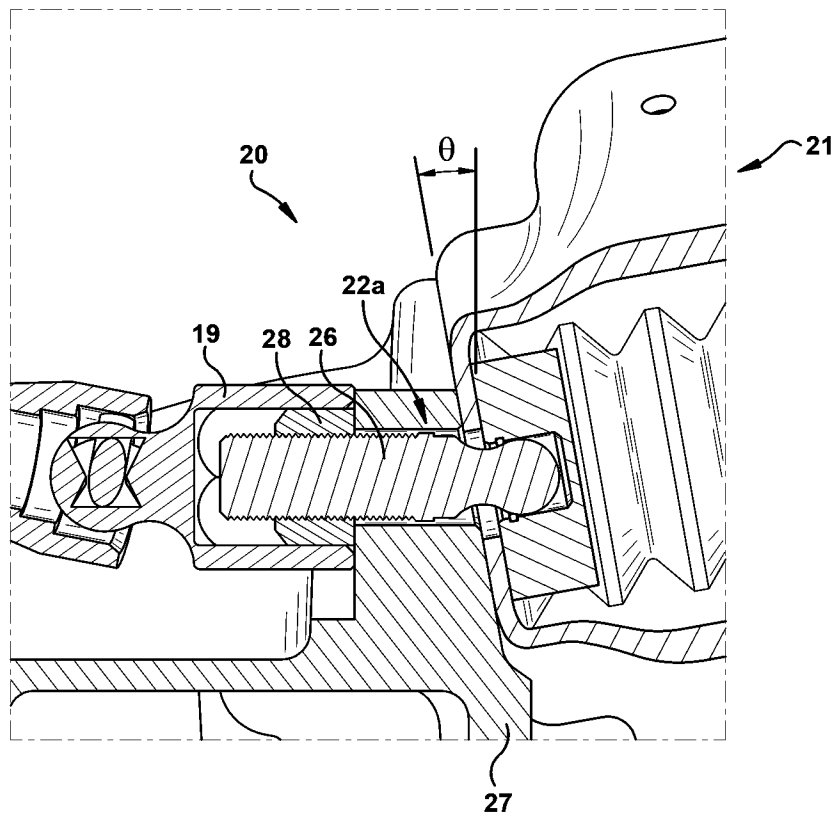


Fig. 5

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/051382

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60T17/08 F16D65/00 F16D65/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60T F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2005 018038 A1 (KNORR BREMSE SYSTEME [DE]) 26 October 2006 (2006-10-26) paragraph [0022]; claim 2; figures 1,2 -----	1,3,15
A	WO 2018/183142 A1 (BENDIX SPICER FOUNDATION BRAKE [US]) 4 October 2018 (2018-10-04) the whole document -----	1-15
A	US 2008/047787 A1 (SCHECKELHOFF KENNETH E [US] ET AL) 28 February 2008 (2008-02-28) the whole document -----	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/051382

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