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(54) **Torziós lengéscsillapító szerkezet, különösen gépjármű hajtóművéhez**

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The invention relates to atorsion damping device, in particular for a motor vehicle transmission.

The invention relates more particularlyto atorsion damping devicehaving an axis of rotation of axial orientationandcomprising at least:

- an input element capable of being rotated by a driving shaft,

- an output element comprising at least one web rotationally connected to a driven shaft,

- elastic members with circumferential action interposed between the input element and the output element, and

- first and second washerswhich, capable of cooperating with the elastic members, are mounted free in rotation with respect to the input and output elements.

It is known from prior artmany examples ofdamping devicesof this type equipping generallyamotor vehicle transmissionsuch as disclosed for examplein document US 2010/0269497 A1.

In amotor vehicle transmission, such atorsion damping deviceis associated with a clutch able to selectively connect the engine to the gearbox, such as a friction clutch ora hydrokinetic coupling apparatuscomprising a lock-up clutch, andthis in order to filter the vibrationscaused by the acyclisms of the engine.

Indeed,a combustion engine has acyclisms due to the succession of explosions in the cylinders of the engine, with said acyclisms varying in particular according to the number of cylinders.

The damping meansof atorsion damping devicehave consequently for function to filter the vibrations generated by theacyclisms andintervenes before the engine torque is transmitted to the gearbox.

Otherwise, vibrations penetrating into the gearbox would provoke therein in operation impacts, noises or sound disturbances that are particularlyundesirable.

This is one of the reasons for which one or severaldamping meansare used able to filter the vibrations atleast at onedetermined frequency.

In the field of transmissions, the search to obtain increasingly higher filter performance has led for certain applications to adding apendulum oscillatorto the damping devices conventionally implemented in friction clutches as well as in motor vehicle hydrokinetic coupling apparatuses.

Apendulum oscillator, also called a pendulum, comprises at least one mass orflyweight, generally several, arranged about the axis of rotation of the engine shaft andwhich is free to oscillate about a fictive axis substantially parallel to the axis of rotation of the engine shaft.

When the masses of apendulum oscillatorreact to the irregularities of rotation, they oscillate in such a way that the centre of gravity of each one of these pendulum masses oscillatesabout an axis substantially parallel to the axis of rotation of the engine shaft.

The radial position of the centre of gravity of each one of thependulum masseswith respect to the axis of rotation of the engine shaft as well as the distance of this centre of gravitywith respect to the fictive axis of oscillation are established in such a way that, under the effect of centrifugal forces, the frequency of oscillation of each one of the pendulum massesis proportional to the speed of rotation of the engine shaft, with this multiple able for exampleto take a value close to the order of the preponderant harmonic of the vibrations responsible for the strong rotation irregularities in the vicinity of the slowdown.

The purpose of this inventionis very particularlyto propose a damping devicethat makes it possible to further improve the results obtained by retaining in particulara low encumbrance.

With this purpose, the invention proposes atorsion damping deviceof the type described hereinabove, characterised in thatthe damping devicecomprises at least two pendulum oscillators, the first washercomprising at least one first pendulum oscillatorandthe second washercomprising at least one second pendulum oscillator.

Thanks to the invention, the damping deviceimproves the filtration of the vibrations andthe pendulum oscillatorsare advantageously borne bythe washers of thedamping devicewhich provide respectively, in relation to theelastic members, a phasing function on the one hand, andaguiding functionon the other hand.

Advantageously,such a washerproviding a double functionof phasing and of guiding makes it possible to reduce the number of parts of thedamping deviceandto optimise the axial encumbrance of the device.

Advantageously,said washers of thedamping deviceare arranged axially at the front and rear ends of the damping devicein such a way as to be separated from each otherby the greatest distance possible for a given axial encumbrance of the damping device.

As such,the masses of each one of the first and second pendulum oscillatorscan be maximal, in particular whensaid masses of thefirst and second pendulum oscillatorsare arrangedover the same diameter in relation to the X axis.

Due to the criteria to be satisfied in order to provide for the two aforementioned functions, said washers of thedamping deviceare parts that are able to withstand the masses of the pendulum oscillatorsandmake it possible to obtain adamping deviceparticularly compact axially as well as radially.

According to other characteristics of the invention:

- the first pendulum oscillatorborne by the first washercomprises at least onependulum massmounted in an oscillating mannerwith respect to the first washerandin that the second pendulum oscillatorborne by the second washercomprises at least onependulum massmounted in an oscillating mannerwith respect to the second washer;

- the first pendulum oscillatorand the second pendulum oscillatorare tuned differently, respectively a first tuning order for the first pendulum oscillatoranda second tuning order for thesecond pendulum oscillator;

- the first pendulum oscillatorand the second pendulum oscillatorare tuned to have one and the same tuning order, the first pendulum oscillatorhaving a first tuning order equal to the second tuning order of the second pendulum oscillator;

- the first pendulum oscillatorand the second pendulum oscillatorare mutually synchronisedby way of synchronisation meansconnecting saidat least onependulum mass of the first pendulum oscillatortosaid at least onependulum mass of the second pendulum oscillator;

- said at least onependulum massof one at least of saidfirst and second pendulum oscillatorscomprises at least two flyweightswhich are arranged axially one on either side of the associated washer;

- the value of the mass of saidat least onependulum mass of the first pendulum oscillatoris different from the value of the mass of saidat least onependulum mass of the second pendulum oscillator;

- the value of the mass of saidat least onependulum mass of the first pendulum oscillatoris equal tothe value of the mass of saidat least onependulum mass of the second pendulum oscillator;

- the input element comprises a first input discanda second input discwhich are rotationally connected by connection means;

- the first and second input discsare arranged axially one on either side of saidat least one output elementandin thatthe first and second input discsare respectively arranged axially between saidat least one output elementandthe associated washer, the first washerbeing arranged axially before thefirst input discandthe second washerbeing arranged axially at the rear of thesecond input disc.

Advantageously,the damping deviceaccording to the inventionequipsa hydrokinetic coupling apparatuscomprising a turbineandthe input element of thedamping deviceis rotationally connected to the turbine.

The turbine is rotationally connected toa turbine hubandto the second input discbymeans of fastening, such as rivets.

Alternatively,the damping deviceaccording to the inventionequipping a hydrokinetic coupling apparatuscomprising a turbine, at least the second washerbearing the second pendulum oscillatoris rotationally connected to the turbine.

The turbine is rotationally connected to the second washerby the intermediary ofmeans of fastening, such as rivets.

According to another alternative,the damping deviceaccording to the inventionequipping a hydrokinetic coupling apparatuscomprising a turbine, the output element of thedamping deviceis rotationally connected to the turbine, directly or via a turbine hub.

Preferably,the turbine is rotationally connected to theturbine hubby means of fastening, such as rivets, andthe turbine hubis rotationally connected bymeans of coupling directly to the driven shaftorby the intermediary of an output hub of thedamping device.

The means of couplingbetweenthe turbine hubandthe output hub of thedamping deviceare carried out by cooperation of forms, in particularby means of complementary splines that respectively comprise the turbine hubandthe output hub.

Alternatively,themeans of couplingbetweenthe turbine hubandthe output hub of thedamping deviceare constituted by keys.

Other characteristics and advantages of the invention shall appear when reading the following detailed description for the understanding of which reference will be made to the annexed drawingsamong which:

- figure 1 is an explodedperspective viewwhich shows an embodiment of adamping deviceaccording to the invention;

- figure 2 is afront view of the damping deviceaccording to figure 1,of the front side corresponding to the side of the engine;

- figure 3 is afront view of the damping deviceaccording to figure 1, of the rear side corresponding to the side of thegearbox;

- figure 4 is a side view of the damping deviceaccording to figure 1;

- figures 5 to 10 are axial cross-section half-views of the damping devicealong the successive cross-sections which are shown in figure 3,respectivelythe plane of section A-A for the figure 5,the plane of section B-B for the figure 6, the plane of section C-C for the figure 7, the plane of section D-D for the figure 8, the plane of section E-E for the figure 9 andthe plane of section F-F for the figure 10;

- figure 11 is anaxial cross-section half-viewshowing an embodiment of the means of synchronisation;

- figure 12 is anaxial cross-section half-viewwhich, similar to figures 5 to 11, shows an alternative embodiment of the embodimentaccording to which the turbineis connected to the second washer of the damping device;

- figure 13 is ahalf-viewas an axial cross-sectionthat, similar to figures 5 to 11, shows an alternative embodiment of the embodimentaccording to which the turbineis connected to the output element.

In the rest of the description and the claims, in a non-limiting manner and in order to facilitate understanding, the terms "front"and "rear"; "outer" and "inner" as well asthe orientations "axial" and "radial" shall be used to designate, according tothe definitions given in the description, elements of the damping device.

By convention, the "axial" orientation corresponds tothe axisof rotation of the damping deviceand the direction from the front towards the rear corresponds to that indicated by the arrow "a" in figure 1, i.e. respectively the left and the right in figure 1.

The "radial" orientation is directed orthogonally to the axis of rotation of the damping devicefrom the inside towards the outside by moving away from said axisandthe "circumferential" orientation is directed orthogonally to the axisof the damping deviceand orthogonally to the radial direction.

The terms "outer" and "inner", like "front" and "rear", are used to define the relative position of an element in relation toanother, in reference tothe axis of rotation of the damping device, an element close tothe axisis as such qualified as inner by opposition to an outer element located radially at the periphery.

For the rest of the description, elements that have similar, identical or analogous functions shall be designated by the same reference numbers.

Figure 1 shows a torsion damping device 10according to the inventionwhich is able to equip amotor vehicle transmission.

In the embodimentandthe alternatives shown in the figures, the damping device 10isin particular, but not exclusively, intendedto equip a hydrokinetic coupling apparatus.

In a known manner, such a hydrokinetic coupling apparatus (not shown) mainly comprises a lock-up clutch, adamping deviceanda coupler or, preferably, a converter.

The hydrokinetic coupling apparatuscomprises a sealed casing formed respectivelyfrom a front portion and from a rear portion, globally in the shape of shells which arefor exampleassembled by welding.

The front and rear portions of the casing delimit a general volume of the apparatus inside of which areaxially arranged from the front to the rear the lock-up clutch, the damping deviceandthe torque converter.

The torque convertercomprisesa rear impeller wheel, a front turbine wheelanda central reaction wheel.

The impeller wheel comprisesblades which are borne by the rear portion of the casing which, integral in rotation with the front portion of the casing, is able to be rotationally connected to adrive shaft.

The turbine wheel also comprisesblades which axially face thebladesof the impeller wheel, the turbine wheel is able to be rotationally connected to adriven shaft, coaxial tothe axisof rotation of the damping device, for exampleby the intermediary of a hub.

In the case of an application to a motor vehicle, the drive shaftis constituted by the crankshaftof the internal combustion engineof the motor vehicle, while the driven shaftis constituted by the input shaft of thegearboxof the vehicle, connected to the means for changing the gear.

The damping device 10has an axis of rotation X that extends, by convention, along the axial orientation.

Such as shown in particularin figures 1 to 4, the damping device 10comprises at least one input element 12, an output element 14andelastic members 16with circumferential actionwhich are interposed between the input element 12andthe output element 14.

The input element 12isintendedto be driven in rotation by adrive shaft (not shown), such as the crankshaftof the internal combustion engineof the motor vehicle equipped with a transmission of whichthe clutch, whichcomprisessaiddamping device 10, is in the application example a hydrokinetic coupling apparatusof the type described hereinabove.

The output element 14 is intended to be rotationally connected to a driven shaft (not shown), such as the input shaft of the gearbox.

The input element 12 comprises a first input disc 12Aand a second input disc 12B, respectivelyarrangedaxiallyat the front and at the rear of the damping device 10andthe output element 14comprisesat least one web22, arrangedaxially in central position between saidfirstandsecond discs 12A, 12B.

The web 22 is here carried out in a singlepart, as an alternative the web22 is carried out in two separate parts, arrangedparallel to one another in the central position of the damping device 10.

Advantageously, the first input disc 12Aand the second input disc 12Bare rotationally connected by means of connection 18, 20.

The means of connection in rotation of thefirst input disc 12Aandof thesecond input disc 12Barefor exampleconstituted by at least oneaxial tab 18 which, integral with one of the discs 12A, is received in a complementary opening 20 arranged in the other of the discs 12B.

Preferably,the means of connection of the discs 12A, 12Bcomprisethreetabs 18 which aredistributed circumferentially and regularlyover the first disc 12A arrangedaxially at the front, i.e. at 120°around the axis of rotation Xof the damping device 10.

In the same way,the second disc 12Barranged axially at the rearalso comprisesthreeopenings 20 distributed circumferentially and regularlyat 120°around the axis of rotation Xof the damping device 10.

Advantageously,the tabs 18 that extendaxiallytowards the rear from the first disc 12A provide a spacing function and participate in the correct positioning of the parts, in particularof thefirst and second input discs 12A, 12Bwith respect to the web22 ofthe output element 14of the damping device 10which is interposed axially betweensaid input discs 12A, 12B.

The damping device 10further comprises at least two washers, respectively afirst washer 24A andasecond washer 24B.

The first washer 24A andthe second washer 24B are able to cooperate withthe elastic members 16.

Inthe damping device 10, the torque is transmittedby the intermediary of elastic members 16 with circumferential action of discs 12A and 12B forming the input element, to theweb 22 forming here a portion of the output element 14.

The first and second input discs 12A, 12Beach comprise windows 26 andthe web 22 comprises windows 28, theelastic members 16 with circumferential actionrespectivelyreceived in saidwindows 26 and 28 as such being interposed between the input element 12andthe output element 14.

The windows 26 and 28 are for examplein the number of threedistributed circumferentially and regularlyaround the axis of rotation Xof the damping device 10.

The windows 26 of the input discs 12A, 12Bare closed and respectively delimited, on the one hand,by an inner edge 30andan outer edge 32which extend respectivelycircumferentiallyand, on the other hand,by two edges 34 extending respectively radially and which, each,connect together an end of the inner edge 30andof the outer edge 32.

The three windows 26 are connected together byportions of material whereon arearranged, at the outer radial periphery, the connection tabs 18 of the input discs 12A, 12Bin such a way that eachtab 18 oropening 20 is arrangedcircumferentiallybetween two consecutive windows 26.

The windows 28 of the web22 of the output element 14 are open radially outwardsandthe windows 28 are separated from each other bythreetabs 26 arrangedin a star, distributed circumferentiallyat 120°, with each one of the tabs 36 comprisingtwo opposite edges 38 withwhich respectively cooperate anendof one of the elastic members 16 with circumferential action.

Preferably,each window 26, 28 receives twoelastic members 16 with circumferential actionand nota singleone in such a way that saidelastic members 16 are in the embodiment in the number of six, distributed circumferentiallyinto threegroups oftwo elastic members 16.

The elastic members 16 are for example formed by helical springs having a main axiswith circumferential orientation. As can be seen in figure 1, theelastic members 16 are arrangedin a circular row around the web22 in particular.

A groupof two elastic members 16 has advantages in relation tothe use of a single arched elastic member 16 of equivalent length, in particulara better solicitationof the elastic members 16 substantiallyaccording totheir main axisanda lesser sensitivity to the radial forces exerted by the centrifugal force.

However,the two elastic members 16 forming a group must be connected together in order to be able to operate in series.

This "phasing" function of theelastic members 16 of the same group is provided, inthe damping device 10, bythe first washer 24A andthe second washer 24B.

To do this,each one of the first and second washers 24A and 24B comprisesmeans for phasing 40able to connect together twoelastic members 16 housed in the same window 26 of the input discs 12A, 12Bandthe same window 28 of the web22.

The first and second washers 24A and 24B comprisewindows 42, here in the number of three, with twoconsecutive windows 42 being separated from each other by a means for phasing 40.

The windows 42 of thefirst and second washers 24A and 24B are angularly offset in relation to thewindows 26 and 28 in such a way that the means for phasing 40are positioned between twoelastic members 16, eachmeans for phasing 40comprisingtwo opposite edges 44 of radial orientation that each cooperate withone of the two elastic members 16 of a group.

In order to provide the phasing function, the first washer 24A andthe second washer 24B are mounted free in rotation with respect to the input 12 and output 14 elements.

The axial distance between the two washers 24A and 24B is less than the diameter of theelastic members 16.

Advantageously,the first washer 24A andthe second washer 24Balso providein addition to a phasing function of the elastic members 16 with circumferential action, aguiding function.

In an alternative not shown, theguiding functionof the elastic members 16 with circumferential actionis provided by other additional and separate parts ofthe first washer 24A andthe second washer 24B.

However, the embodiment shown in the figures isparticularly advantageous whenthe first washer 24A andthe second washer 24B provide the phasing function andtheguiding functionthanks to which, in addition to the reduced number of parts, the damping device 10has in particularless encumbrance axially.

The first washer 24A andthe second washer 24B comprise respectively, on windows 42 of the guiding means 46 able to maintain in position theelastic members 16 with circumferential action, axially as well as radially.

The elastic members 16 with circumferential actionarein particularsolicited during operation by forces due to the centrifugal force being exerted according to the radial direction.

In the example of a damping device 10equipping a hydrokinetic coupling apparatus, the first input disc 12Ais able to be rotationally connected, by the intermediary of a connected part 48, to alock-up clutch (not shown).

In particular visible in figures 1 and 4, the connecting part 48has as an axial cross-sectionan inverted "L" shape comprising a branch with a radial orientation anda branch with an axial orientation which extends towards the front, from the outer portion of the branch with radial orientation.

Preferably,in the embodiment shown in figures 1 to 11, the second input disc 12Bis rotationally connected to a turbine 50 of the converter, the turbine 50 being shown only in figures 5 to 11.

In operation,the lock-up clutchbeing in the disengaged state (open), the torque is first transmitted by the converter, more precisely by the turbine 50 to the second disc 12B through which the torque enters intothe damping device 10before being transmitted by the web 22.

Then,when the lock-up clutchis in the engaged state (closed), the torque is transmitted bythe connecting part 48to the first input disc 12Athrough which the torque enters intothe damping device 10before being transmitted by the web 22.

Preferably,the lock-up clutchcomprisingsaid connecting part 48is of the multi-disc type. Alternatively,the lock-up clutchcomprisingsaid connecting part 48is of the mono- or bi-disc type.

In a known mannerthe lock-up clutch (not shown) comprises a piston which is able to be selectively controlled in displacementin order to clamp or not friction discs rotationally connected to the connecting part 48andas such provoke the changes in the state of the clutch, between the disengaged and engaged states.

Preferably,the damping device 10comprises a flange 52 which is interposed axially between the first input disc 12Aandsaid connecting part 48, in the vicinity of theradially interior portion of thefirst input disc 12Aandofsaid connecting part 48.

Alternatively, the flange 52 is suppressed andthe connecting part 48is conformed to come directly into contact with the first input disc 12A.

Advantageously, such a flange 52 makes it possible to simplify the manufacture ofthe connecting part 48andto reinforcethe connection between the first input disc 12Aandthe connecting part 48between which the flange 52 is interposed axially.

The connection between the first input disc 12Aandthe connecting part 48 of the lock-up clutch, as well as the flange 52 whenthe damping device 10 comprisessuch a flange 52, is carried out by the intermediary ofmeans of fastening 54.

Preferably, the means of fastening 54are constituted by rivets, alternatively by any othersuitable means of connection.

Advantageously, the damping device 10 comprises an output hub 56by the intermediary of which the web 22 is able to be rotationally connectedto the driven shaft.

Advantageously, the web 22 is fastened by weldingto the output hub 56to rotationally connect, without play, these two parts forming saidoutput element 14of the damping device 10.

Preferably, the rotational connection betweenthe web 22 andthe output hub 56is carried out via friction welding.

Alternatively, the rotational connection betweenthe web 22 andthe output hub 56is carried out by any suitable means for exampleby cooperation of forms, such as by meshing between complementary toothing.

Advantageously, the input element 12andthe output element 14of the damping device 10are rotationally connected withan angular clearance which is limited by abutment means 58.

Preferably and as shown in figure 5, theabutment means 58of the damping device 10are constituted by at least onespacer intervening between the first and second input discs 12A and 12Bandthe web 22.

The abutment means 58arefor exampleconstituted by three spacersregularly angularly spacedon the circumference of thefirst and second input discs 12A and 12B.

Each spacer 58 comprises a central section 60 which isreceived in an associated opening 62 of the web 22, with the opening 62 determining the angular clearance capacity between the input 12 and output 14 elementswhen the central section 60 of the spacer 58 abuts against one of the endsof the opening 62.

Advantageously,the first washer 24A andthe second washer 24B are rotationally connected by means of connecting 64.

Preferably,the means of connecting 64 between the first washer 24A andthe second washer 24B are constituted by the spacers which can be seen more particularlyin figure 7.

In the embodiment, the second input disc 12Bis rotationally connected to the turbine 50 of the converter.

Advantageously,the damping device 10comprises a turbine hub 66. The second input disc 12B, the turbine hub 66andthe turbine 50 are rotationally connected by means of fastening 68.

Preferably,the means of connection 68are constituted by rivetsthat connect togetherthe second input disc 12B, the turbine hub 66and the turbine 50.

The spacers 58 forming the means of abutment alsoprovide at each one of their endsa connecting function, axiallyat the front between the first input disc 12A, the flange 52 andthe connecting part 48and, axiallyat the rear, between the second input disc 12B, the turbine hub 66and the turbine 50.

As such,eachspacer 58 then respectively replaces a rivet 54 at the front anda rivet 68 at the rear.

The damping device 10comprises firsttorsion damping means formed by theelastic members 16 with circumferential actionand second torsion damping meansformed by at least one pendulum oscillatororpendulum.

Advantageously,said first torsion damping meanscomprisea singlerow of elastic members 16 circumferentially distributed around the axisof rotation X of the damping device 10.

Alternatively,said first torsion damping meanscomprisetwo rows of elastic members 16 offset radially in relation toone another, with theelastic members 16 of each one of the rows (orstage) having more preferablydifferent stiffnesses.

According to the invention,the damping device 10comprises at least two pendulum oscillatorsforming second torsion damping meansof the damping device 10.

In the embodiment shown in the figures, the damping device 10according to the inventioncomprises at least two pendulum oscillators, here a double pendulum oscillator.

The damping device 10comprisesrespectivelyat least onefirst pendulum oscillator P1 borne by the first washer 24A andat least one second pendulum oscillator P2 borne by the second washer 24B.

Preferably,each one of the washers 24A, 24B comprises a pendulum oscillatorcharacterised by its tuning order.

However, in an alternative not shown, at least one of the washers 24A, 24B comprises more than onependulum oscillator, i.e.at least one primary pendulum oscillatorand one secondary pendulum oscillator, each one respectively characterised by a tuning order that is different from that of the other.

The first pendulum oscillator P1 comprises at least onependulum mass $M_n$mounted in an oscillating mannerwith respect to the first washer 24A and the second pendulum oscillator P2 comprises at least onependulum mass M_{n+1}mounted in an oscillating mannerwith respect to the second washer 24B.

As a non-limiting example, a four-cylinder motor causes vibrations that have a harmonic of a given frequency having different harmonic orders.

According to a first design, the first pendulum oscillator P1andthe second pendulum oscillator P2are tuned differently, respectively according to a first tuning order for the first pendulum oscillator P1andaccording to a second tuning order forthe second pendulum oscillator P2.

Advantageously,each one of the first and second pendulums P1, P2 borne by the associate of the washers 24A, 24B therefore has a given tuning order corresponding to a determined harmonic order.

In a non-limiting manner,in the aforementioned exampleof a four-cylinder engine the vibrations of a frequency harmonic 2Fo are advantageouslyable to be filtered by afirst pendulum oscillator P1having a tuning order equal tothe order"2"andby asecond pendulum oscillator P2having a tuning order equal tothe order"4".

In the same way for a six-cylinder engine, the first pendulum oscillator P1advantageously hasa tuning order equal to the order"3"andthe second pendulum oscillator P2a tuning order equal to the order"6".

According to the applications andconsequently the type of engine, the vibrations to be filtered sometimes have a preponderant harmonic order.

In this case,according to a second design, the first pendulum oscillator P1andthe second pendulum oscillator P2can be tuned to have one and the same tuning order.

Indeed,in the presence of a harmonic order that is particularly preponderant with respect to the other orders, apendulum oscillatoris sometimes insufficient in obtaining satisfactory filtering, except by increasing the mass thereof butrecall that, for the transmissions, the requirement to comply with installation constraints in the engine.

According to this second designcorresponding to the embodiment of the invention shown in the figures, the first pendulum oscillator P1andthe second pendulum oscillator P2advantageously have one and the same tuning order, for examplea tuning order equal to the order"2"for a four-cylinder engine.

Advantageously, the first pendulum oscillator P1andthe second pendulum oscillator P2are then synchronised together by way of synchronisation meansconnecting saidat least onependulum mass $M_n$of thefirst pendulum oscillator P1 tosaid at least onependulum mass $M_{n+1}$of the second pendulum oscillator P2.

Preferably,in the embodiment, the value of the mass of saidat least onependulum mass M_n of thefirst pendulum oscillator P1is equal tothe value of the mass of saidat least onependulum mass $M_{n+1}$of thesecond pendulum oscillator P2.

Preferably,the value of the pendulum masses of thefirst pendulum oscillator P1andof thesecond pendulum oscillator P2are equalas is that ofthe tuning order, however the tuning ordercould be the same for the first pendulum oscillator P1andthe second pendulum oscillator P2without necessarily the value of the pendulum masses being equal.

Alternatively,the value of the mass of saidat least onependulum mass $M_n$of the first pendulum oscillator P1is different from the value of the mass of saidat least onependulum mass $M_{n+1}$of the second pendulum oscillator P2.

Preferably andsuch as shown in figures 1 to 4, at least one of thefirstandsecondpendulum oscillators P1, F2of the damping device 10, here both, comprises an even number ofpendulum masses M_n; M_{n+1}.

Advantageously, the first pendulum oscillator P1comprises at least one pair of pendulum masses $M_n$respectively comprisinga pendulum mass M1anda pendulum mass M3.

Preferably,the index "n" is an odd integer.

Preferably,the pendulum mass M1andthe pendulum mass M3are consequently paired.

The pendulum masses M1, M3of thefirst pendulum oscillator P1are arranged, circumferentially on the associated washer 24A, diametrically opposite one another.

Preferably, the first pendulum oscillator P1borne by the washer 24A comprises an even number ofpendulum masses, here a total of four masses M1, M3, M5 and M7distributed circumferentially and regularly, such as shown in figures 1,2 and 4.

Advantageously,said at least onependulum mass $M_n$of the first pendulum oscillator P1comprises at least two flyweights 70A and 70B which are arranged axiallyon either side of the associated washer 24A.

Each one of the four masses M1, M3, M5 and M7 of the first pendulum oscillator P1comprises at least two flyweights 70A and 70B which are arranged axiallyon either side of the associated washer 24A.

Of course,the embodiment is given solely as an exampleand, alternatively, the first pendulum oscillator P1comprises an odd number of masses M_n, for examplethree or five masses, with each one of said massesadvantageously comprisingtwo flyweights 70A and

70B which are arranged axiallyon either side of the associated washer 24A.

Advantageously,the second pendulum oscillator P2comprises at least one pair of pendulum masses M_{n+1}respectively comprisinga pendulum mass M2anda pendulum mass M4.

Preferably,the pendulum mass M2andthependulum mass M4 are consequently paired. The pendulum masses M2, M4 of the second pendulum oscillator P2are arranged, circumferentially on the associated washer 24B, diametrically opposite one another.

Preferably,the second pendulum oscillator P2borne by the washer 24B comprises an even number ofpendulum masses, here a total of four masses M2, M4, M6 and M8 distributed circumferentially and regularly, such as shown in figures 1,3 and 4.

Advantageously,said at least onependulum mass $M_{n+1}$of the second pendulum oscillator P2comprises at least two flyweights 72A and 72B which are arranged axiallyon either side of the associated washer 24B.

Each one of the four masses M2, M4, M6 and M8 of thesecond pendulum oscillator P2comprises at least two flyweights 72A and 72B which are arranged axiallyon either side of the associated washer 24B.

Alternatively,the second pendulum oscillator P2comprises an odd number of masses M_n, with each one of said massesadvantageously comprisingtwo flyweights 72A and 72Bwhich are arranged axiallyon either side of the associated washer 24B.

Such as can be seen in particularin figure 4, the first and second input discs 12A, 12Barearrangedaxiallyon either side ofthe output element 14formed by the web 22.

The axial separation between the first input disc 12Aand the second input disc 12Bis given by the tabs 18 that form the means for connecting andis determined in such a way as to prevent any contact with the web 22.

The first and second input discs 12A, 12Bare respectively arranged axially between the web 22 andthe associated washer 24A, 24B, the first washer 24A being arranged axially before thefirst input disc 12Aandthe second washer 24Bbeing arranged axially at the rear of thesecond input disc 12B.

The output hub 56comprises, axiallyat the rear, an external cylindrical face 74 whereon is mounted the turbine hub 66, the turbine hub 66being blocked axiallytowards the front by a central portion of theoutput hub 56andaxiallytowards the rear by an elastic ring 76 which ismounted in a groove 78 of theoutput hub 56.

The output hub 56 isaxiallytieredandcomprises, at the front of the cylindrical face 74, saidcentral portion to which the web 22 is welded and also at the front, a cylindrical face 80.

The turbine hub 66axially comprises successively, from the front towards the rear, a cylindrical face 82 whereon is centred the second input disc 12B, a central cylindrical face 84 whereon is centred the second washer 12Banda cylindrical face 86 whereon is centred the turbine 50.

The firstandsecondpendulum oscillators P1, P2are able to be carried out according tomany alternative embodiments, the example described and shown is consequently given in a non-limiting manner.

As shown in figure 1, the flyweights 70Aet 70B of the first pendulum oscillator P1andthe flyweights 72A and 72B of the second pendulum oscillator P2arerespectivelyarrangedat the outer radial peripheryofthe first washer 24A and ofthe second washer 24B in such a way as to be subjected to a maximum centrifugal force during the rotation about the X axisof the damping device 10.

In the embodiment, the first pendulum oscillator P1comprisesfour pairs of flyweights 70A, 70B corresponding to the masses M1 to M7 andthe second pendulum oscillator P2comprisesalsofour pairs of flyweights 72A, 72B corresponding to the masses M2 to M8.

The flyweights 70A, 70B borne by the first washer 24A andtheflyweights 72A, 72B borne by the second washer 24B are radially arrangedover the same diameter, i.e.at the same distance fromthe axisof rotation X andoutside of the elastic members 16.

As such,the damping device 10is balanced.

Alternatively,theflyweights 70A, 70B of the first pendulum oscillator P1are radially offset in relation to theflyweights 72A, 72Bof the second pendulum oscillator P2.

Alternatively,the number of flyweights of the first pendulum oscillator P1is different from that of the second pendulum oscillator P2andeven when each one comprisesthe same number of flyweights, the value of the mass and/orof the tuning order can differ from one pendulum oscillatorto the other.

As shown in figure 1, each one of the pendulum flyweights 70A, 70B and 72A, 72Bglobally has a form of a plate that extends in a radial planeandwhich iscurved in an arc of circle in such a way that its outer contour hugs the outer peripheral edge of the associated washer 24.

Preferably,theflyweights 70A and 70B of the first pendulum oscillator P1are mounted oscillatingwith respect to the first washer 24A by the intermediary ofassociated means of bearing 88, as are also theflyweights 72A and 72B of the second pendulum oscillator P2with respect to the second washer 24B.

The pendulum oscillators P1 and P2are here analogous in such a way that the description that follows for one, is also valid for the other.

In the first pendulum oscillator P1andsuch as shown in figure 10, the means of bearingare constituted by at least one hinge pin 88 of whicheachend section 90 is received in an orifice 92 of an associated pendulum flyweight 70A, 70B, said pin comprisinga central section 94 received sliding in an associated guiding slot 96 of the washer 24A.

The orifice 92 of each pendulum flyweight 70A, 70B is a track whereinthe associated end section 90 of the hinge pin 88 is received sliding in a radial plane, orthogonal to the axis X of axial orientation.

Such as shown in figure 6, the first pendulum oscillator P1also comprises at least one fastening pin

98, preferably three pins, with each end section of the fastening pin 98 being fastened to one of the pendulum flyweights 70A, 70B.

Each free axial end section of a fastening pin 98 is fastened in an orifice 100 of an associated pendulum flyweight, the pins 98 are fastened to the flyweights by deformation of their free axial endsin the manner of a rivet so that the two flyweights 70A and 70B for the first pendulum oscillator P1 (or 72A and 72B) are rigidly fastened to one another.

The fastening pin 98 forms a spacer that maintains the two pendulum flyweights 70A and 70B axiallyseparated by a distance determined in such a way that the pendulum flyweights 70A, 70Bdo not enter into contact with the washer 24A.

The first washer 24A comprises for each fastening pin 98 an axially pass-through guiding slot 102 in order to allow for the passing of the central section of each pin 98.

Figure 11 showsan embodiment of the aforementioned means of synchronisation implemented when the first pendulum oscillator P1andthe second pendulum oscillator P2have the same tuning order.

The first pendulum oscillator P1andthe second pendulum oscillator P2are advantageouslymutually synchronised by way of synchronisation meansconnecting saidat least onependulum mass M1of the first pendulum oscillator P1tosaid at least onependulum mass M2 of the second pendulum oscillator P2.

Such as shown in figure 11, the means for synchronisation arefor examplecarried out in the form of a part 104 forming a bridge axiallyconnecting a flyweight 70B of the first pendulum oscillator P1 toa flyweight 72A of the second pendulum oscillator P2.

Thanks to such means of synchronisation 104, the first and second pendulum oscillators P1, P2behave globally as a single pendulum oscillator.

In the preceding example of a preponderant harmonic order, it is as such possible, thanks to the double pendulum oscillatoraccording to the invention, to obtain a particularly effective filtration of a given harmonic order by using two pendulum oscillatorsthat have the same tuning order andadvantageouslymutually synchronised.

Of course,such an example is not limiting, it is understood that adamping device 10comprising at leasttwo pendulum oscillatorshas as much interest in particular wheneachpendulum oscillatorhas a given tuning order corresponding to one of the harmonic orders.

The rotational connection of the turbine 50 withthe damping device 10is able to be carried out in different manners, in particularaccording towhether or not it is desired to add inertia of the turbine 50 on an element of the damping device 10.

In the embodimentshown in the figures 1 to 11, the turbine 50 is rotationally connected to thesecond input disc 12Band tothe second washer 24B.

Figure 12 showsan alternative embodiment whereinat least the second washer 24Bbearing the second pendulum oscillator P2is rotationally connected to the turbine 50 of the converter.

In comparison withthe preceding embodiment, the turbine 50 here is no longer rotationally connected to the second input disc 12B, therefore to the input element 12of the damping device 10.

Indeed,the first washer 24A andthe second washer 24Bare mounted free in rotationwith respect to the input 12 and output 14 elements.

The turbine is rotationally connected to the second washerby the intermediary ofmeans for fastening 106, such as rivets.

Such as described hereinabove,the damping device 10advantageously comprisesaturbine hub 66to which is rotationally connected the turbine 50 of a converter, saidturbine hub 66being rotationally connected directly to adriven shaftorby the intermediary of theoutput hub 56of the damping device 10.

The turbine hub 66is rotationally connected to the output hub 56by the intermediary ofmeans of coupling, saidoutput hub 56being, on the one hand,rotationally connected tothe output element 14of the damping device 10and, on the other hand,able to drive in rotation a driven shaft, in particularby meshing.

Figure 13 shows another alternativewhereinthe output element 14of the damping device 10is rotationally connected to the turbine 50, directly or through the intermediary of the turbine hub 66.

Preferably, the turbine 50 is rotationally connected to theturbine hub 66by means of fastening 108, such as rivets, and the turbine hub 66is rotationally connected bymeans of coupling 110 directly to the driven shaftorby the intermediary of an output hub 56of the damping device 10.

Preferably,the coupling means 110between the turbine hub 66andthe output hub 56of the damping device 10are carried out by cooperation of forms, in particularby means of complementary splinesthat respectivelycomprise the turbine hub 66andthe output hub 56.

Alternatively,the coupling means 110between the turbine hub 66andthe output hub 56of the damping device 10are constituted by keys (not shown).

The coupling means 110between the turbine hub 66andthe output hub 56of the damping device 10can be carried out according toother alternatives, for exampleandin a non-limiting mannerby a mounting with force (clamping), by welding orby a mounting of the "bikini" type, i.e.a crimping and an axial stoppage.

TORZIÓS LENGÉSCSILLAPÍTÓ SZERKEZET, KÜLÖNÖSEN GÉPJÁRMŰ HAJTÓMŰVÉHEZ

SZABADALMI IGÉNYPONTOK

1. Torziós lengéscsillapító szerkezet, különösen gépjármű hajtóművéhez, amely szerkezetnek van egy tengelyirányú forgástengelye (X), és magában foglal legalább:

- egy bemeneti elemet (12), amely forgó módon hajtható egy hajtótengellyel,
- egy kimeneti elemet (14), amely magában foglal legalább egy lemezt (22), amely együttforgó módon össze van kötve egy hajtott tengellyel,
- kerületi hatású rugalmas szerveket (16), amelyek a bemeneti elem (12) és a kimeneti elem (14) közé vannak behelyezve, és
- első és második tárcsákat (24A, 24B), amelyek együtt tudnak működni a rugalmas szervekkel (16), és a bemeneti elemhez (12) és a kimeneti elemhez (14) képest szabadon forgathatóan vannak szerelve,

azzal jellemezve, hogy a lengéscsillapító szerkezet (10) magában foglal legalább két lengő rezgéskeltőt, az első tárcsa (24A) magában foglal legalább egy első lengő rezgéskeltőt (P1), a második tárcsa (24B) pedig magában foglal legalább egy második lengő rezgéskeltőt (P2).

2. Az 1. igénypont szerinti szerkezet, azzal jellemezve, hogy az első tárcsa (24A) által hordozott első lengő rezgéskeltő (P1) magában foglal legalább egy lengő tömeget (M_n), amely az első tárcsához (24A) képest lengően van szerelve, és azzal, hogy a második tárcsa (24B) által hordozott második lengő rezgéskeltő (P2) magában foglal legalább egy lengő tömeget (M_{n+1}), amely a második tárcsához (24B) képest lengően van szerelve.

3. Az 1. vagy a 2. igénypont szerinti szerkezet, azzal jellemezve, hogy az első lengő rezgéskeltő (P1) és a második lengő rezgéskeltő (P2) eltérően vannak beállítva, az első lengő rezgéskeltő (P1) egy első beállítási rend szerint, a második lengő rezgéskeltő (P2) pedig egy második beállítási rend szerint.

4. Az 1. vagy a 2. igénypont szerinti szerkezet, azzal jellemezve, hogy az első lengő rezgéskeltő (P1) és a második lengő rezgéskeltő (P2) úgy vannak beállítva, hogy beállítási rendjük ugyanaz.

5. A 4. igénypont szerinti szerkezet, azzal jellemezve, hogy az első lengő rezgéskeltő (P1) és a második lengő rezgéskeltő (P2) össze van hangolva egy szinkronizáló eszközön (104) keresztül, amely az első lengő rezgéskeltő (P1) legalább egy lengő tömegét (M_n) összeköti a második lengő rezgéskeltő (P2) legalább egy lengő tömegével (M_{n+1}).

6. Az 1-5. igénypontok bármelyike szerinti szerkezet, azzal jellemezve, hogy az első és a második lengő rezgéskeltő (P1, P2) közül legalább az egyiknek a legalább egy lengő tömege (M_n, M_{n+1}) magában foglal legalább két röpsúlyt (70A, 70B, 72A, 72B), amelyek tengelyirányban az adott tárcsa (24A, 24B) két oldalán vannak elhelyezve.

7. Az 1-6. igénypontok bármelyike szerinti szerkezet, azzal jellemezve, hogy az első lengő rezgéskeltő (P1) legalább egy lengő tömegének (M_n) tömegértéke különbözik a második lengő rezgéskeltő (P2) legalább egy lengő tömegének (M_{n+1}) tömegértékétől.

8. Az 1-6. igénypontok bármelyike szerinti szerkezet, azzal jellemezve, hogy az első lengő rezgéskeltő (P1) legalább egy lengő tömegének (M_n) tömegértéke egyenlő a második lengő rezgéskeltő (P2) legalább egy lengő tömegének (M_{n+1}) tömegértékével.

9. Az 1-8. igénypontok bármelyike szerinti szerkezet, azzal jellemezve, hogy a bemeneti elem magában foglal egy első bemeneti lemezt (12A) és egy második bemeneti lemezt (12B), amelyek összekötő eszközök (18, 20) révén együttforgó módon össze vannak kötve.

10. A 9. igénypont szerinti szerkezet, azzal jellemezve, hogy az első és a második bemeneti lemez (12A, 12B) tengelyirányban a legalább egy kimeneti elem (14) két oldalán vannak elhelyezve, és azzal, hogy az első és a második bemeneti lemez (12A, 12B) tengelyirányban a legalább egy kimeneti elem (14) és az adott tárcsa (24A, 24B) között van elhelyezve.

11. Az 1-10. igénypontok bármelyike szerinti szerkezet, amellyel el van látva egy turbinát (50) magában foglaló, hidrodinamikus tengelykapcsoló berendezés, azzal jellemezve, hogy a lengéscsillapító szerkezet (10) bemeneti eleme (12) együttforgó módon össze van kötve a turbinával (50).

12. Az 1-10. igénypontok bármelyike szerinti szerkezet, amellyel el van látva egy turbinát (50) magában foglaló, hidrodinamikus tengelykapcsoló berendezés, azzal jellemezve, hogy legalább a második tárcsa (24B), amely a második lengő rezgéskeltőt (P2) hordozza, együttforgó módon össze van kötve a turbinával (50).

13. Az 1-10. igénypontok bármelyike szerinti szerkezet, amellyel el van látva egy turbinát (50) magában foglaló, hidrodinamikus tengelykapcsoló berendezés, azzal jellemezve, hogy a lengéscsillapító szerkezet (10) kimeneti eleme (14) a turbinával (50) közvetlenül vagy a turbina kerékagyán (66) keresztül van együttforgó módon összekötve.

(A meghatalmazott)

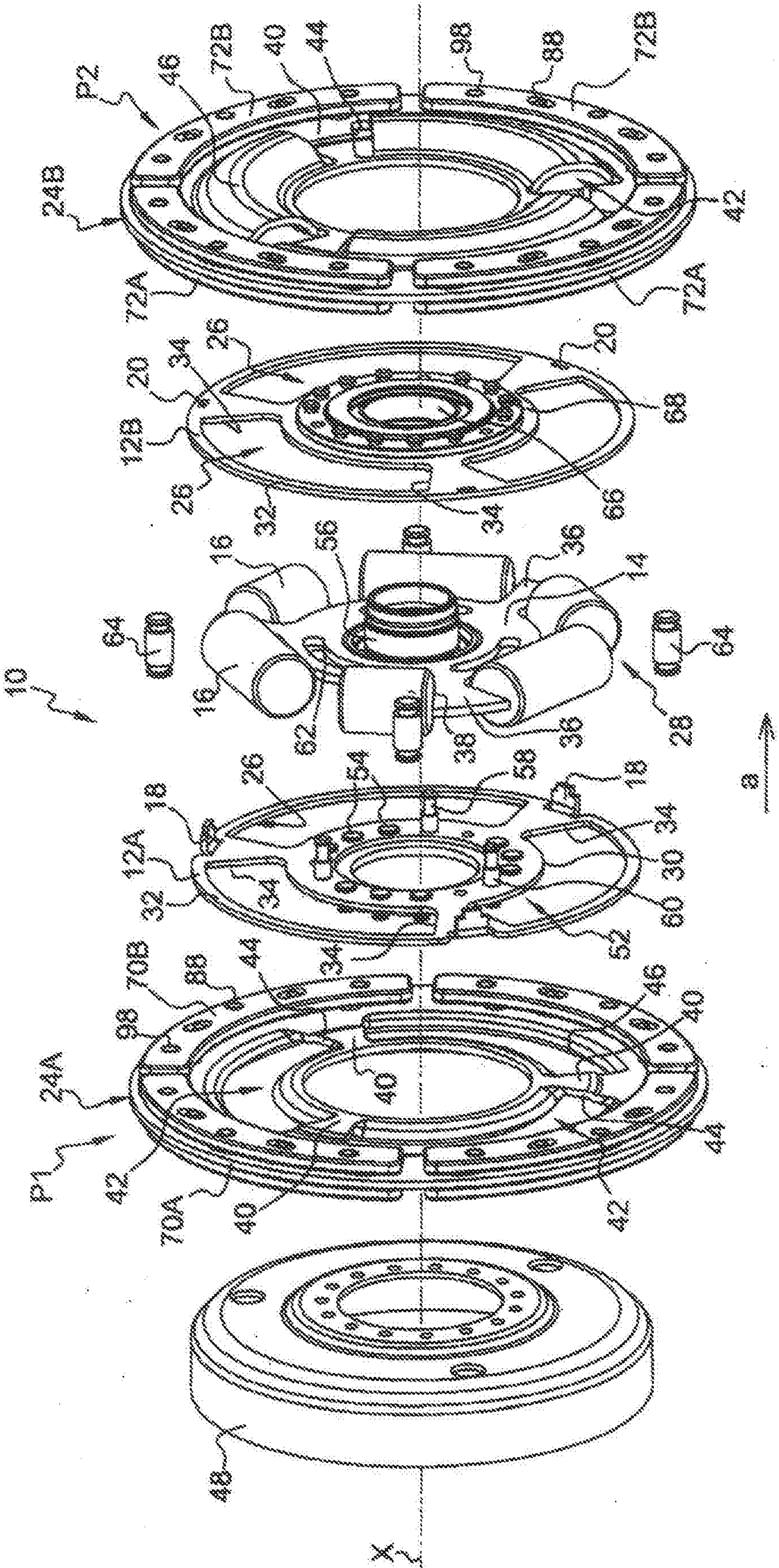
P2
24B
46
72B
40
44
98
88
72B
42
72A
72A
26
20
34
20
12B
68
66
26
32
34
16
56
36
14
64
16
64
10
62
38
36
28
18
26
54
58
18
12A
34
34
30
32
60
34
52
a
70B
88
44
46
40
98
24A
40
40
42
P1
70A
40
44
42
48
X

Fig. 1

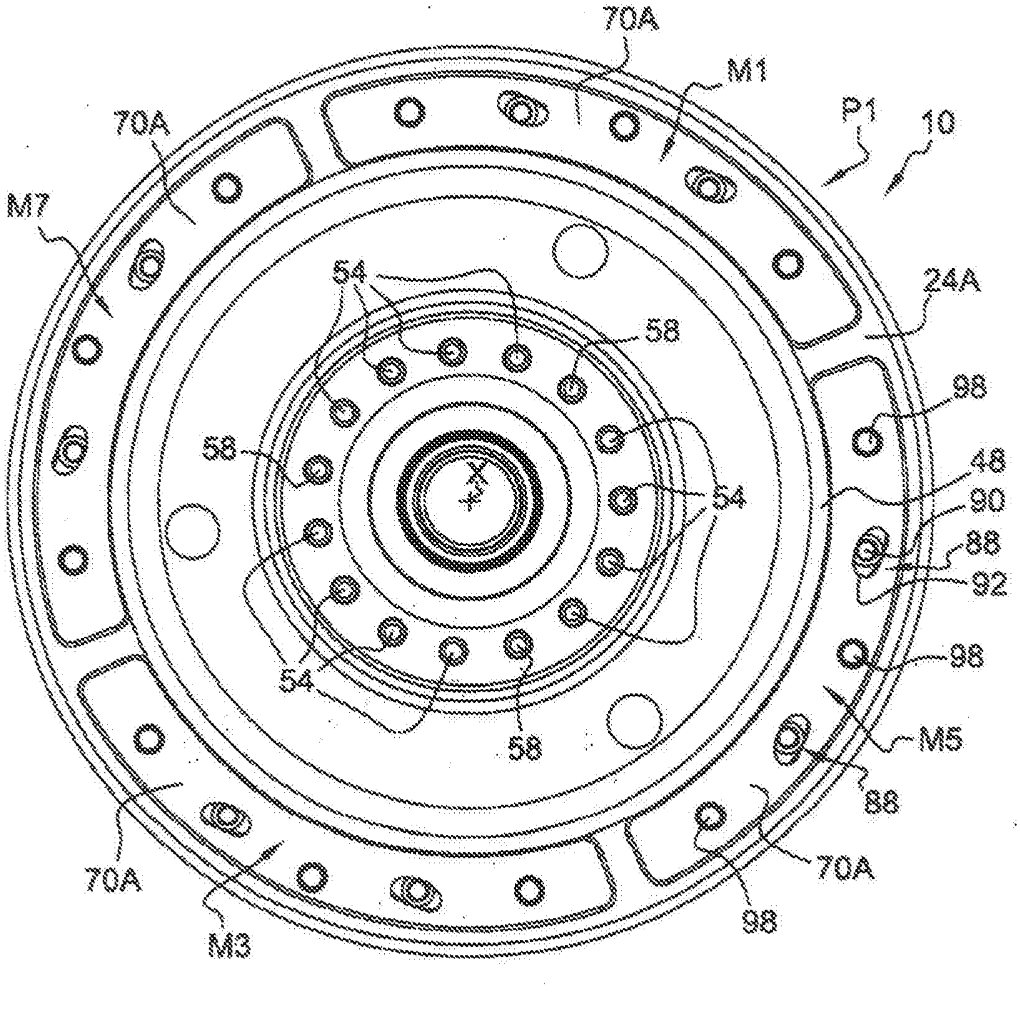
70A
M1
P1
10
70A
M7
24A
54
58
98
58
48
X
90
54
88
92
98
54
58
M5
88
70A
70A
M3
98

Fig. 2

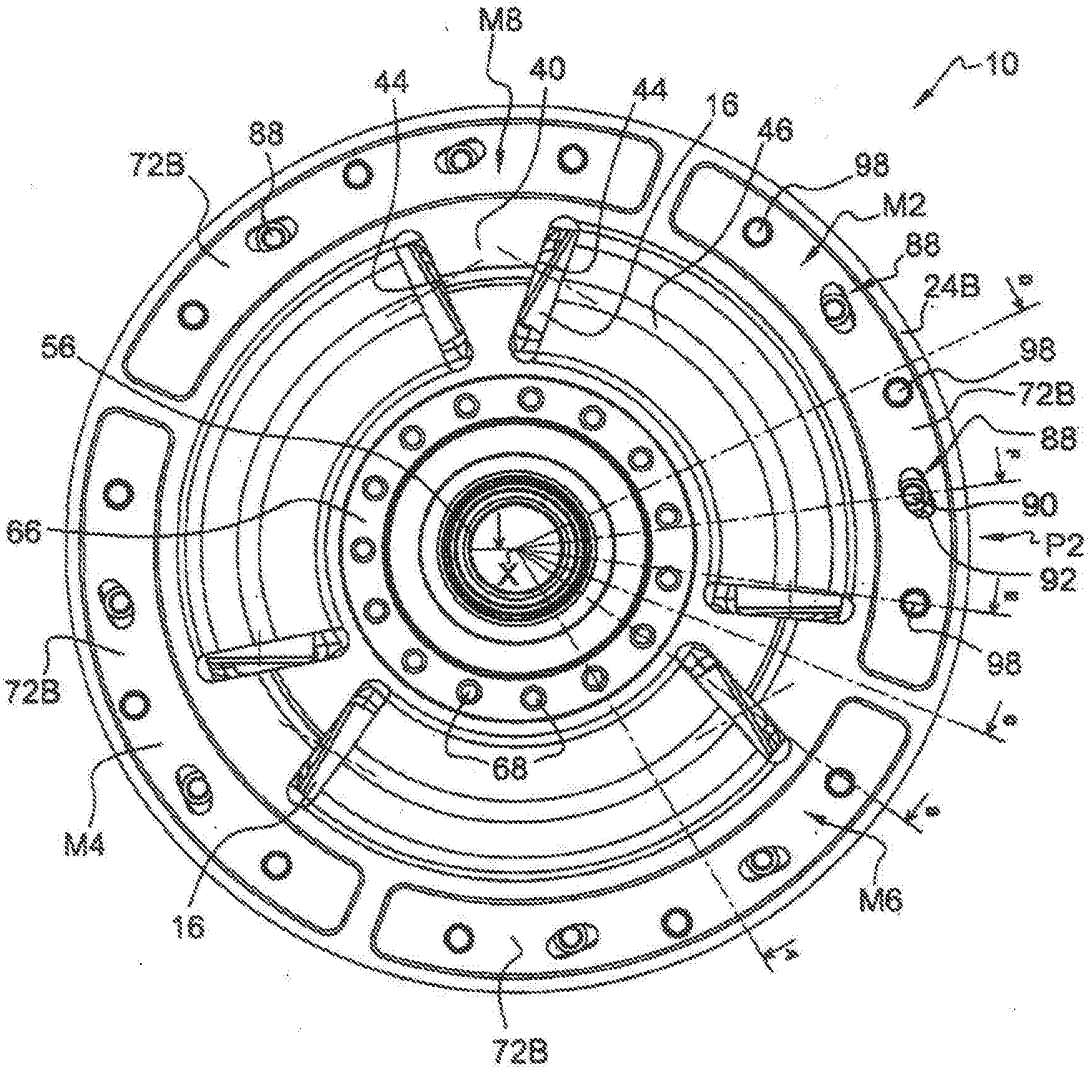
M8
40
44
44
16
46
10
88
72B
98
M2
88
24B
56
98
72B
88
90
66
P2
92
98
72B
M4
68
16
M6
72B

Fig. 3

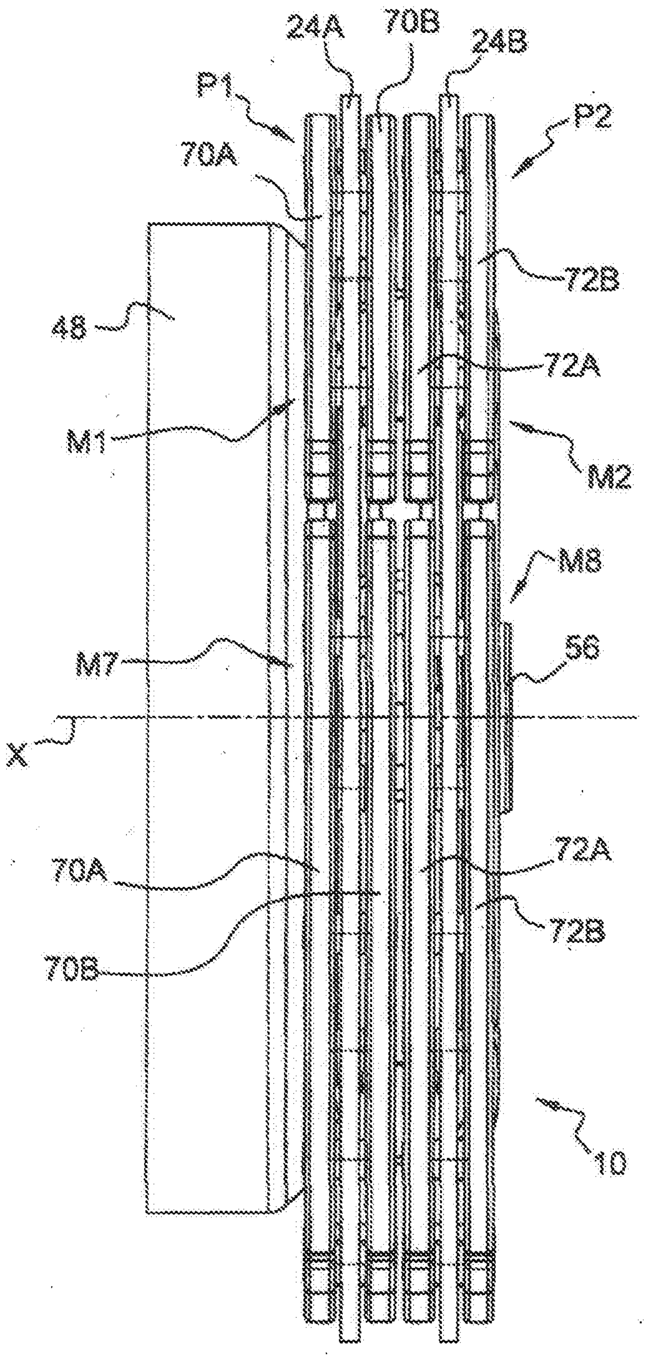

Fig. 4

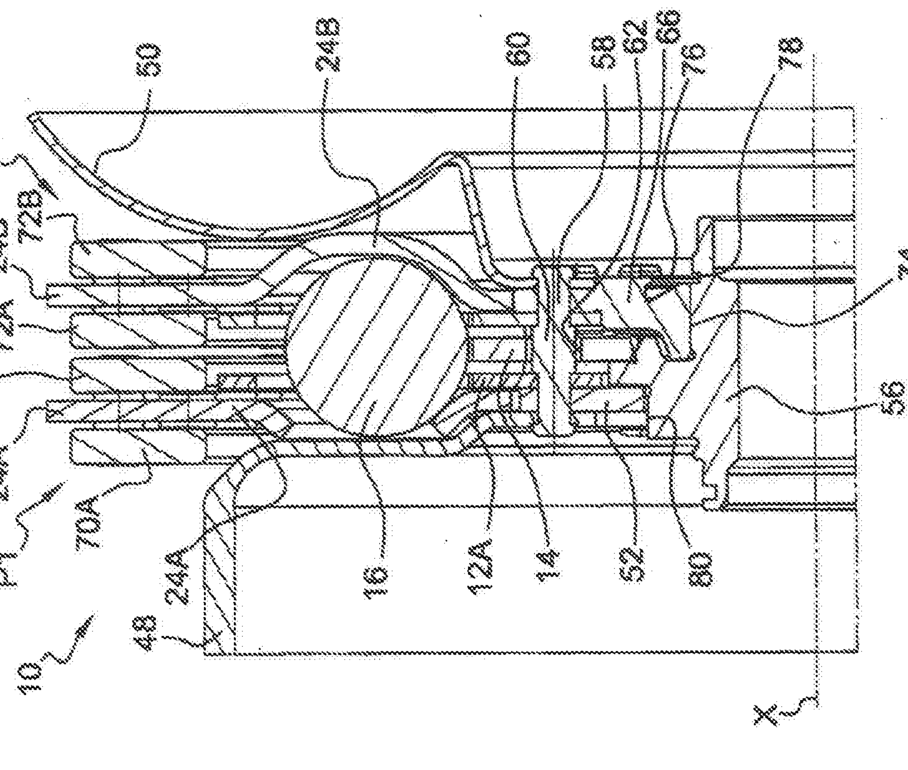
10
P1
P2
48
24A
70A
24A
70B
72A
24B
72B
50
16
24B
12A
14
60
58
62
66
76
78
52
80
74
56
X

Fig. 5

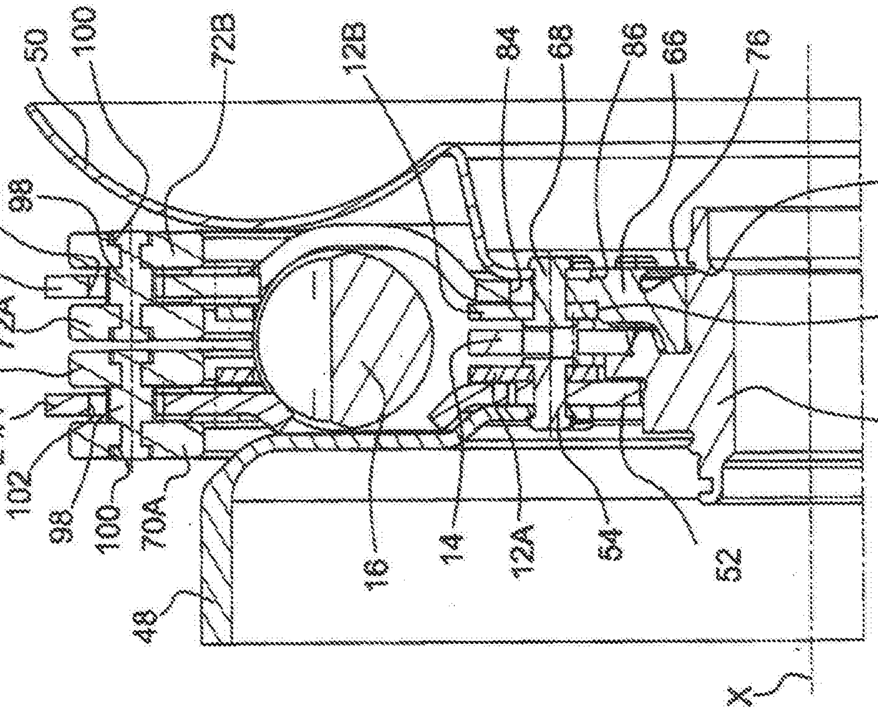
48
98
100
102
70A
24A
70B
72A
24B
102
98
100
50
72B
16
12B
14
12A
84
68
54
86
66
52
76
82
78
56
X

Fig. 6

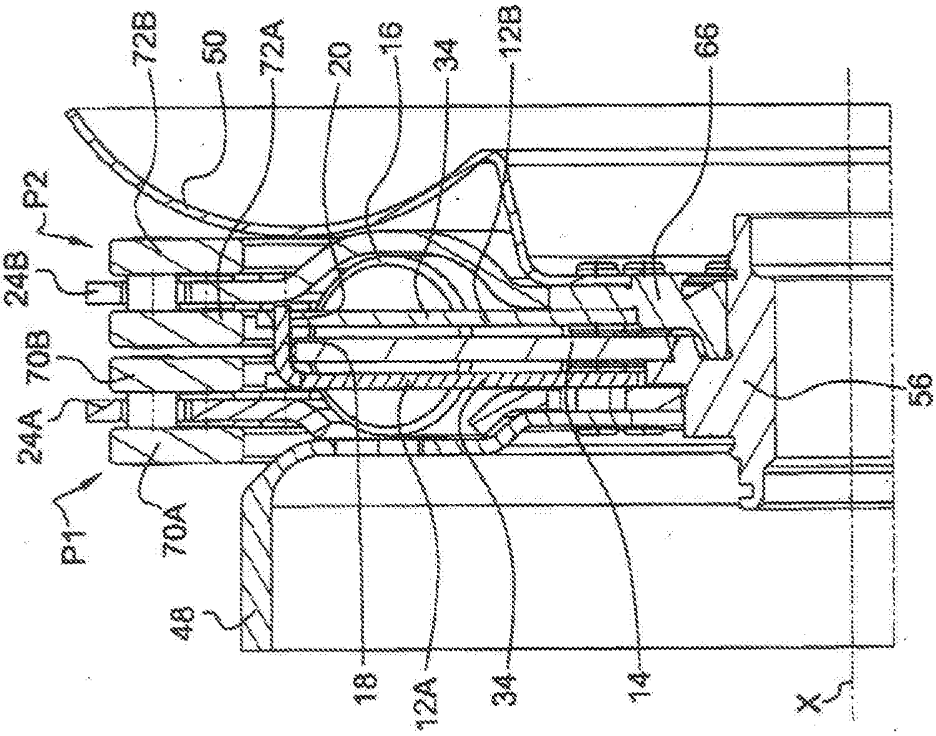
72B
50
72A
20
16
34
12B
66
P2
24B
70B
24A
P1
70A
48
18
12A
34
14
56
X

Fig. 8

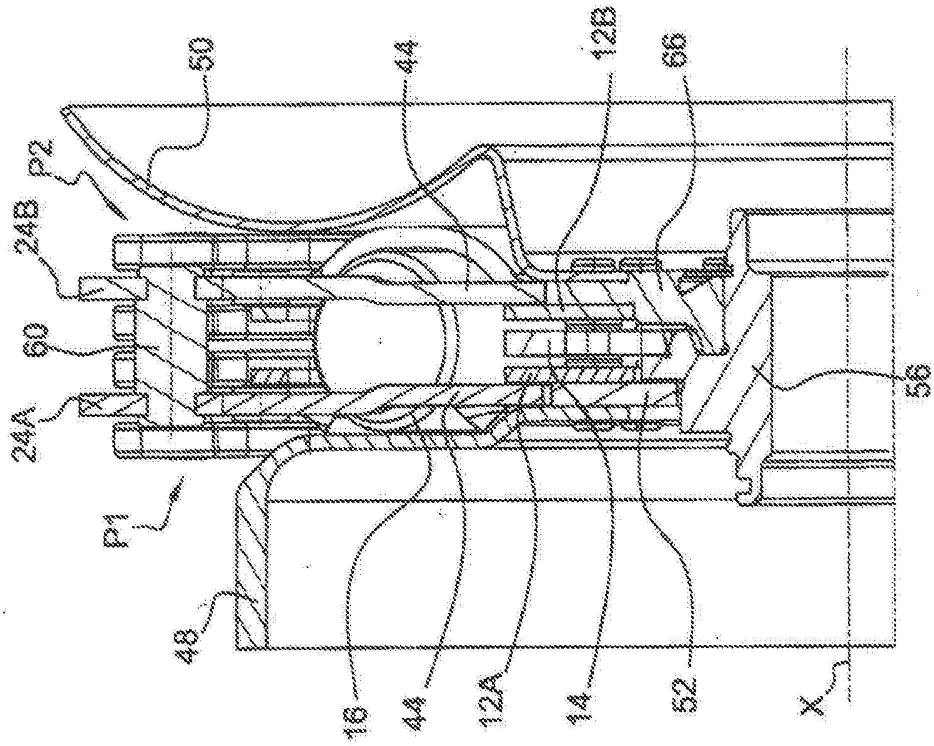
50
44
12B
66
P2
24B
60
24A
P1
48
16
44
12A
14
52
56
X

Fig. 7

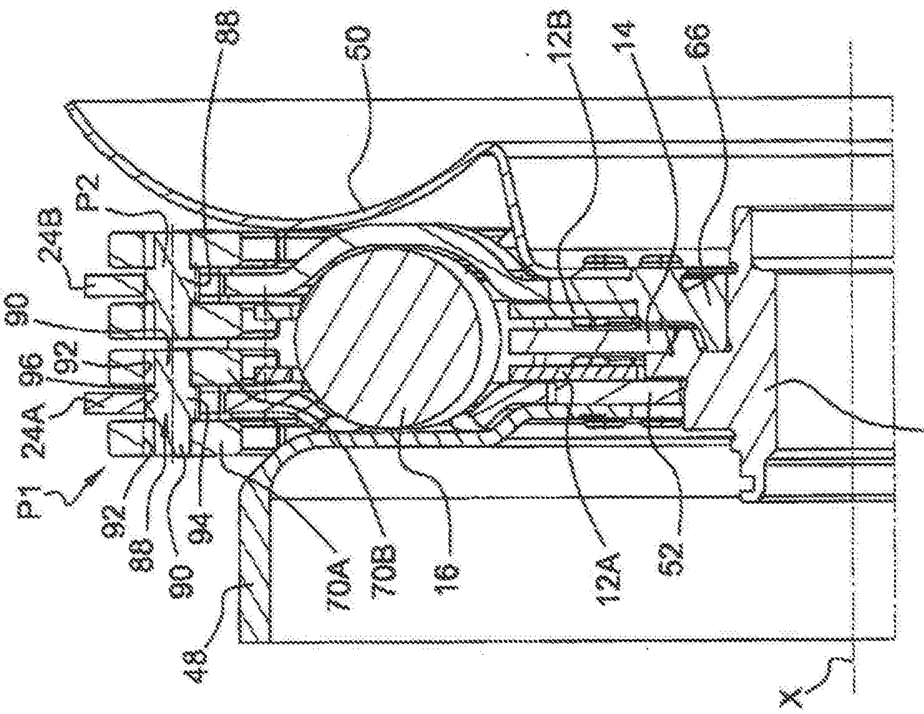
P1
P2
24A
24B
96
92
90
88
94
70A
70B
16
12A
12B
14
52
50
66
56
48
X

Fig. 10

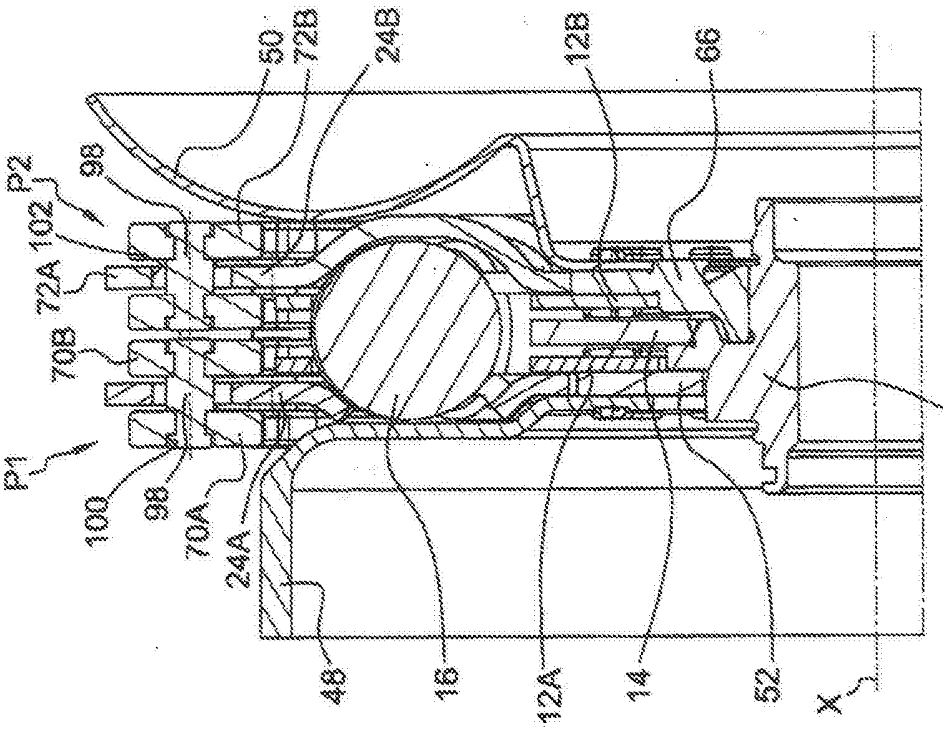
P1
P2
100
98
70A
24A
70B
72A
102
72B
24B
50
48
16
12A
12B
14
52
66
56
X

Fig. 9

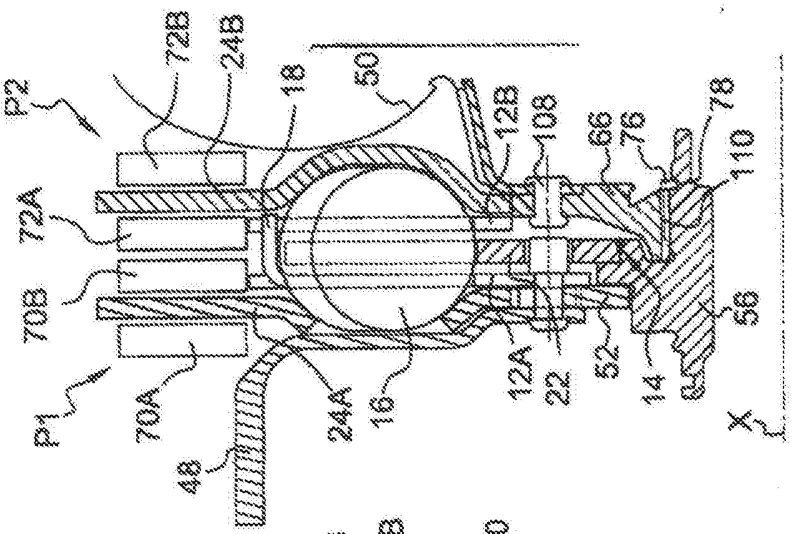

Fig. 13

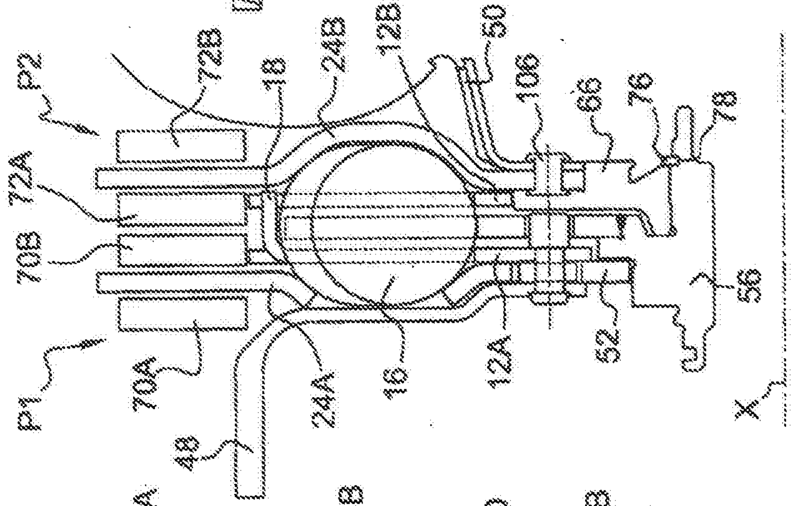

Fig. 12

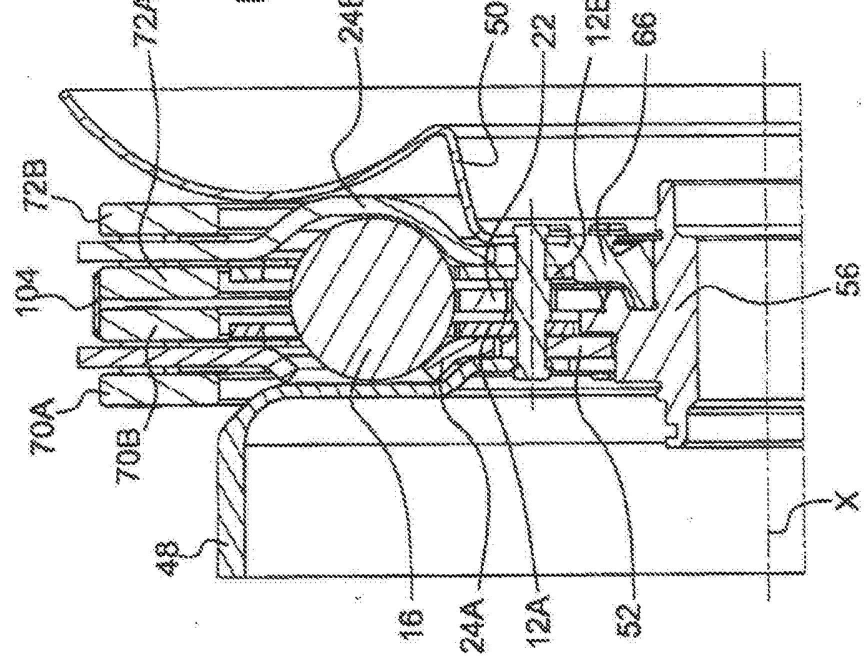

Fig. 11