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(72) Inventor; and
(71) Applicant : **BIGGS, Robert** [US/US]; 4137 Manor House Drive, Marietta, Georgia 30062 (US).

(74) Agent: **REARDON, George**; 3356 Station Court, Lawrenceville, Georgia 30044 (US).

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(54) Title: MODULAR BRAKE CALIPER

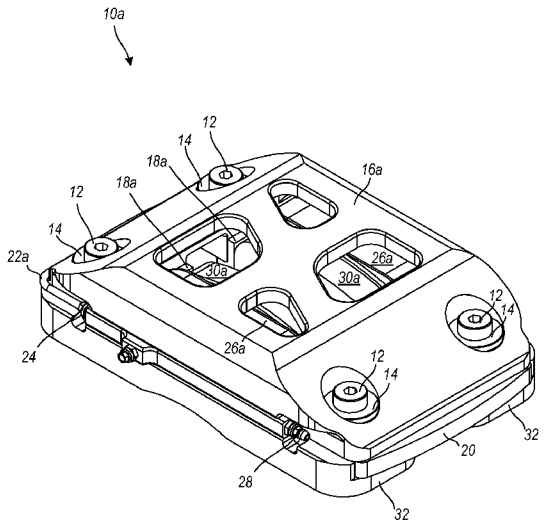

FIG. 1

(57) Abstract: In various exemplary embodiments, the technology described herein provides a modular hydraulic brake caliper for use on automobile vehicles and motorcycles. A modular hydraulic disc brake caliper housing to house a piston block assembly includes one or more top bridge configured to stiffen and strengthen a disc brake caliper. The housing includes one or more caliper body configured to stiffen and strengthen a modular hydraulic brake caliper assembly, to securely receive the top bridge and to restrain a piston block assembly, and is configured with or without the use of an integral piston. The housing can include at least one side bridge configured to stiffen and strengthen the modular hydraulic brake caliper assembly. The housing can include at least one end bridge configured to secure one side bridge to another and to the top bridge. A modular hydraulic disc brake caliper assembly, a disc brake assembly, and associated methods are disclosed.

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— *as to the identity of the inventor (Rule 4.17(i))*

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MODULAR BRAKE CALIPER

TECHNICAL FIELD

The technology described herein relates generally to disc brake systems for automobile vehicles and motorcycles. More specifically, this technology relates to a modular brake caliper.

BACKGROUND ART

In various applications, many automobile vehicles and motorcycles utilize disc brake systems. Disc brake systems have brake calipers. A brake caliper is an assembly which houses the brake pads and pistons. There is an ongoing challenge to maintain the integrity of brake calipers. By way of example, many brake calipers known in the art are mono-block assemblies, wherein the caliper body and piston bores are machined from one original piece. Maintaining strength, stiffness, and performance of such brake calipers with known methods often results in manufacturing complexity, increased cost, and complex geometry to achieve better stress optimization.

A related patent known is U.S. Patent No. 5,810,121, issued to Anger et al. on September 22, 1998. This patent discloses a modular pin mounted caliper assembly for use in a disc brake. The modular caliper assembly can be angled with one or more other modular caliper assemblies. Each caliper segment has a housing with a piston disposed in an inboard portion thereof for movement in an axial direction. A pair of flanges extends from opposite sides of the housing and is axially offset from each other enabling the connection and alignment of a plurality of segments. The resulting caliper can be used in a wide variety of vehicles despite changes in brake torque requirements. The modular caliper assembly includes a plurality of inboard and outboard brake shoe pairs. Each brake shoe has a pair of pin engaging features extending from opposite outboard ends of the brake shoe. Like the caliper segment flanges, the pin engaging features are axially offset from one another, enabling the shoes to be overlapped on common pins.

The foregoing patent and other information reflect the state of the art of which the inventor is aware and are tendered with a view toward discharging the inventor's acknowledged duty of candor in disclosing information that may be pertinent to the patentability of the

technology described herein. It is respectfully stipulated, however, that the foregoing patent and other information do not teach or render obvious, singly or when considered in combination, the inventor's claimed invention.

DISCLOSURE OF THE INVENTION

In various exemplary embodiments, the technology described herein provides a modular hydraulic brake caliper for use on automobile vehicles and motorcycles.

In one exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly with integral piston block. The caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. The caliper assembly includes at least one side bridge with an integral piston block configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. The caliper assembly includes at least one end bridge configured to interconnect with the top bridge and side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

The caliper assembly can further include a heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the piston block and side bridge. The caliper assembly can further include a coating applied to one or more of the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. The caliper assembly can further include a means of attachment to interconnect the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly.

In another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly with integral piston block. This caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one side bridge with an integral piston block configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. This caliper assembly includes at least one caliper body configured to interconnect with the top bridge and the side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block and caliper body. This caliper assembly can include a coating applied to one or more of the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly.

In yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly with integral piston block. This caliper assembly includes at least one top bridge, configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one side bridge with an integral piston block configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic

brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block. This caliper assembly can include a coating applied to one or more of the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly.

In yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly with integral piston block. This caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one caliper body with an integral piston block configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge and at least one caliper body with an integral piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block and caliper body. This caliper assembly can include a coating applied to one or more of the at least one top bridge

and at least one caliper body with an integral piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge and at least one caliper body with an integral piston block comprising the caliper assembly.

In yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly configured without the use of an integral piston block. The caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. The caliper assembly includes at least one side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. The caliper assembly includes at least one end bridge configured to interconnect with the top bridge and side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. The caliper assembly includes at least one piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

The caliper assembly can include a heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and side bridge. The caliper assembly can include a coating applied to one or more of the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. The caliper assembly includes a means of attachment to interconnect the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly.

In still yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly configured without the use of an integral piston block. This caliper assembly includes at least one top bridge configured to stiffen and

strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. This caliper assembly includes at least one caliper body configured to interconnect with the top bridge and the side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. This caliper assembly includes at least one piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block, caliper body, and side bridge. This caliper assembly can include a coating applied to one or more of the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly.

In still yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly configured without the use of an integral piston block. This caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one caliper body configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. This caliper assembly includes at least one piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and caliper body. This caliper assembly can include a coating applied to one or more of the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly.

In still yet another exemplary embodiment, the technology described herein provides a modular hydraulic disc brake caliper assembly configured without the use of an integral piston block. This caliper assembly includes at least one top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly. This caliper assembly includes at least one side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces. This caliper assembly includes at least one piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

The material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

This caliper assembly can include a heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and side bridge. This caliper assembly can include a coating applied to one or more of the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly to prevent corrosion,

reduce heat transfer, and increase lubricity. This caliper assembly includes a means of attachment to interconnect the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly.

There has thus been outlined, rather broadly, the more important features of the technology in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional features of the technology that will be described hereinafter and which will form the subject matter of the claims appended hereto. In this respect, before explaining at least one embodiment of the technology in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The technology described herein is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the technology described herein.

Further objects and advantages of the technology described herein will be apparent from the following detailed description of a presently preferred embodiment which is illustrated schematically in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The technology described herein is illustrated with reference to the various drawings, in which like reference numbers denote like device components and/or method steps, respectively, and in which:

Figure 1 is a front perspective view of a modular hydraulic brake caliper having a split interlocking multi-piston block design with side and end bridges, according to an embodiment of the technology;

Figure 2 is an expanded front perspective view of the modular hydraulic brake caliper having a split interlocking multi-piston block design with side and end bridges depicted in Figure 2;

Figure 3 is a front perspective view of a modular hydraulic brake caliper having an interlocking multi-piston design with integral piston blocks, according to an embodiment of the technology;

Figure 4 is an expanded front perspective view of the modular hydraulic brake caliper having an interlocking multi-piston design with integral piston blocks depicted in Figure 3;

Figure 5 is a front perspective view of a modular hydraulic brake caliper having a multi-piston block with integral side bridge, according to an embodiment of the technology;

Figure 6 is an expanded front perspective view of the modular hydraulic brake caliper having a multi-piston block with integral side bridge depicted in Figure 5;

Figure 7 is a front perspective view of a modular hydraulic brake caliper having a multi-piston block with side bridge, according to an embodiment of the technology;

Figure 8 is an expanded front perspective view of the modular hydraulic brake caliper having a multi-piston block with side bridge depicted in Figure 7;

Figure 9 is a front perspective view of a modular hydraulic brake caliper having a multi-piston block with integral side bridge for a motorcycle, according to an embodiment of the technology,

Figure 10 is an expanded front perspective view of the modular hydraulic brake caliper having a multi-piston block with integral side bridge for a motorcycle depicted in Figure 9;

Figure 11 is a front perspective view of a modular hydraulic brake caliper having a single piston block configuration, according to an embodiment of the technology;

Figure 12 is an expanded front perspective view of the modular hydraulic brake caliper having a single piston block configuration depicted in Figure 11;

Figure 13 is a front perspective view of a modular hydraulic brake caliper having a twin piston block configuration, according to an embodiment of the technology;

Figure 14 is an expanded front perspective view of the modular hydraulic brake caliper having a twin piston block configuration depicted in Figure 13;

Figure 15 is a front perspective view of a modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge and end bridge, according to an embodiment of the technology;

Figure 16 is an expanded front perspective view of the modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge and end bridge depicted in Figure 15;

Figure 17 is a front perspective view of a modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge, according to an embodiment of the technology;

Figure 18 is an expanded front perspective view of the modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge depicted in Figure 17;

Figure 19 is a front perspective view of a modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge and end bridge, according to an embodiment of the technology; and

Figure 20 is an expanded front perspective view of the modular hydraulic brake caliper having an interlocking multi-piston block configuration with integral side bridge and end bridge depicted in Figure 19.

BEST MODE FOR CARRYING OUT THE INVENTION

Before describing the disclosed embodiments of this technology in detail, it is to be understood that the technology is not limited in its application to the details of the particular arrangement shown here since the technology described is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

Standard performance brake calipers are made in two halves and bolted together. To improve strength, stiffness, and performance, brake calipers are made as mono-block assemblies. For example, caliper body and piston bores are machined from one piece. This creates manufacturing complexity and high cost. Further improvement on the mono-block technology has led to very complex machined caliper bodies to maximize strength.

In various exemplary embodiments, the technology described herein provides a modular hydraulic brake caliper for use on automobile vehicles and motorcycles. The modular hydraulic brake caliper provides equivalent or greater stiffness and strength and is manufactured at a lower cost. Additionally, performance is increased in both weight and heat resistance through the use of advanced materials and coatings. Furthermore, the modular hydraulic brake caliper places reaction forces through the bolt attachments. The modular hydraulic brake caliper separates the major components into modules which allows for functional optimization through the use of materials, geometric stress optimization, and coatings.

A modular hydraulic disc brake caliper **10** having a housing to house a piston block assembly **26** is disclosed. The housing includes at least one top bridge **16**. The top bridge **16** is configured to stiffen and strengthen a disc brake caliper. In at least one embodiment, the top bridge **16** is configured to be removable. The top bridge **16** is the primary component to provide added strength to a modular hydraulic disc brake caliper **10**, when compared to the traditional two-piece and open-top, mono-block brake caliper designs known in the art. The top bridge **16** can be designed to strengthen and oppose piston hydraulic reaction forces as well as to stiffen the caliper opposing tangential braking forces. The modular top bridge **16** allows for material

and geometric optimization for strength requirements based on specific applications. The modular top bridge **16** can be designed in many fashions, providing attachment on different planes, and using different attachment methods. By way of example, attachments means can include a mechanical fastener, press and shrink fit, glue, adhesive, and welding.

The housing of the modular hydraulic disc brake caliper **10** can also include one or more caliper body **36**. The caliper body **36** is configured to stiffen and strengthen a modular hydraulic brake caliper assembly **10**, to securely receive the top bridge **16** and to restrain a piston block assembly **26**. The caliper body **36** can be configured with an integral piston or without the use of an integral piston. The caliper body **36** can include a single piece or two separate parts connected using side bridges **32**. This non-integral caliper body design eliminates the use of integral pistons and, thus, simplifies the manufacturing process. The caliper body **36** can be optimized for tangential loading and less biased on piston hydraulic reaction forces. Alternatively, the caliper body **36** can be optimized for both factors.

The side bridges **32** used in two-piece caliper body **36** embodiments tie the two pieces of the caliper body **36** together. The side bridge **32** is bolted to each caliper body **36** to join them together. The side bridge **32** can be optimally designed to oppose piston hydraulic reaction forces as well as opposing tangential braking forces. The side bridge **32** can be designed in many fashions, providing attachment on different planes, and using different attachment methods. End bridges **20** can also be used in two-piece caliper body **36** embodiments to join two side bridges **32**.

Components of each modular hydraulic disc brake caliper **10** can be altered to accommodate specific applications. Both racing and automobile applications are focused on the same disc brake caliper performance. For the auto applications, cost will be a greater driving force and yield compromises in balancing a lower required performance threshold, as compared to racing, with material and manufacturing costs.

The geometric shape of the components is very important to the functionality of this technology. The geometric shape, size, and configuration of each component are varied in manufacture in order to yield desired strength and dimensional characteristics. The shapes and sizes depicted in the Figures are exemplary. As will be apparent to those of ordinary skill in the art, varied shapes and sizes can be utilized for these components.

The material of manufacture of each of the components is varied in manufacture in order to optimize weight and strength characteristics. In regard to weight, lower is better in performance. Light and strong materials such as aluminum, titanium, and magnesium can be used. Heavier materials with ultra high strength characteristics may be lighter in application given certain optimized geometric and attachment designs. Strength and stiffness of the part and assembly are determined by the material used, the geometric shape of the component, and attachment methods. These three interrelated factors are dependent on one another and are evaluated holistically.

Material costs of components are balanced based on market application, performance requirements, and performance gains.

Manufacturing costs are considered when evaluating the manufacturing components of each modular hydraulic disc brake caliper **10**. All elements of the design are critical in creating the best product at the lowest price. Fundamental to this technology is focusing on the simplest machining processes, lowest cost capital machinery, standard mass produced tooling, least skilled manpower, lowest cost consumables, etc. The modular design opens up the prospect of making individual components by other process such as forging, molding, casting, etc.

Heat resistance is considered when evaluating the manufacturing components of each modular hydraulic disc brake caliper **10**. It is important to reduce heat around the piston block **26**. It is desirable to keep the brake fluid as cool as possible and therefore provide heat shields and insulating properties at the interface between the pistons **26** and brake pads **30**. The modular piston block **26** allows for use of different materials and coatings to aid in this pursuit which is not as feasible with "mono-block" designs.

Cooling characteristics are considered when evaluating the manufacturing components of each modular hydraulic disc brake caliper **10**. One element of the geometric design that will be tailored to allow the greatest amount of air flow around the friction interface of the pad and rotor **40**, rotor cooling vane exhaust, and piston block **26**.

Serviceability is considered when evaluating the manufacturing components of each modular hydraulic disc brake caliper **10**. The modular piston block **26** allows for easy exchange

of new, rebuilt, and or different piston configurations with out having to purchase a complete new caliper assembly.

Components can be manufactured from varied materials based upon the application of the modular hydraulic disc brake caliper **10**. The desire is to find the best material that yields the highest performance in terms of strength, weight, heat characteristics, and cost for a given application. Geometric design is extremely critical to determining these factors and Finite Element Analysis will be used extensively to iterate best solutions. In addition to industry standard aluminum other materials such as titanium, magnesium, high strength steels, stainless steels, ceramic composites, carbon fiber composites, etc. may be used for certain components.

Due to the modular nature of the technology described herein, individual components easily can be coated to enhance the performance. This is not as easily done with the current state of the art "mono-block" design calipers. For instance the face of the piston block could be coated with a ceramic coating or inlay to insulate the pistons and brake fluid from heat. Coatings in general can be used to improve the base material in areas of corrosion resistance, esthetics, friction wear, insulating properties, etc.

Referring now to Figures 1 and 2, a modular hydraulic brake caliper **10a** having a split interlocking multi-piston block design with both side **32a** and end bridges **20** is shown. The top bridge **16a** is secured, for example, to the end bridges **20** and side bridges **32a** with interlocking top bridge shoulder bolts **12**. At each corner of the top bridge **16**, a top bridge shoulder bolt **12** is placed through a split bushing **14** and through a hole in the end bridge **20** and through a hole in the side bridge **32** to a side bridge split bushing **34**. The top bridge **16a** utilizes abutment plates **18a** to secure the brake pads **30a**. Securely housed within the modular hydraulic brake caliper **10a** are brake pads **30a**, each disposed adjacent to a piston block **26a** that selectively presses the brake pads **30a** against a rotor. The pair of piston blocks **26a** are fluidly connected via hydraulic crossover tube **22a**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**.

Referring now to Figures 3 and 4, a modular hydraulic brake caliper **10b** having an interlocking multi-piston design with integral piston blocks **26b** is shown. The top bridge **16b** is secured, for example, to a caliper body **36b** with top bridge mounting bolts **42** and top bridge interlocking bushings **44**. The caliper body **36b** utilizes abutment plates **18b** to secure the brake

pads **30b**. Securely housed within the modular hydraulic brake caliper **10b** are brake pads **30b**, each disposed adjacent to an integral piston block **26b** that selectively presses the brake pads **30b** against a rotor. The integral piston block **26b** is integrally formed with the caliper body **36b**. On each side of the caliper body **36b** the integral piston blocks **26b** include at least one hydraulic tube fitting **24** and hydraulic bleed screw **28.** Each side is fluidly connected via a hydraulic crossover tube **22b**.

Referring now to Figures 5 and 6, a modular hydraulic brake caliper **10c** having a multi-piston block with integral side bridge is shown on rotor **40**. The top bridge **16c** is secured, for example, to a caliper body **36c** with top bridge bolts **46** and top bridge bushings **48** on one rotor side and top bridge shoulder bolts **50** on the opposite side. The caliper body **36c** utilizes abutment plates **18c** to secure the brake pads **30c**. Securely housed within the modular hydraulic brake caliper **10c** are brake pads **30c**, each disposed adjacent to an integral piston block **26c** that selectively presses the brake pads **30c** against the rotor **40**. Each piston block **26c** is adjacent to each brake pad **30c** and configured to selectively depress the brake pads **30c** against the rotor **40**. Each piston block **26c** includes at least one hydraulic tube fitting **24** and hydraulic bleed screw **28.** Each side is fluidly connected via a hydraulic crossover tube **22c**.

Referring now to Figures 7 and 8, a modular hydraulic brake caliper **10d** having a multi-piston block **26d** with side bridges **32d** is shown on rotor **40**. The top bridge **16d** is secured, for example, to the caliper body **36d** (in two pieces) with top bridge bolts **46** and top bridge bushings **48** on one rotor side and top bridge shoulder bolts **50** on the opposite side. Each is secured on the underside of the caliper body **36d** with a caliper body bushing **52**. The side bridges **32d** are secured to the caliper body **36d** with side bridge bolts **54** and side bridge pins **56**. The caliper body **36d** utilizes abutment plates **18d** to secure the brake pads **30d**. Securely housed within the modular hydraulic brake caliper **10d** are brake pads **30d**, each disposed adjacent to a piston block **26d** that selectively presses the brake pads **30d** against the rotor **40**. Heat shields **38d** are utilized to reduce radiant heat transfer into the piston block assembly **26d**. The pair of piston blocks **26d** are fluidly connected via hydraulic crossover tube **22d**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**.

Referring now to Figures 9 and 10, a modular hydraulic brake caliper **10e** having a multi-piston block **26e** with integral side bridge **32e** for a motorcycle is shown. The top bridge **16e** is secured, for example, to the side bridges **32e** with top bridge bolts **46** and top bridge

bushings **48** on one rotor side and side bridge nuts **58** on the opposite side. In this embodiment, top bridge **16e** utilizes a brake pad retainer **60**. The side bridge nuts **58** connect with side bridge bolts **54** from the underside of one side bridge **32e**. Securely housed within the modular hydraulic brake caliper **10e** are brake pads **30e**, each disposed adjacent to a piston block **26e** that selectively presses the brake pads **30e** against the rotor **40**. The side bridges **32e** utilize abutment plates **18e** to secure the brake pads **30e**. The pair of piston blocks **26e** are fluidly connected via hydraulic crossover tube **22e**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**.

Referring now to Figures 11 and 12, a modular hydraulic brake caliper **10f** having a single piston block **26f** configuration is shown. The top bridge **16f** is secured, for example, to the side bridge **32f** with top bridge bolts **46**. Securely housed within the modular hydraulic brake caliper **10f** are brake pads **30f**, one disposed adjacent to the single piston block **26f** that selectively presses the brake pads **30f** against the rotor and another disposed against a backing plate **64**. The backing plate **64** is secured to the top bridge **16f**, with the brake pads **30f** disposed in between, with backing plate bolts **62**. The side bridge **32f** utilizes abutment plates **18f** to secure the brake pads **30f**. The piston block **26f** has a hydraulic tube fitting **24** and a hydraulic bleed screw **28**.

Referring now to Figures 13 and 14, a modular hydraulic brake caliper **10g** having a twin piston block **26g** configuration is shown. The top bridge **16g** is secured, for example, to the side bridges **32g** with top bridge bolts **46**. Securely housed within the modular hydraulic brake caliper **10g** are brake pads **30g**, each disposed adjacent to a piston block **26g** that selectively presses the brake pads **30g** against the rotor. The side bridges **32g** utilizes abutment plates **18g** to secure the brake pads **30g**. Each piston block **26g** has a hydraulic tube fitting **24** and a hydraulic bleed screw **28** and are fluidly coupled one via a hydraulic crossover tube **22g**.

Referring now to Figures 15 and 16, a modular hydraulic brake caliper **10h** having an interlocking multi-piston block configuration with integral side bridge **32h** and end bridge **20h** is shown. The top bridge **16h** is secured, for example, to the side bridges **32h** with top bridge bolts **46** and top bridge mounting bolts **42** through top bridge interlocking bushings **44** and secured with bottom nuts **66** and bottom bushings **72**. Securely housed within the modular hydraulic brake caliper **10h** are brake pads **30h**, each disposed adjacent to a piston block (integral with side bridge **32h**) that selectively presses the brake pads **30h** against the rotor **40**.

The side bridges **32h** utilize abutment plates **18h** to secure the brake pads **30h**. The integral piston blocks in side bridges **32h** are fluidly connected via hydraulic crossover tube **22h**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**.

Referring now to Figures 17 and 18, a modular hydraulic brake caliper **10i** having an interlocking multi-piston block configuration with integral side bridge **32i** is shown. The top bridge **16i** is secured, for example, to the side bridges **32i** with top bridge bolts **46** and top bridge mounting bolts **42** through top bridge interlocking bushings **44**. The side bridges **32i** are secured to the caliper body **36i** with side bridge shoulder bolts **68**. Securely housed within the modular hydraulic brake caliper **10i** are brake pads **30i**, each disposed adjacent to a piston block (integral with side bridge **32i**) that selectively presses the brake pads **30i** against the rotor **40**. The side bridges **32i** utilize abutment plates **18i** to secure the brake pads **30i**. The integral piston blocks in side bridges **32i** are fluidly connected via hydraulic crossover tube **22i**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**.

Referring now to Figures 19 and 20, a modular hydraulic brake caliper **10j** having an interlocking multi-piston block configuration with integral side bridge **32j** and end bridge **20j** is shown. The top bridge **16j** is secured, for example, to the side bridges **32j** and end bridges **20j** with top bridge shoulder bolts **50** and shoulder bolt washers **70** and connected with bottom nuts **66** and bottom bushings **72**. Securely housed within the modular hydraulic brake caliper **10j** are brake pads **30j**, each disposed adjacent to a piston block (integral with side bridge **32j**) that selectively presses the brake pads **30j** against a rotor. The side bridges **32j** utilize abutment plates **18j** to secure the brake pads **30j**. The integral piston blocks in side bridges **32j** are fluidly connected via hydraulic crossover tube **22j**, and each has at least one hydraulic tube fitting **24** and hydraulic bleed screw **28**. Heat shields **38j** are utilized to reduce radiant heat transfer into the piston block assembly integral in each side bridge **32j**.

The various modular hydraulic brake calipers **10** depicted in Figure 1-20 can be manufactured utilizing varied processes. By way of example, factors such as strength, stiffness, weight, material costs, manufacturing costs, heat resistance, cooling characteristics, and serviceability can be considered. Additionally, application, such as for traditional automobiles or motorcycles or for racing, can be considered. Factors analysis can include results with one or more top bridge **16**, one or more side bridge **32**, one or more end bridge **20**, varied piston block assemblies **26**, varied caliper bodies **36**, etc.

The following method steps are disclosed: designing a modular hydraulic brake caliper by analyzing the geometric shape, size, and configuration of each component are varied in manufacture in order to yield desired strength and dimensional characteristics; designing a modular hydraulic brake caliper by analyzing the material of manufacture of each of the components in regard to overall weight, strength, and stiffness; designing a modular hydraulic brake caliper by analyzing the material costs; designing a modular hydraulic brake caliper by analyzing the manufacturing costs; designing a modular hydraulic brake caliper by analyzing the heat resistance of the components in order to reduce heat around the piston block and to keep the brake fluid as cool as possible; designing a modular hydraulic brake caliper by analyzing the cooling characteristics in order to allow the greatest amount of air flow around the friction interface of the pad and rotor, rotor cooling vane exhaust, and piston block; and designing a modular hydraulic brake caliper by analyzing the serviceability of the manufacturing components to allow for and prepare for the easy exchange of new, rebuilt, and or different piston configurations with out having to purchase a complete new caliper assembly.

Although this technology has been illustrated and described herein with reference to preferred embodiments and specific examples thereof, it will be readily apparent to those of ordinary skill in the art that other embodiments and examples can perform similar functions and/or achieve like results. All such equivalent embodiments and examples are within the spirit and scope of the invention and are intended to be covered by the following claims.

CLAIMS

What is claimed is:

1. A modular hydraulic disc brake caliper assembly with integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one side bridge with an integral piston block, the side bridge configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one end bridge, the end bridge configured to interconnect with the top bridge and side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

2. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 1, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

3. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 1, further comprising:

a heat shield, the heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the piston block and side bridge;

a coating, the coating applied to one or more of the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one side bridge with an integral piston block, and at least one end bridge comprising the caliper assembly.

4. A modular hydraulic disc brake caliper assembly with integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one side bridge with an integral piston block, the side bridge configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one caliper body, the caliper body configured to interconnect with the top bridge and the side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

5. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 4, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

6. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 4, further comprising:

a heat shield, the heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block and caliper body;

a coating, the coating applied to one or more of the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one side bridge with an integral piston block, and at least one caliper body comprising the caliper assembly.

7. A modular hydraulic disc brake caliper assembly with integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly; and

an at least one side bridge with an integral piston block, the side bridge configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

8. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 7, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

9. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 7, further comprising:

a heat shield, the heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block and side bridge;

a coating, the coating applied to one or more of the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge and at least one side bridge with an integral piston block comprising the caliper assembly.

10. A modular hydraulic disc brake caliper assembly with integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly; and

an at least one caliper body with an integral piston block, the caliper body configured to interconnect with the top bridge, to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces.

11. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 10, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge and at least one caliper body with an integral piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

12. The modular hydraulic disc brake caliper assembly with integral piston block of Claim 10, further comprising:

a heat shield, the heat shield disposed upon the integral piston block and configured to reduce radiant heat transfer into the integral piston block and caliper body;

a coating, the coating applied to one or more of the at least one top bridge and at least one caliper body with an integral piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge and at least one caliper body with an integral piston block comprising the caliper assembly.

13. A modular hydraulic disc brake caliper assembly configured without the use of an integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one side bridge, the side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces;

an at least one end bridge, the end bridge configured to interconnect with the top bridge and side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one piston block, the piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

14. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 13, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

15. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 13, further comprising:

a heat shield, the heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and side bridge.

a coating, the coating applied to one or more of the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one side bridge, at least one end bridge, and at least one piston block comprising the caliper assembly.

16. A modular hydraulic disc brake caliper assembly configured without the use of an integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one side bridge, the side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces;

an at least one caliper body, the caliper body configured to interconnect with the top bridge and the side bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one piston block, the piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

17. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 16, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

18. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 16, further comprising:

a heat shield, the heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block, caliper body, and side bridge;

a coating, the coating applied to one or more of the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one side bridge, at least one caliper body, and at least one piston block comprising the caliper assembly.

19. A modular hydraulic disc brake caliper assembly configured without the use of an integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one caliper body, the caliper body configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one piston block, the piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

20. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 19, wherein the material of manufacture and the geometric shape, size, and configuration of each of the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

21. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 19, further comprising:

a heat shield, the heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and caliper body;

a coating, the coating applied to one or more of the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one caliper body, and at least one piston block comprising the caliper assembly.

22. A modular hydraulic disc brake caliper assembly configured without the use of an integral piston block, the caliper assembly comprising:

an at least one top bridge, the top bridge configured to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, to oppose braking forces, and to provide for movement of an air flow through the caliper assembly to cool the caliper assembly;

an at least one side bridge, the side bridge configured to interconnect with the top bridge, to stiffen and strengthen the caliper assembly, to oppose hydraulic forces, and to oppose braking forces; and

an at least one piston block, the piston block configured to house an at least one piston that applies force to a brake pad, to deliver pressurized hydraulic brake fluid to an at least one piston bore.

23. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 22, wherein the material of manufacture and the geometric shape,

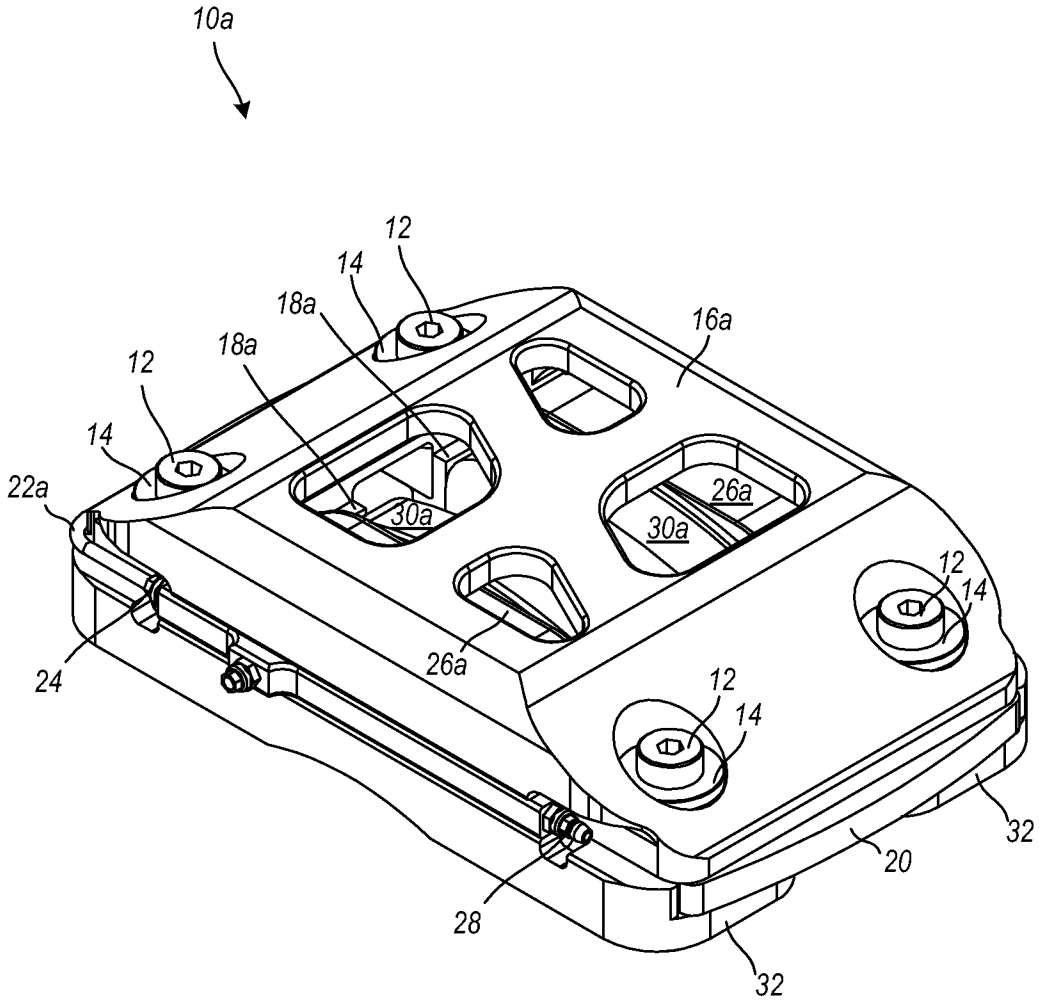
size, and configuration of each of the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly is varied in manufacture in order to optimize weight, strength, and dimensional characteristics.

24. The modular hydraulic disc brake caliper assembly configured without the use of an integral piston block of Claim 22, further comprising:

a heat shield, the heat shield disposed upon the piston block and configured to reduce radiant heat transfer into the piston block and side bridge;

a coating, the coating applied to one or more of the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly to prevent corrosion, reduce heat transfer, and increase lubricity; and

a means of attachment to interconnect the at least one top bridge, at least one side bridge, and at least one piston block comprising the caliper assembly.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18a
16a
18a
12
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14
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14
32
20
28
32

FIG. 1

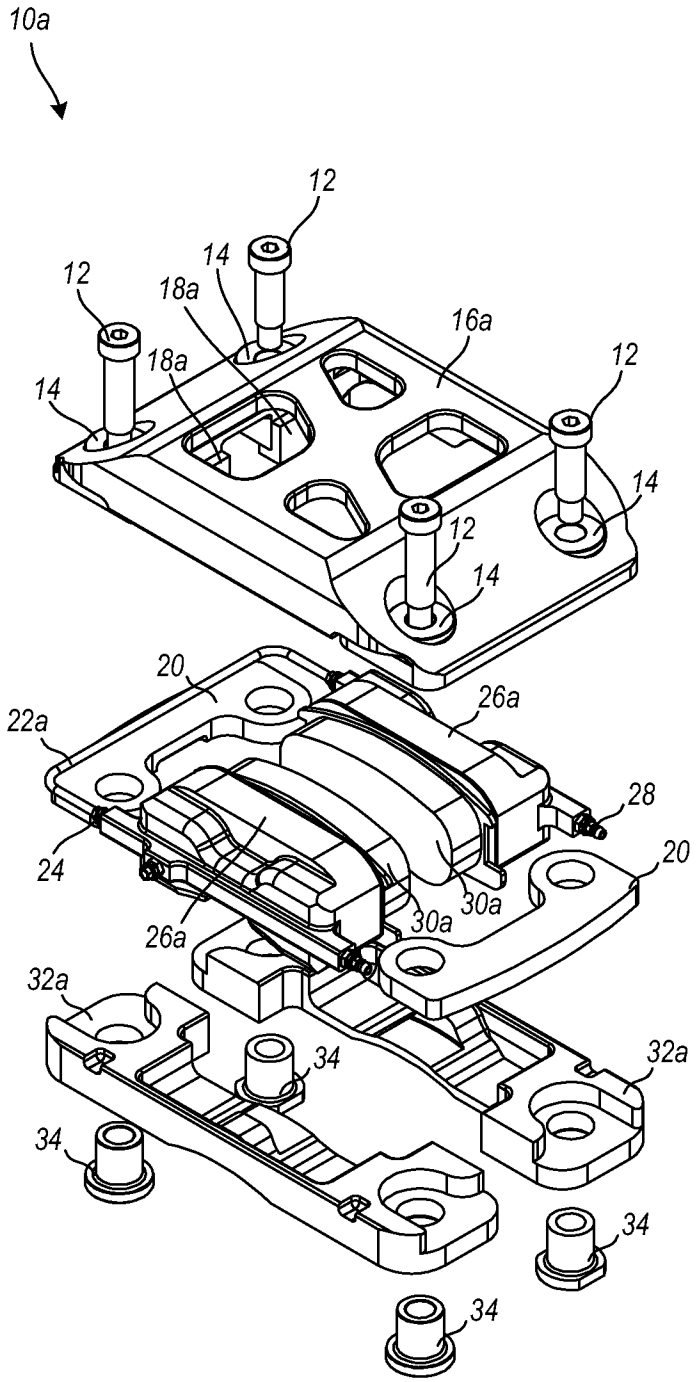


FIG. 2

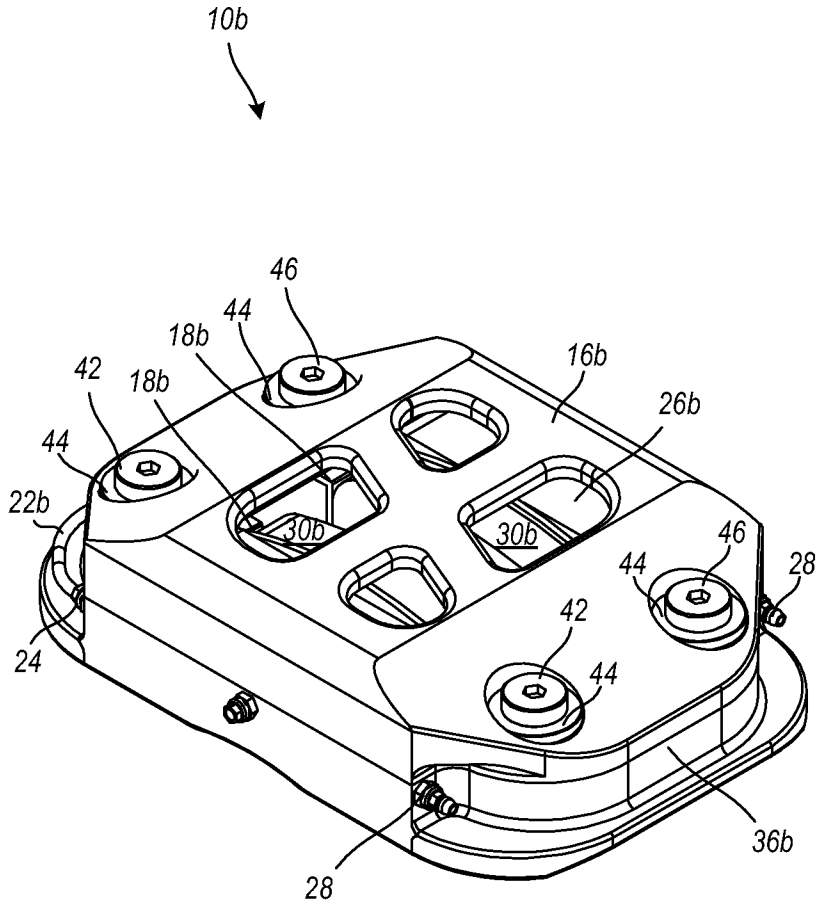
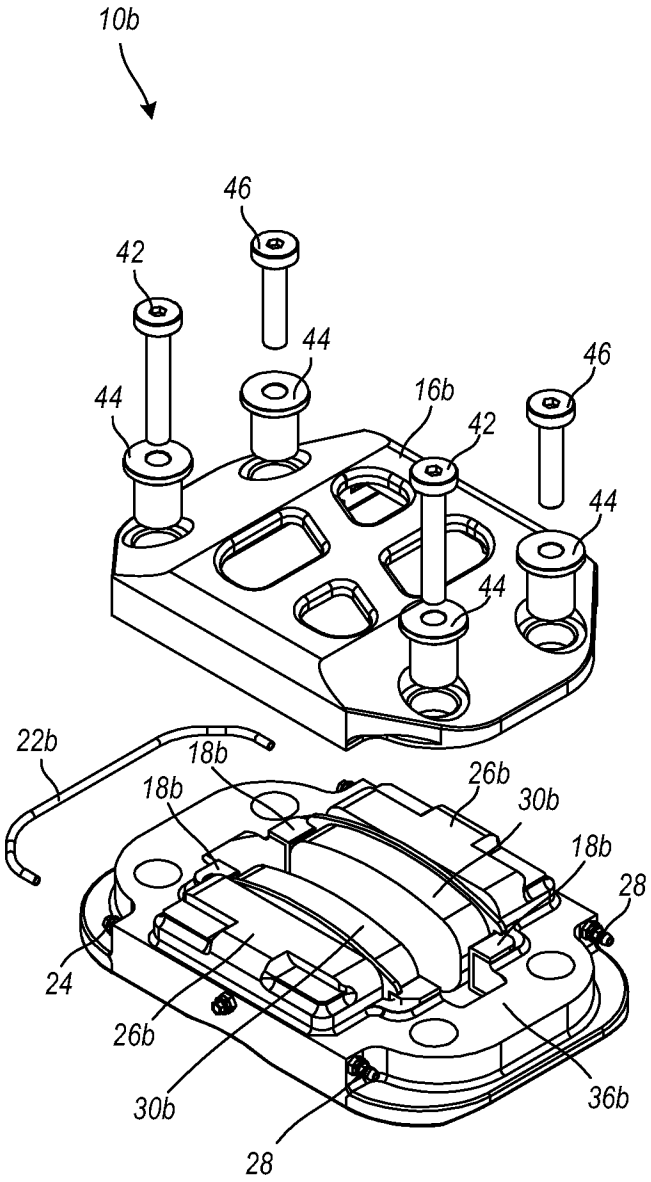


FIG. 3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16b
42
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22b
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26b
30b
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26b
30b
36b
28

FIG. 4

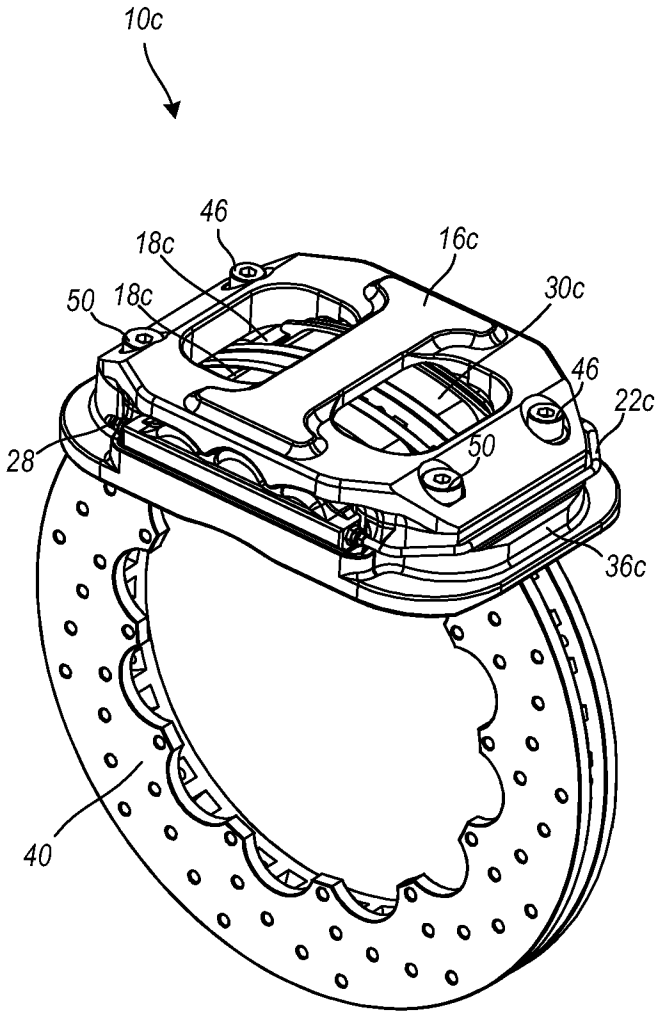
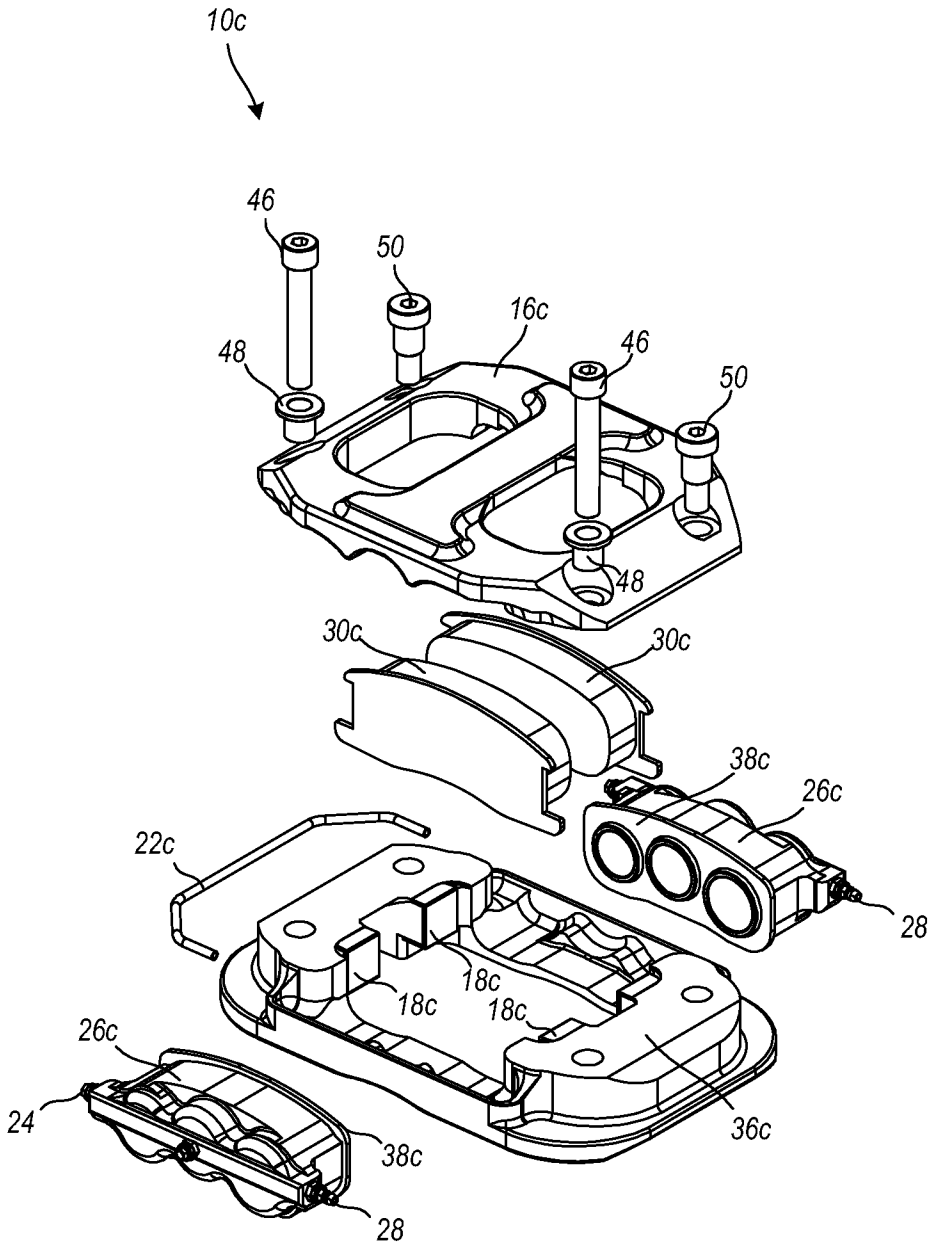


FIG. 5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16c
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26c
24
36c
38c
28

FIG. 6

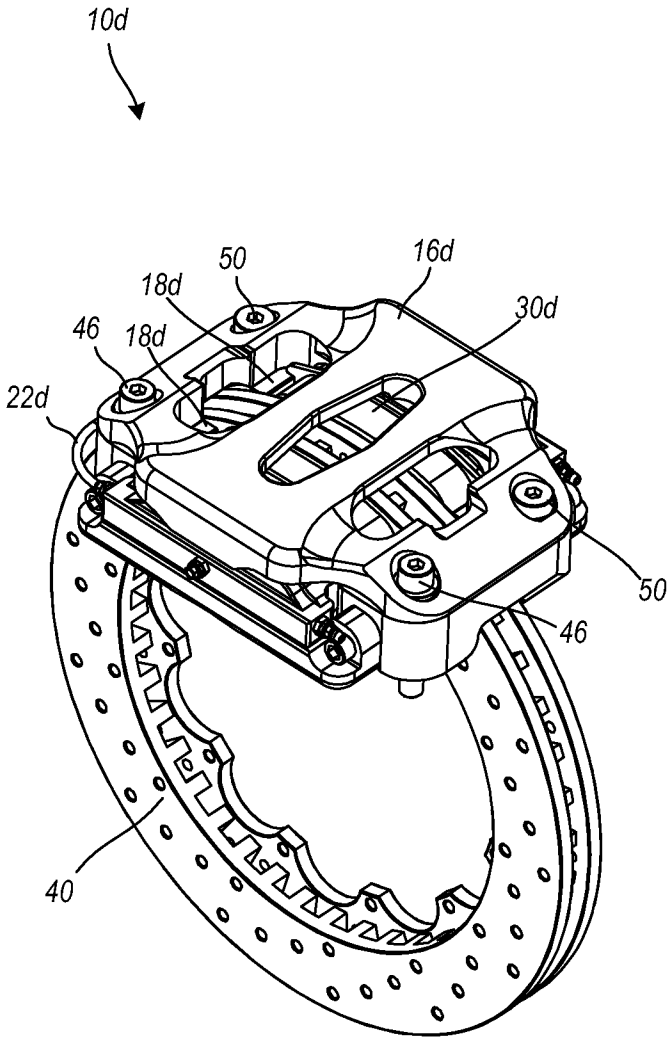
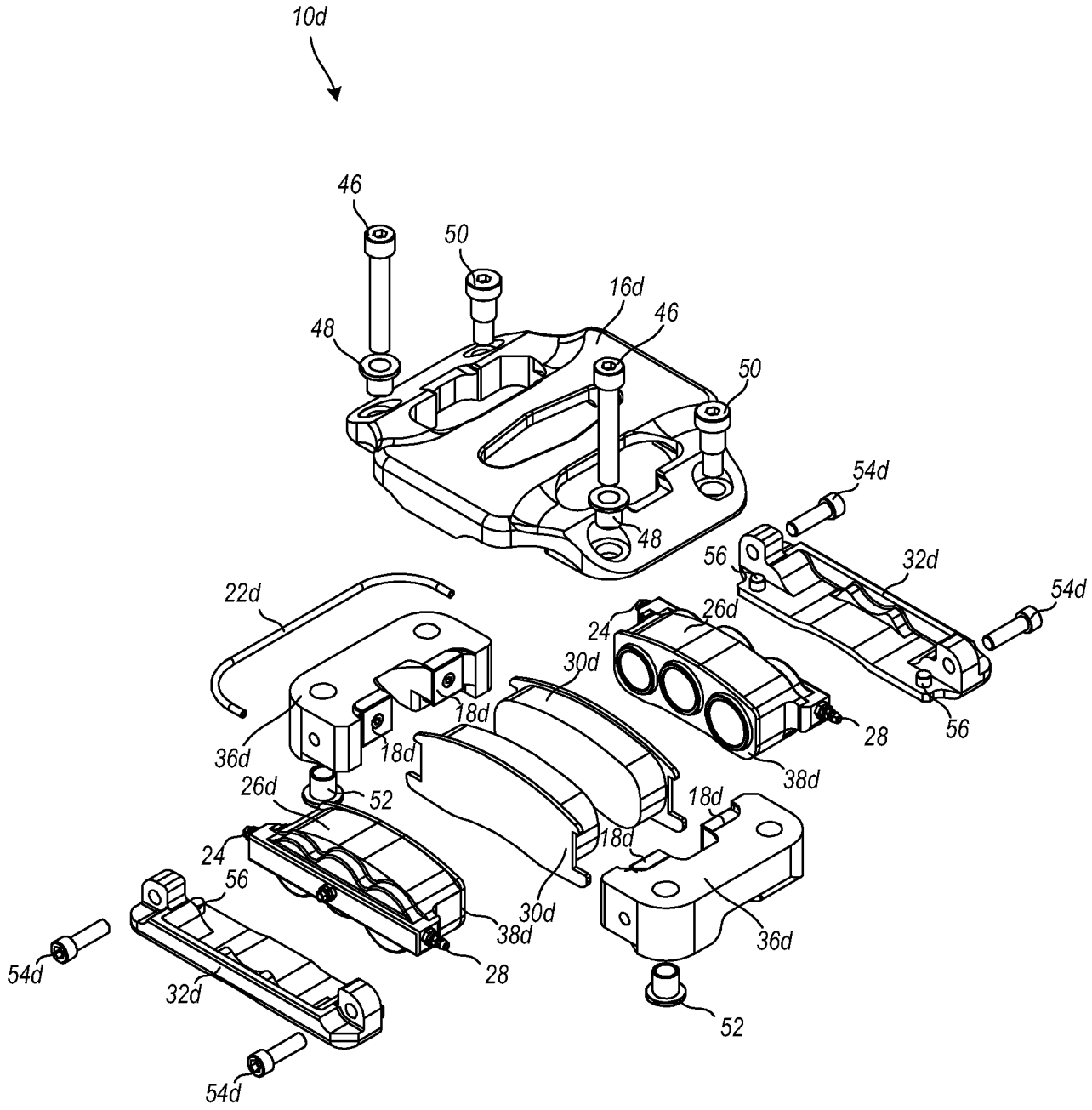


FIG. 7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36d
18d
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32d
52
54d

FIG. 8

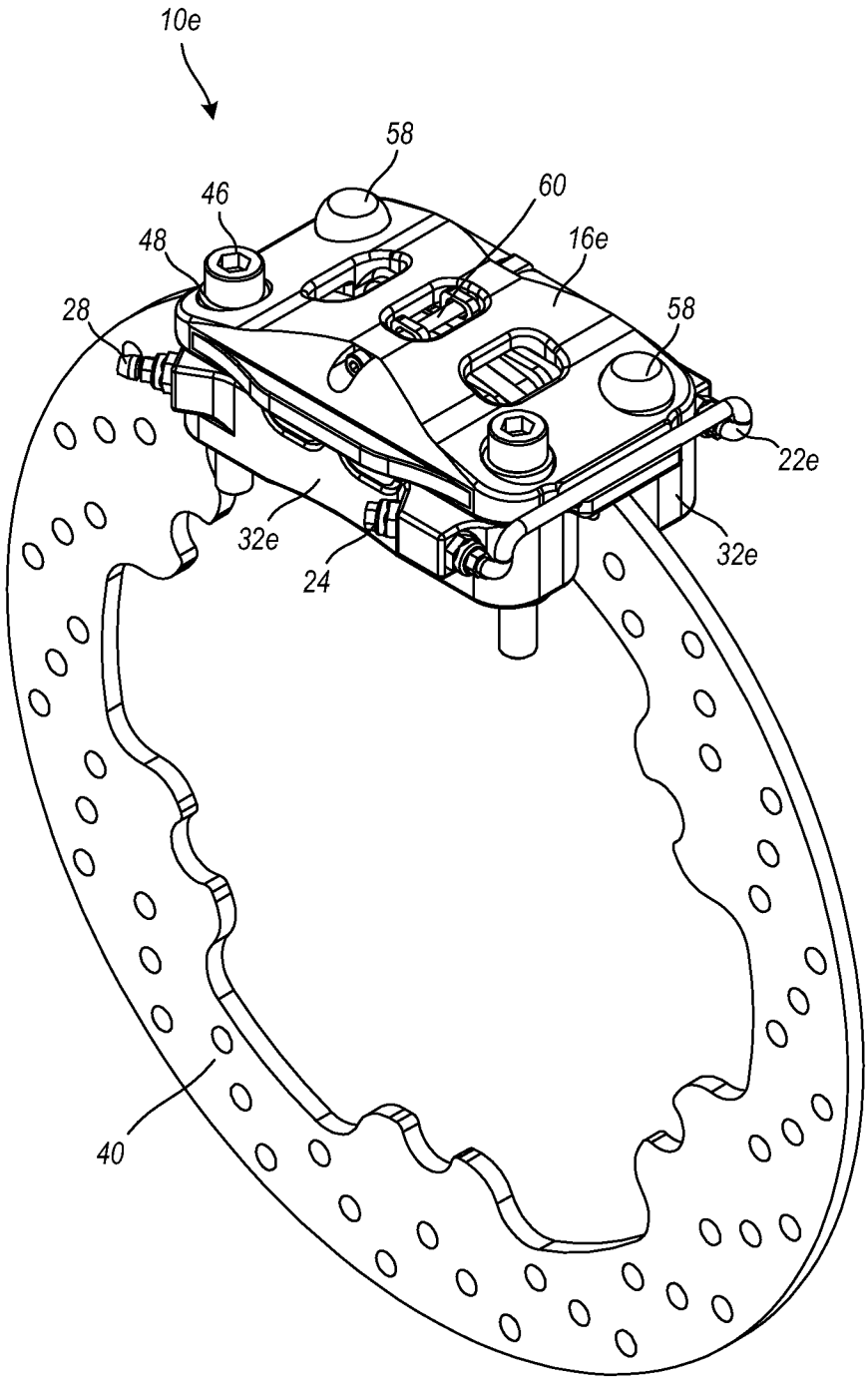


FIG. 9

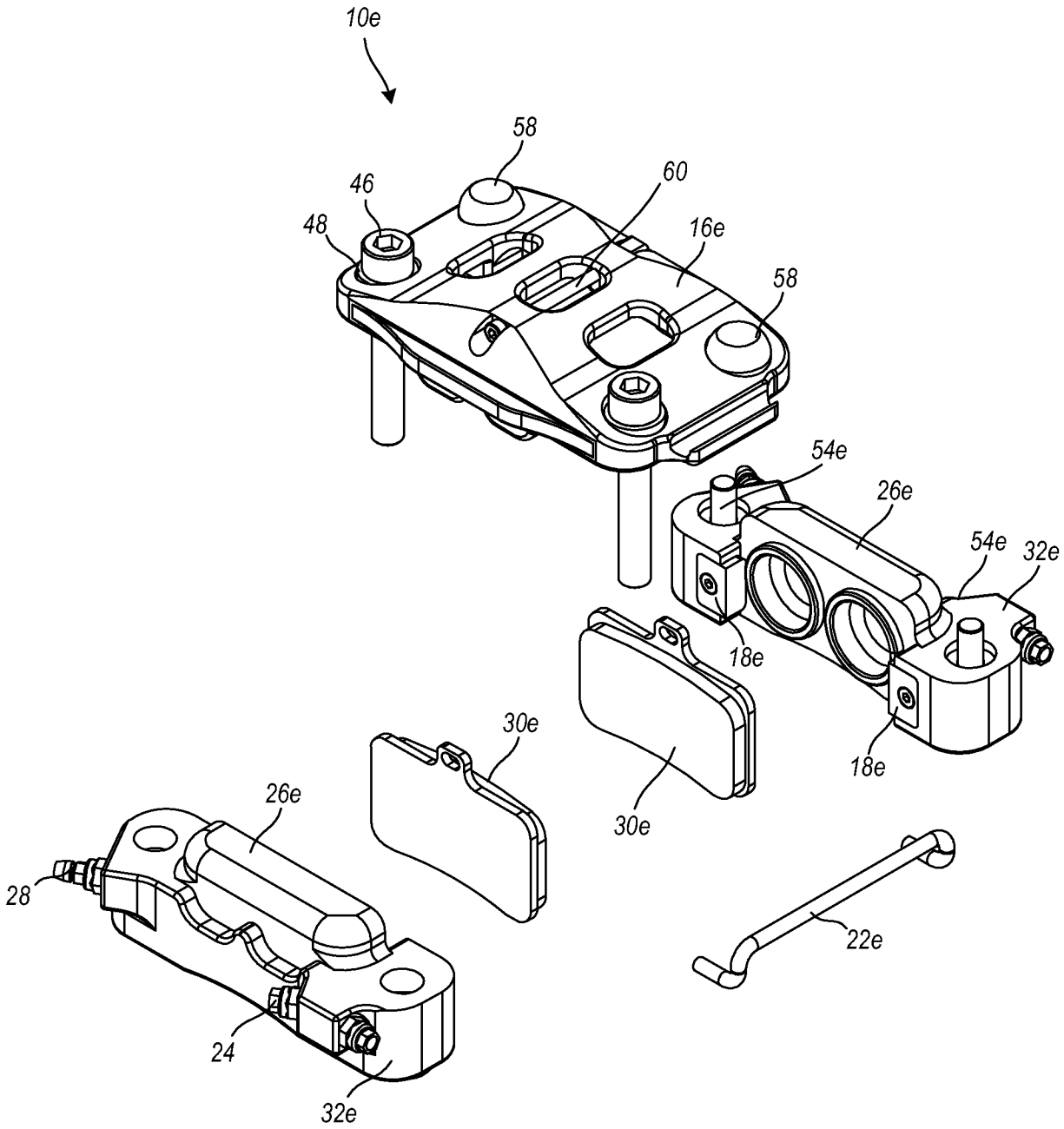

10e
58
46
60
48
16e
58
54e
26e
54e
32e
18e
18e
30e
30e
26e
28
22e
24
32e

FIG. 10

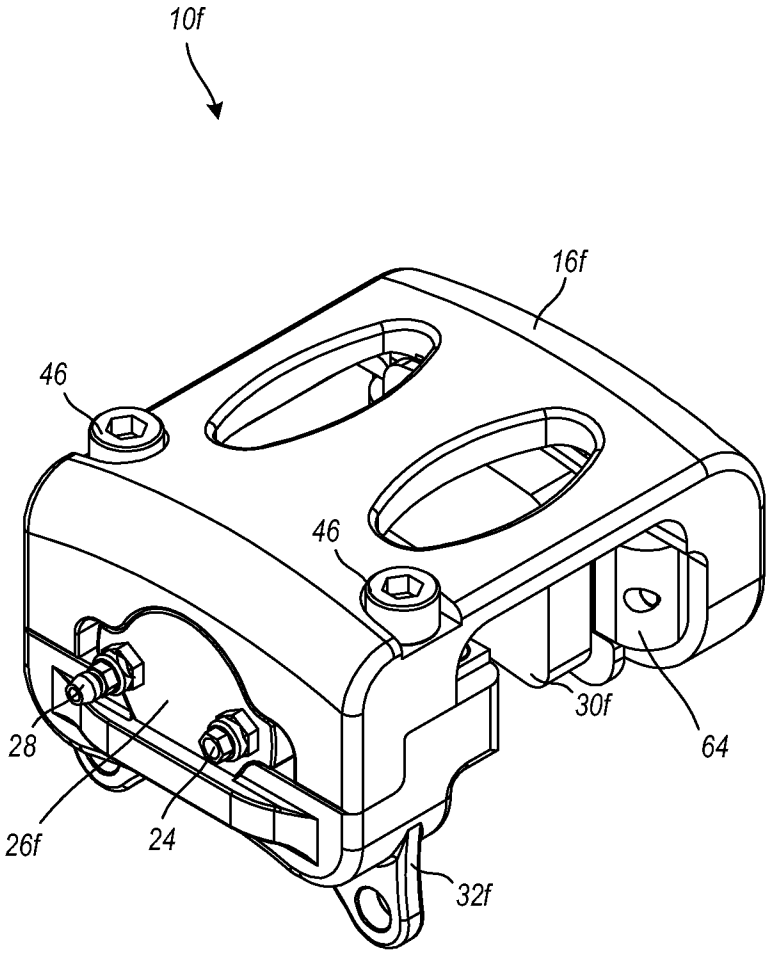


FIG. 11

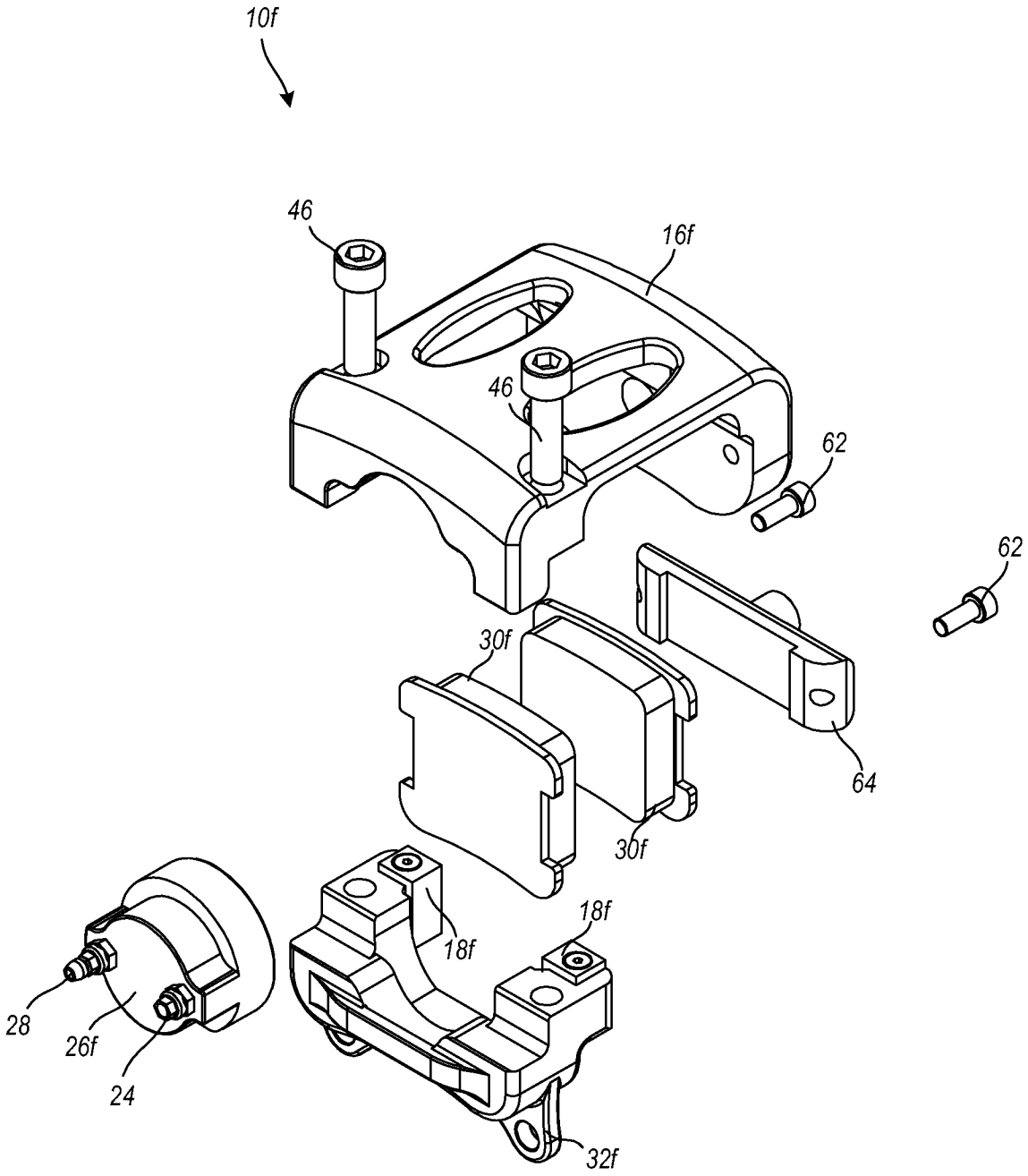


FIG. 12

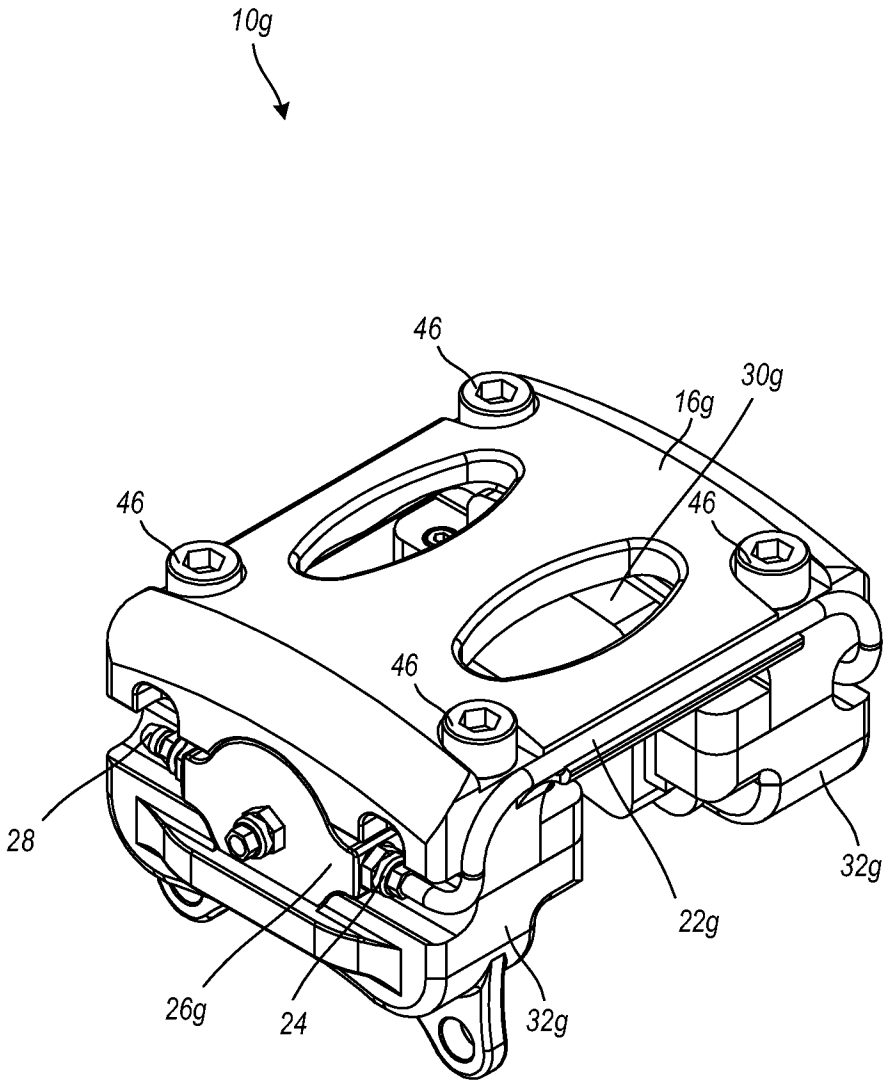
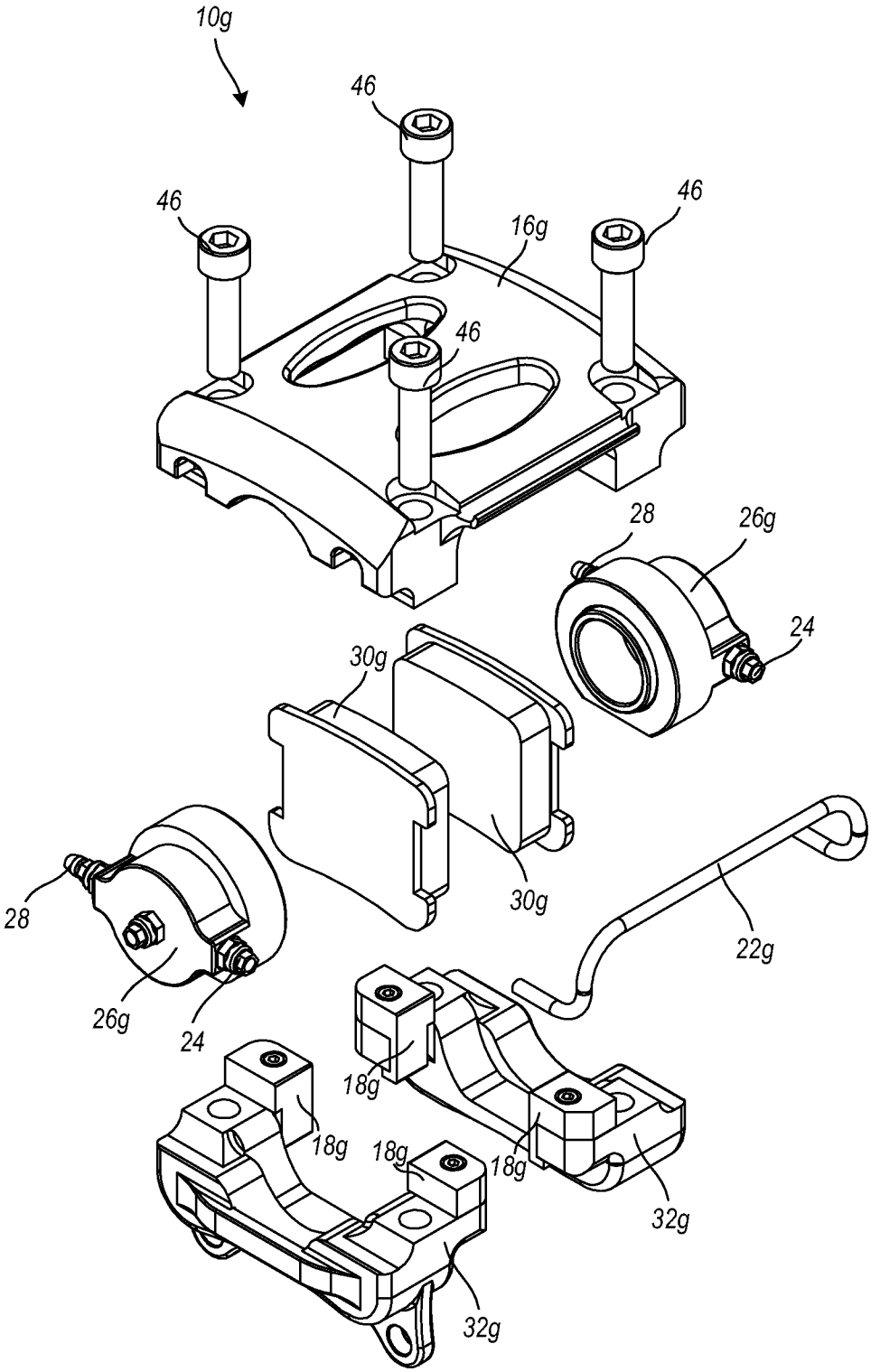


FIG. 13


10g
46
46
46
16g
46
28
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24
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30g
28
26g
24
22g
18g
18g
18g
18g
32g
32g

FIG. 14

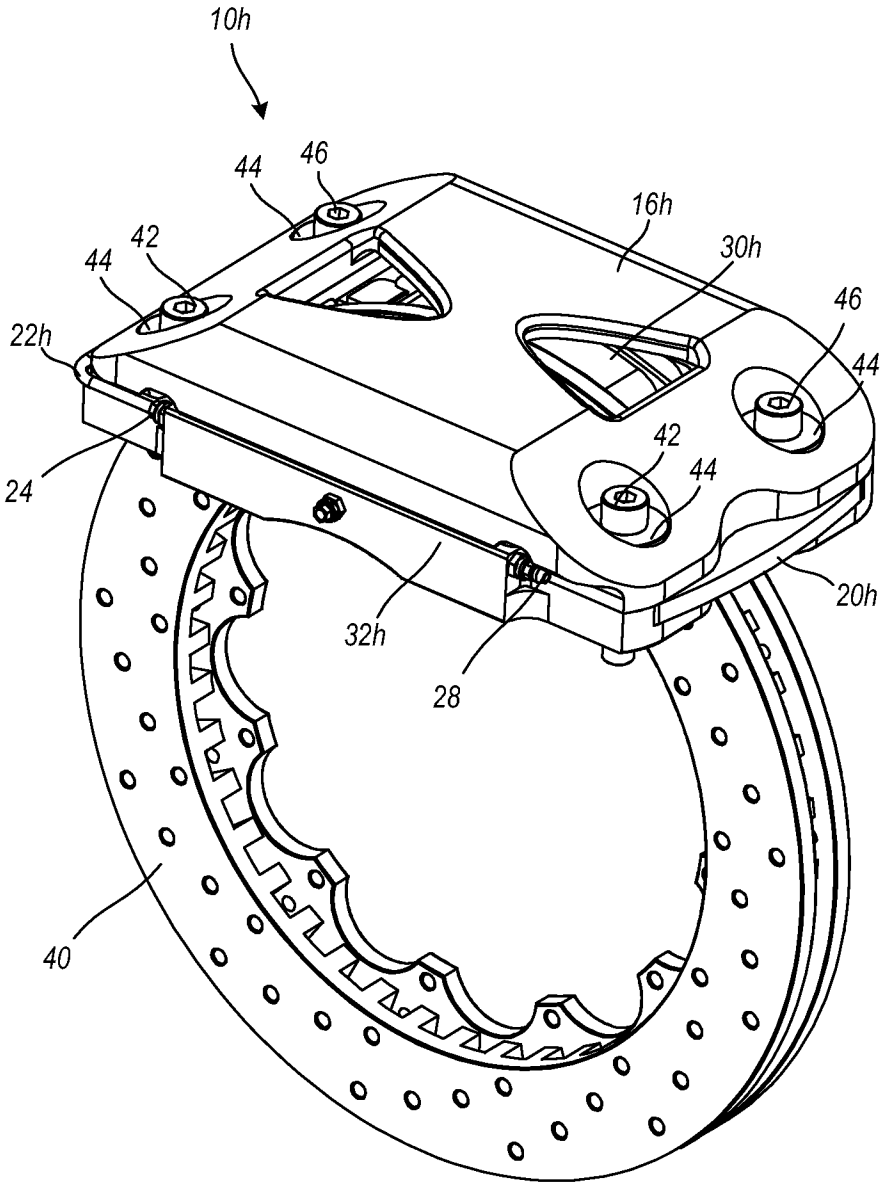

FIG. 15

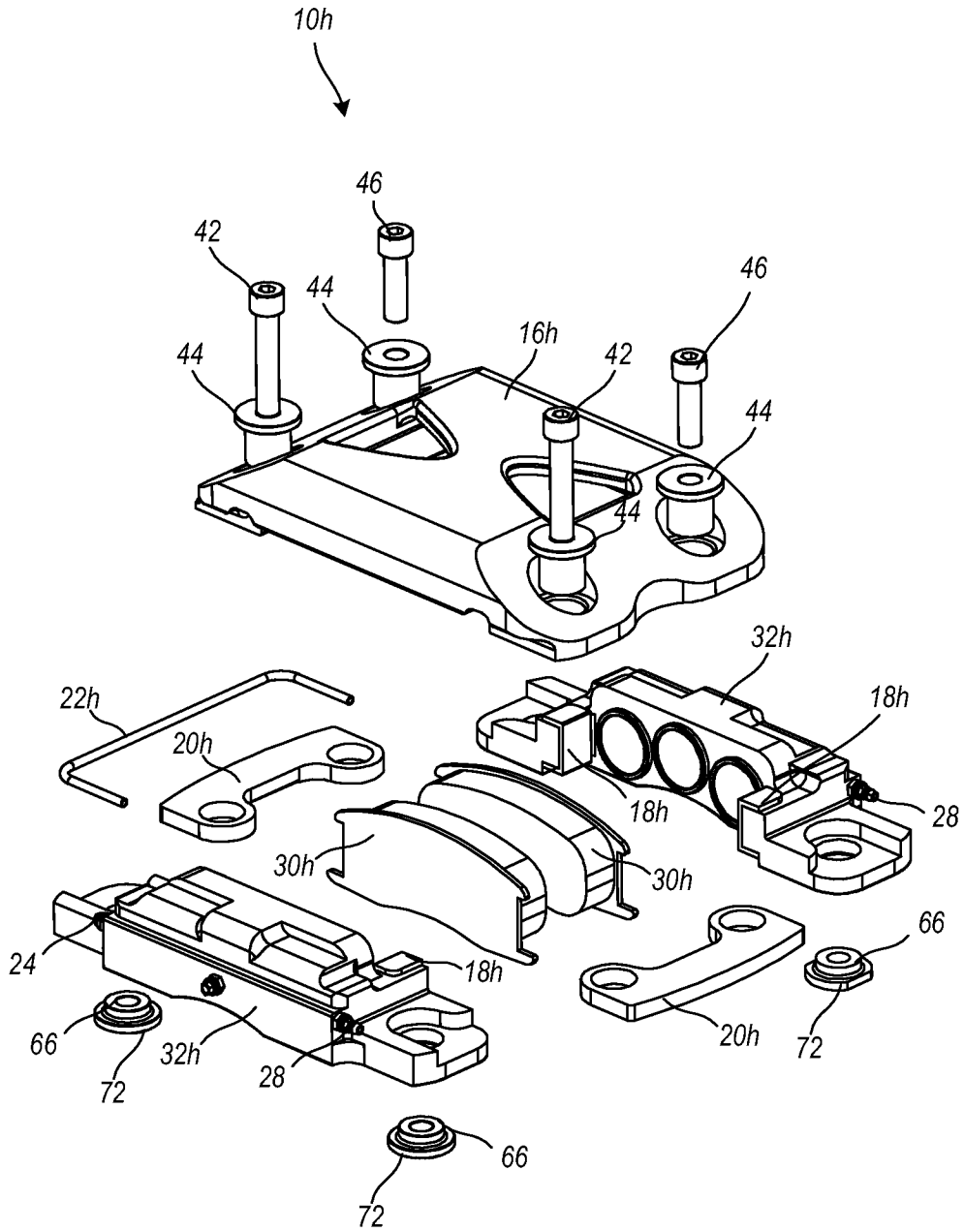
10h
46
42
44
46
44
16h
42
44
44
32h
22h
18h
20h
18h
28
30h
30h
24
18h
66
66
72
32h
28
72
66
20h
72

FIG. 16

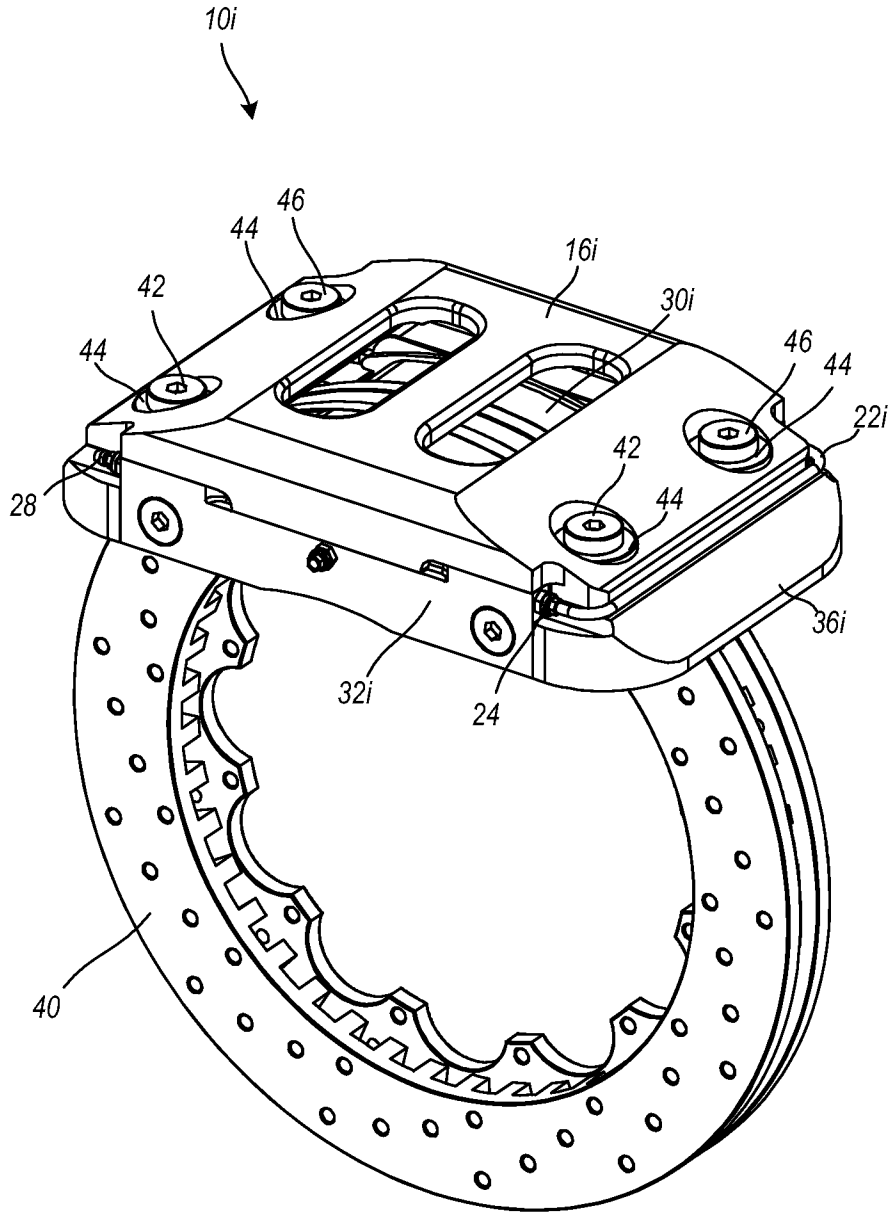

FIG. 17

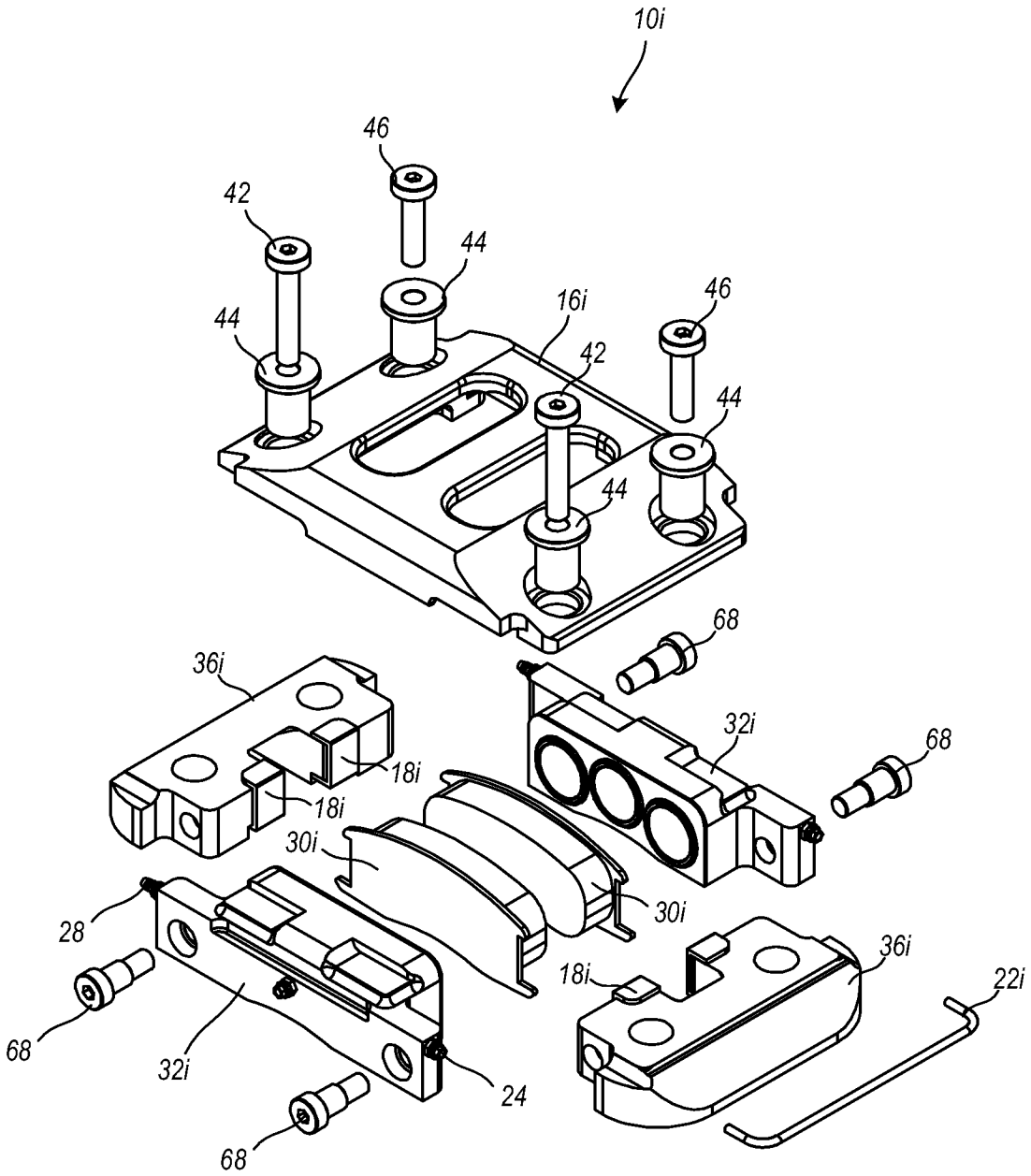
10i
46
42
44
16i
46
44
42
44
44
68
36i
32i
68
18i
18i
30i
30i
28
36i
18i
22i
68
32i
24
68

FIG. 18

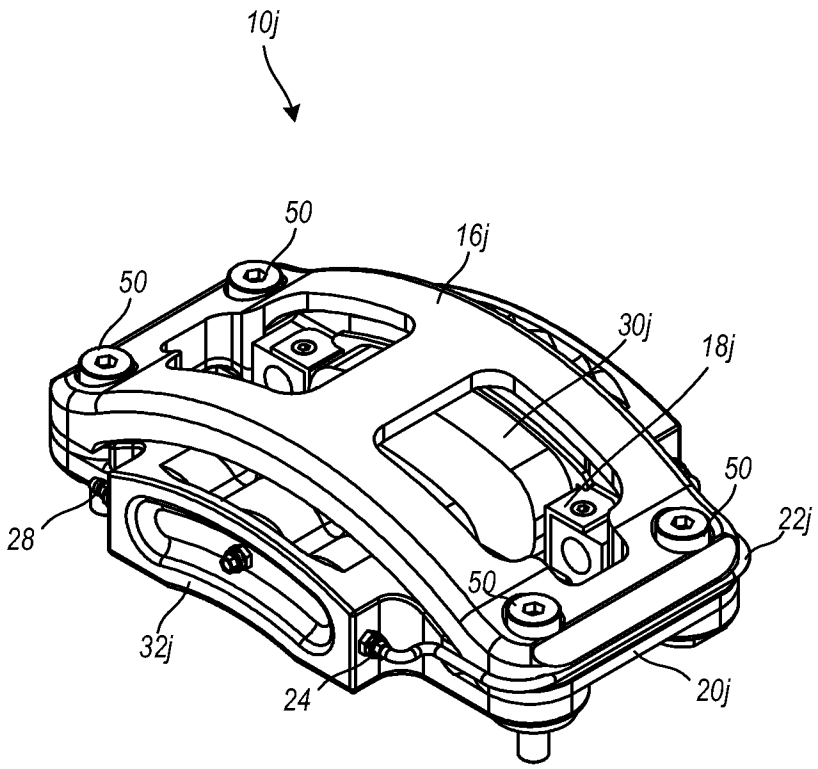

FIG. 19

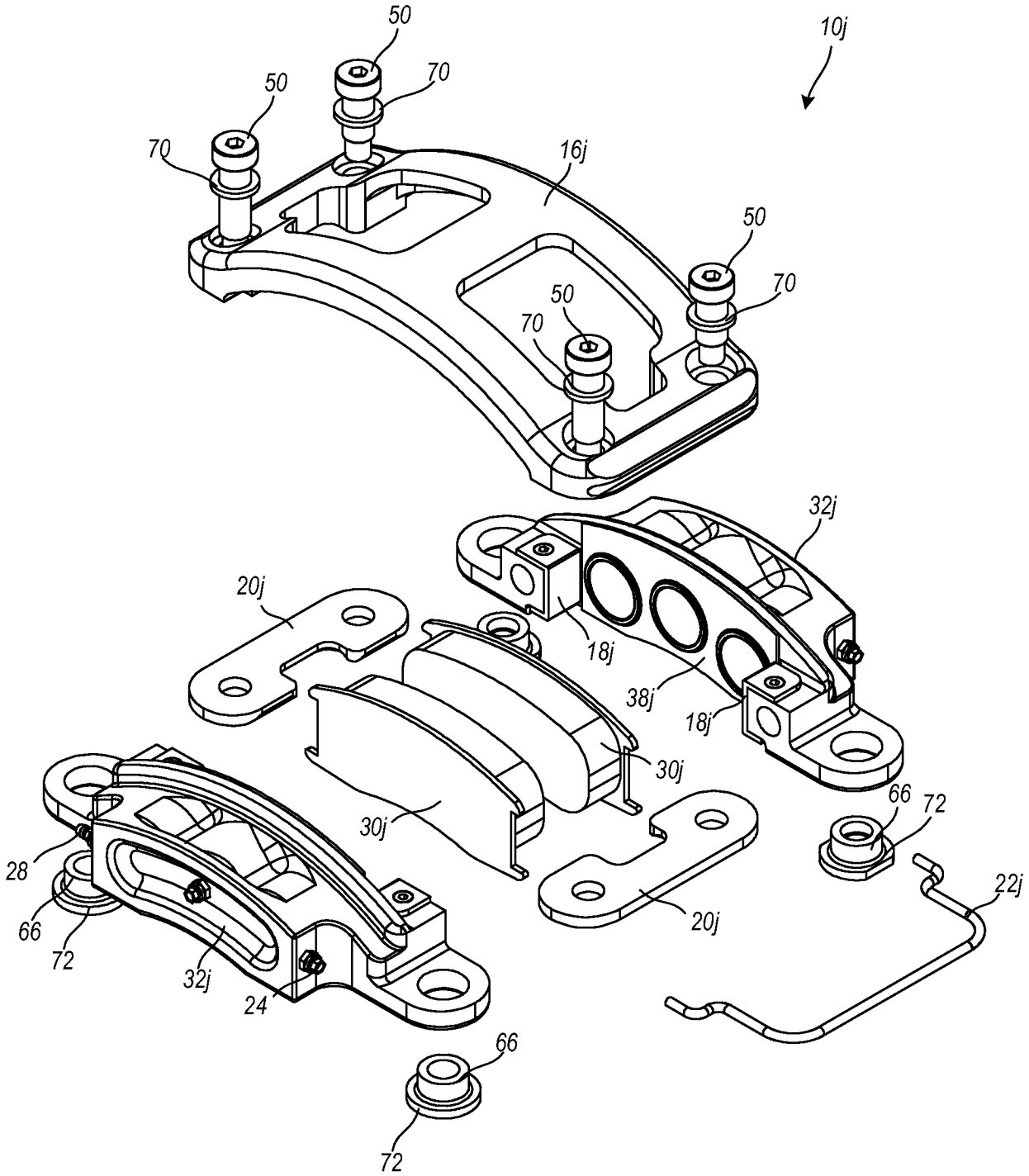
50
70
50
70
16j
10j
50
70
50
70
32j
20j
18j
38j
18j
30j
30j
66
72
28
66
72
32j
24
20j
22j
66
72

FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/030852

A. CLASSIFICATION OF SUBJECT MATTER

F16D 65/095(2006.01)i, F16D 65/04(2006.01)i, F16D 55/224(2006.01)i

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)

F16D 65/095; F16D 65/02

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)

eKOMPASS(KIPO internal) & Keywords: brake, caliper and module

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6302243 B1 (RUIZ; STEPHEN JOHN) 16 October 2001	10-12,19-21
A	See column 2, line 45 - column 4, line 53 and Figures 1-2.	1-9,13-18,22-24
X	JP 2000-291700 A (AKEBONO BRAKE IND CO LTD) 20 October 2000	10-12,19-21
A	See paragraph [0009]- paragraph [0017] and Figures 1-4.	1-9,13-18,22-24
X	JP 2008-075750 A (AKEBONO BRAKE IND CO LTD) 03 April 2008	10-12,19-21
A	See paragraph [0013]- paragraph [0031] and Figures 1-8.	1-9,13-18,22-24
A	JP 2008-241010 A (AKEBONO BRAKE IND CO LTD) 09 October 2008	1-24
A	US 2004-0238292 A1 (ORTEGREN ANDERS et al.) 02 December 2004	1-24

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 FEBRUARY 2010 (05.02.2010)	**09 FEBRUARY 2010 (09.02.2010)**

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Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

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TAK, Hyeong Yeop

Telephone No. 82-42-481-8421

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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