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F16H 57/02 // B60Q 1/06

(52) UK CL (Edition N)
F2U U12
F2Q Q3A4
F4R RMA RMC R765 R768
U1S S1820 S1919

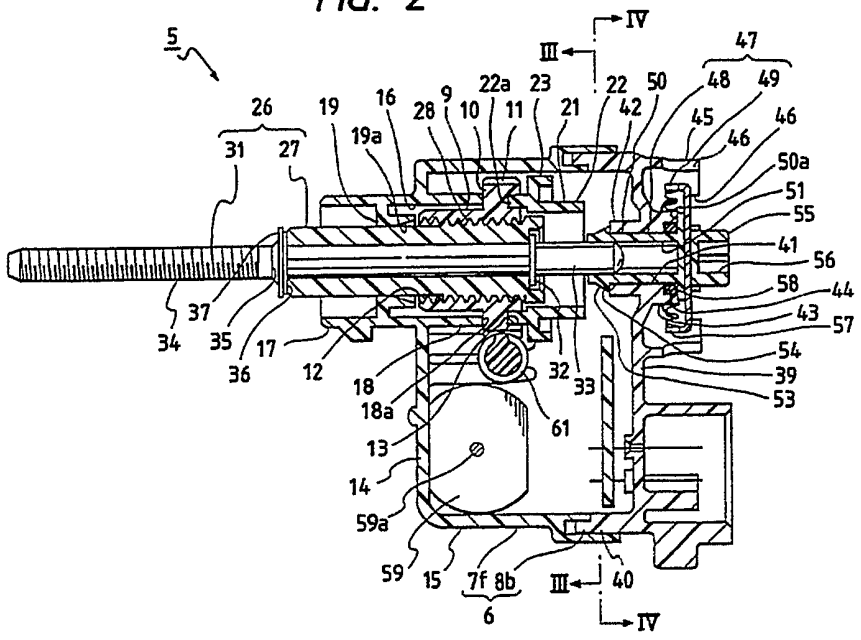
(56) Documents Cited
GB 1481283 A EP 0129519 A

(58) Field of Search
UK CL (Edition M) F2U , F4R RMA RMC
INT CL^5 B60Q 1/06 1/064 1/068 1/072 1/076 , F16H 57/00 57/02
On-line databases: WPI

(54) **Snap-fit gear mounting**

(57) A gear comprising a metal toothed portion 49 and a synthetic resin tubular portion 50 is rotatably mounted in a hole in, a rear wall 39 of a housing by a snap-fit. The tubular portion has integral elastic, engagement pieces 53 with claws 54 which engage the inner end of a tubular section 42, surrounding the hole, another surface of the gear engaging the outside of wall 39. The gear is used in the initial adjustment of a headlamp levelling mechanism. The headlamp levelling mechanism subsequently operates using an electric motor 59 which drives a worm 61 to rotate a gear 11 and so effect adjustment via a screw an nut device.

FIG. 2



GB 2 283 556 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

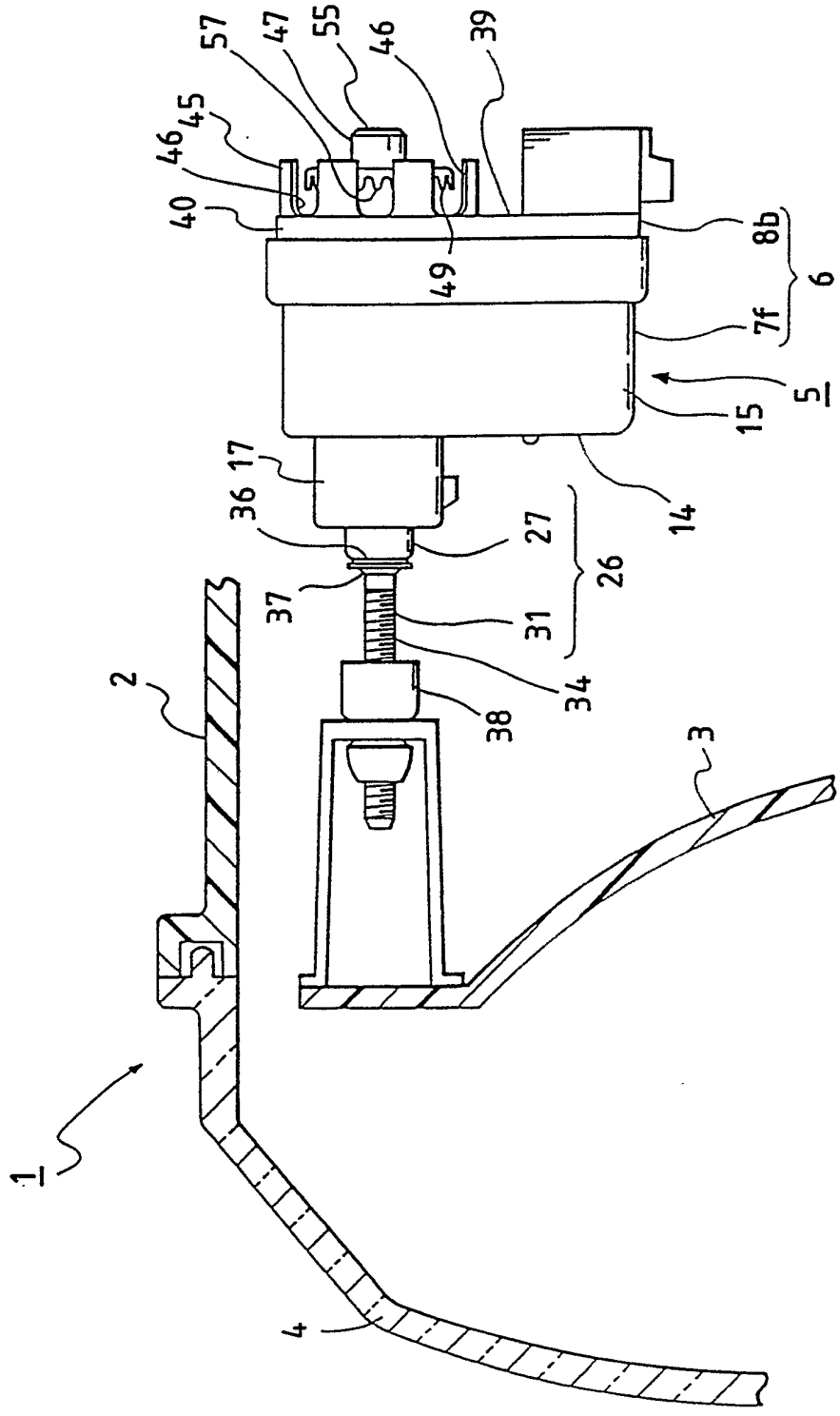


FIG. 2

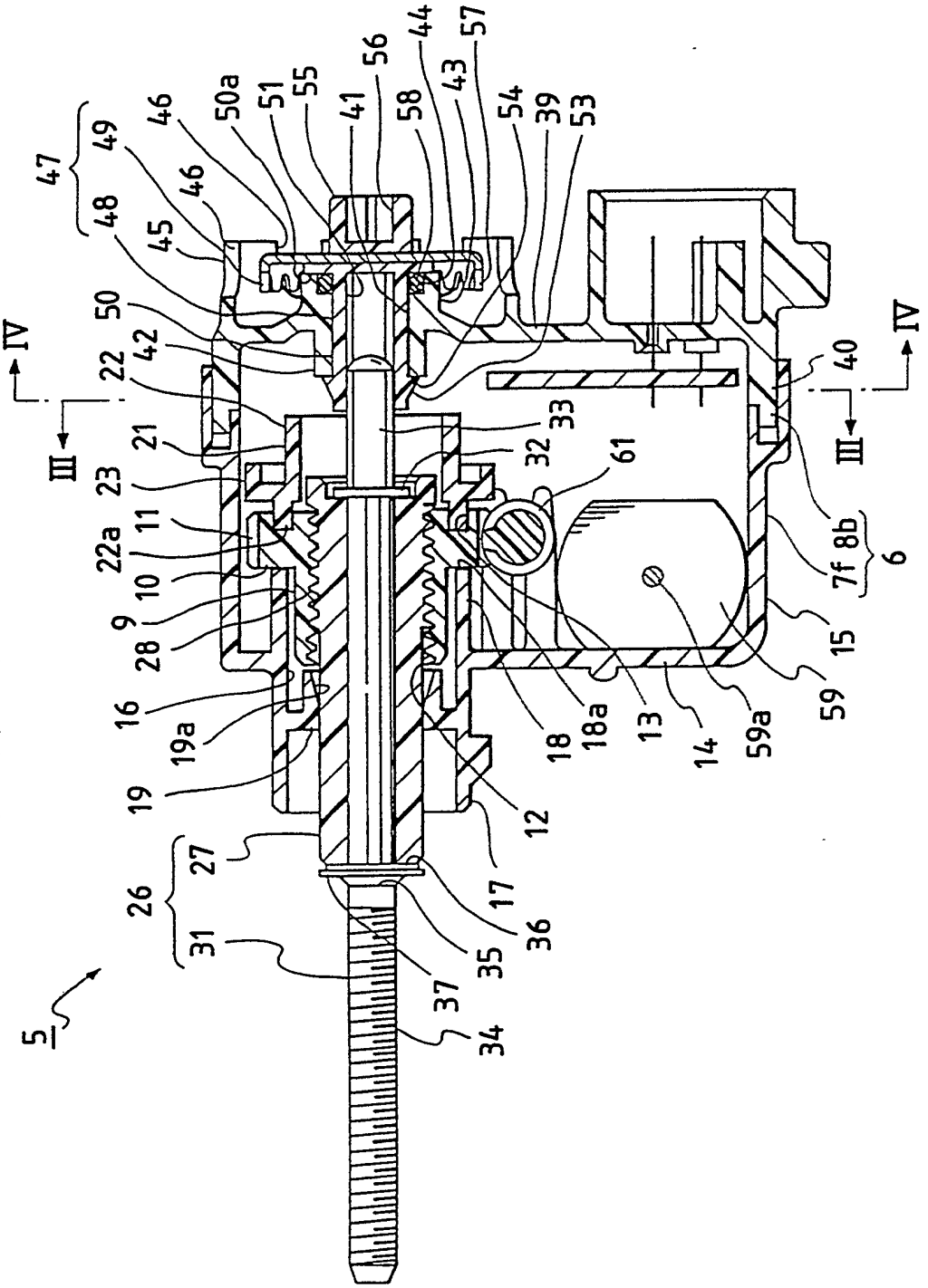

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FIG. 4

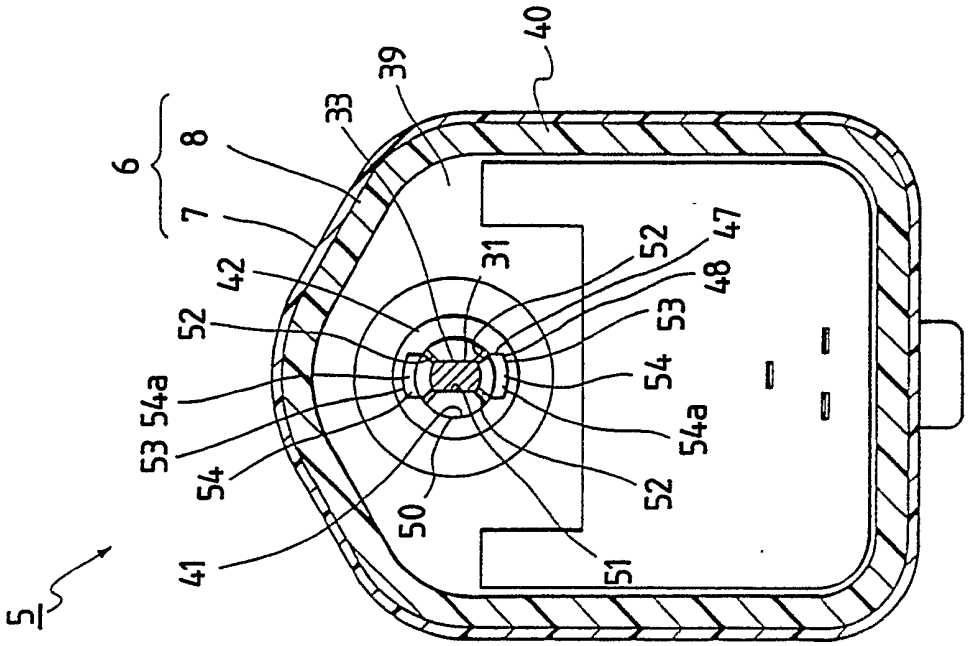
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FIG. 3

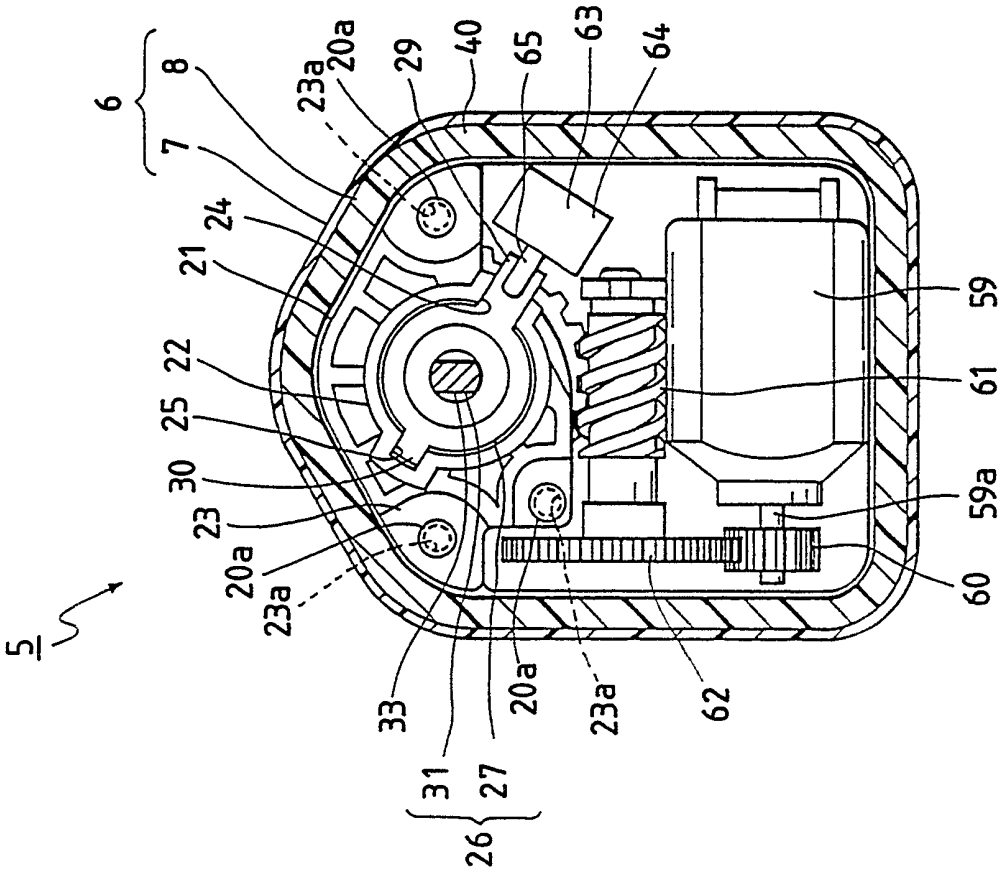
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FIG. 5

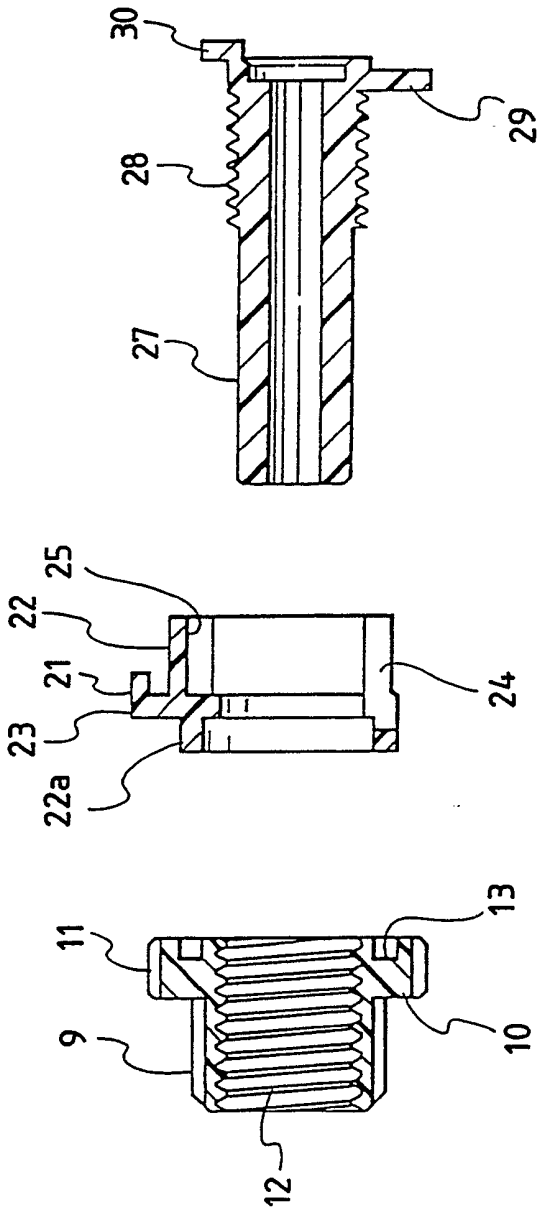

FIG. 6

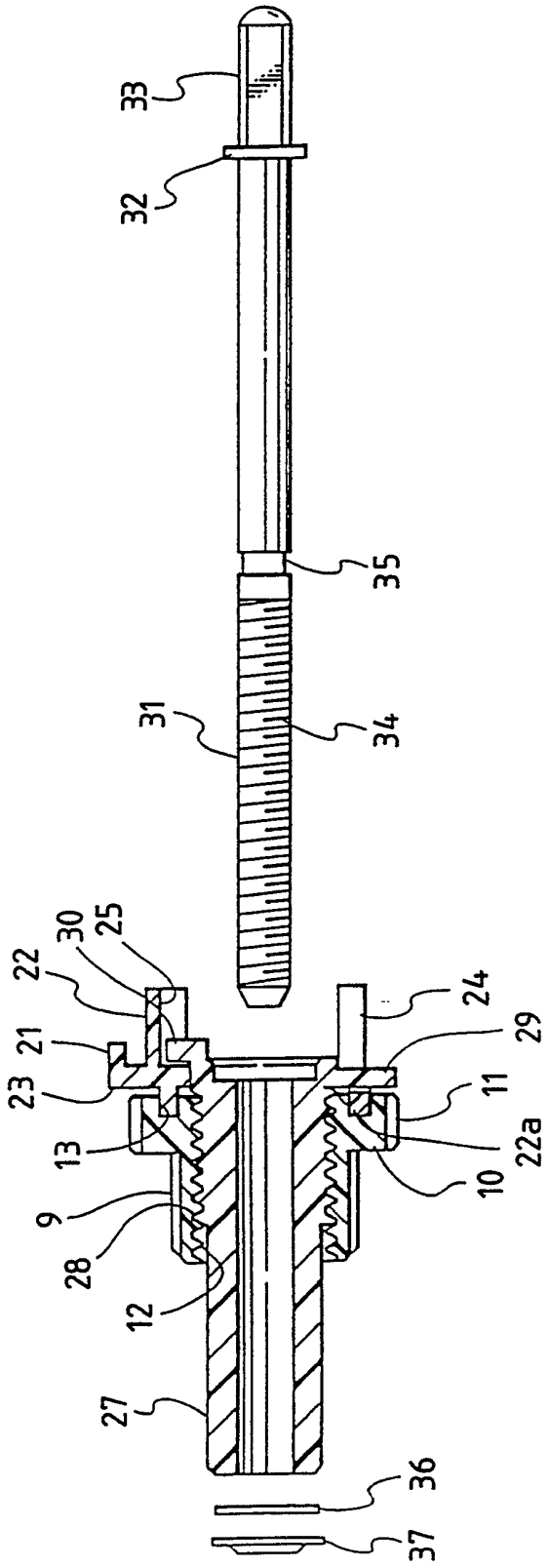

FIG. 7

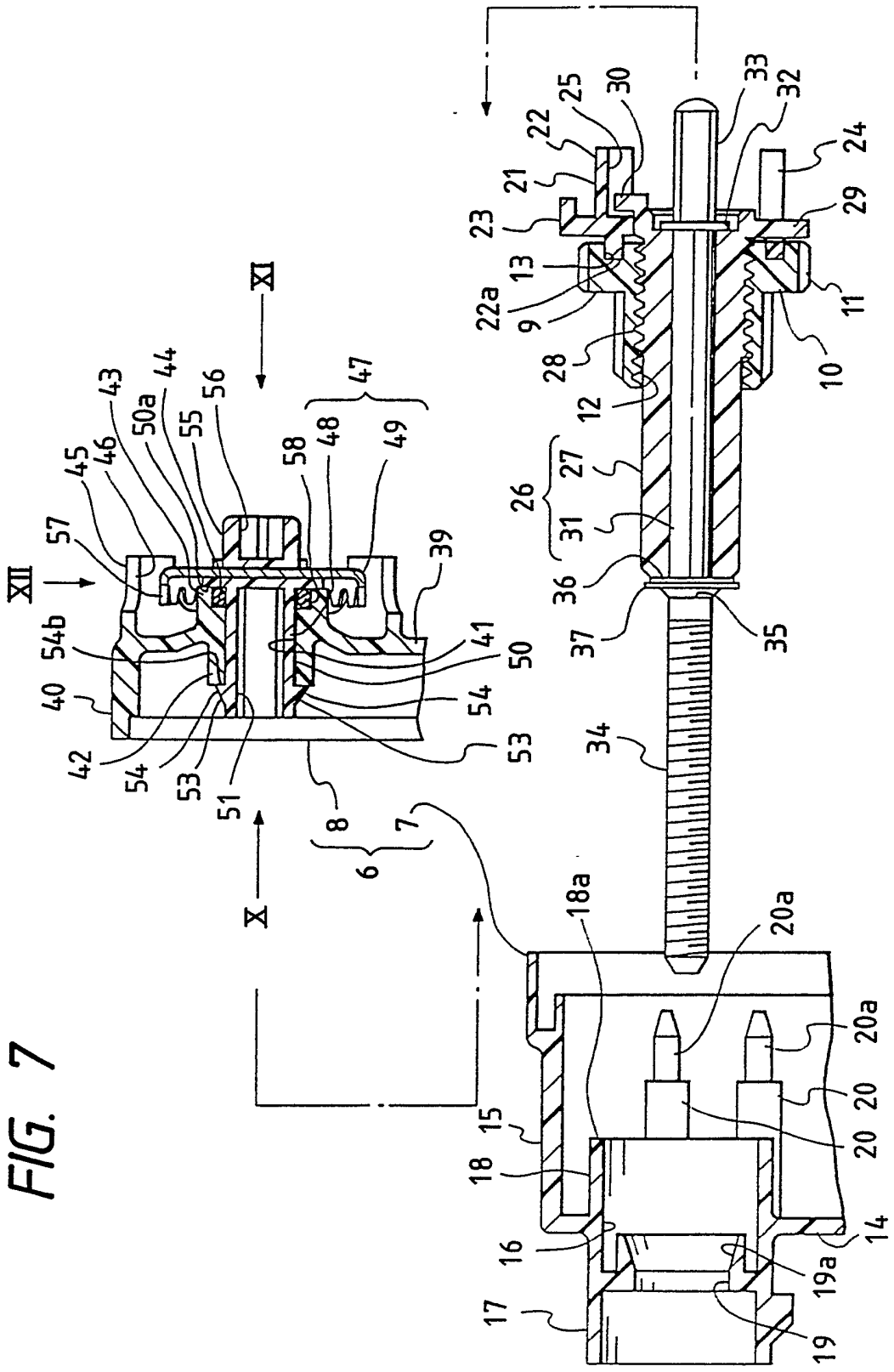
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FIG. 8

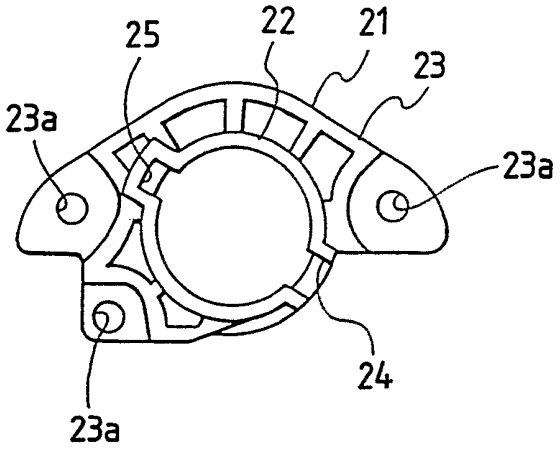

FIG. 9

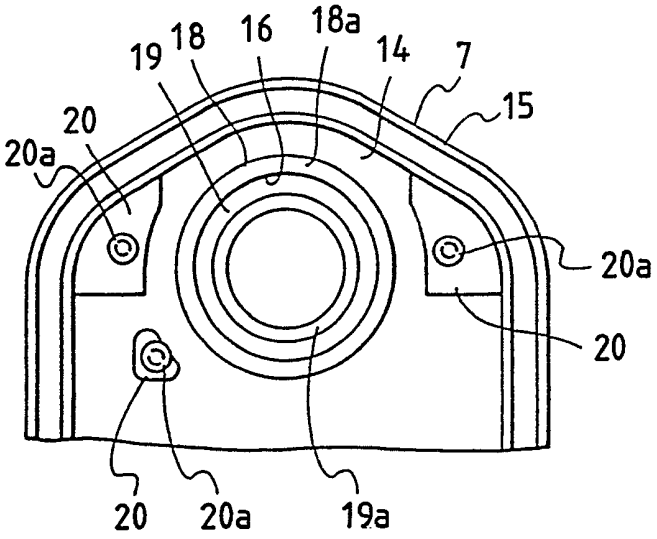

FIG. 10

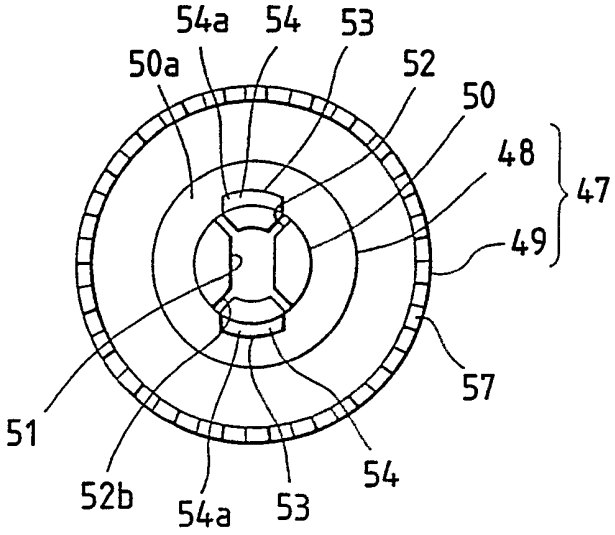

FIG. 11

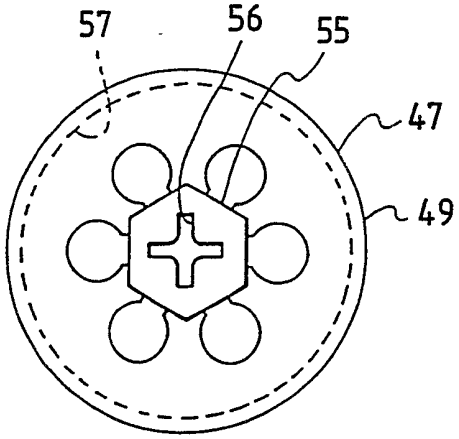

FIG. 12

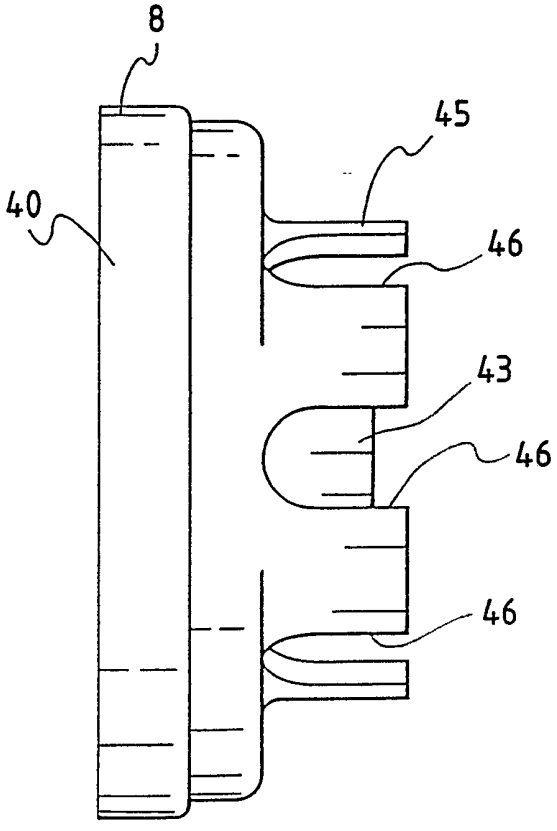

FIG. 13

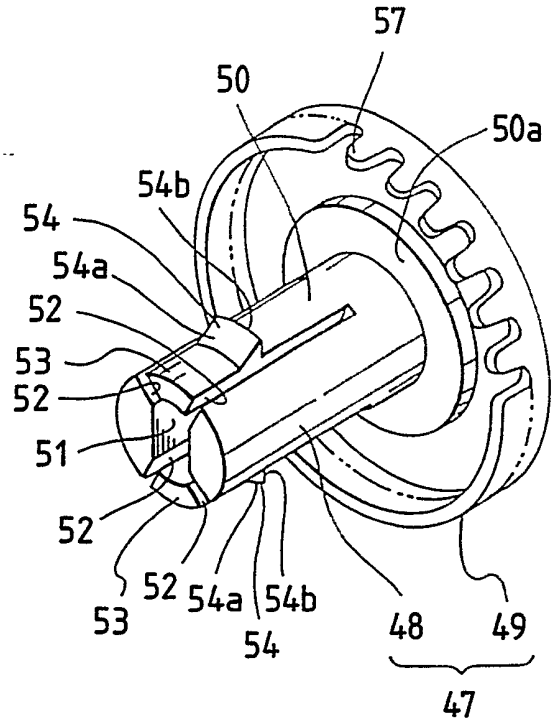
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FIG. 14

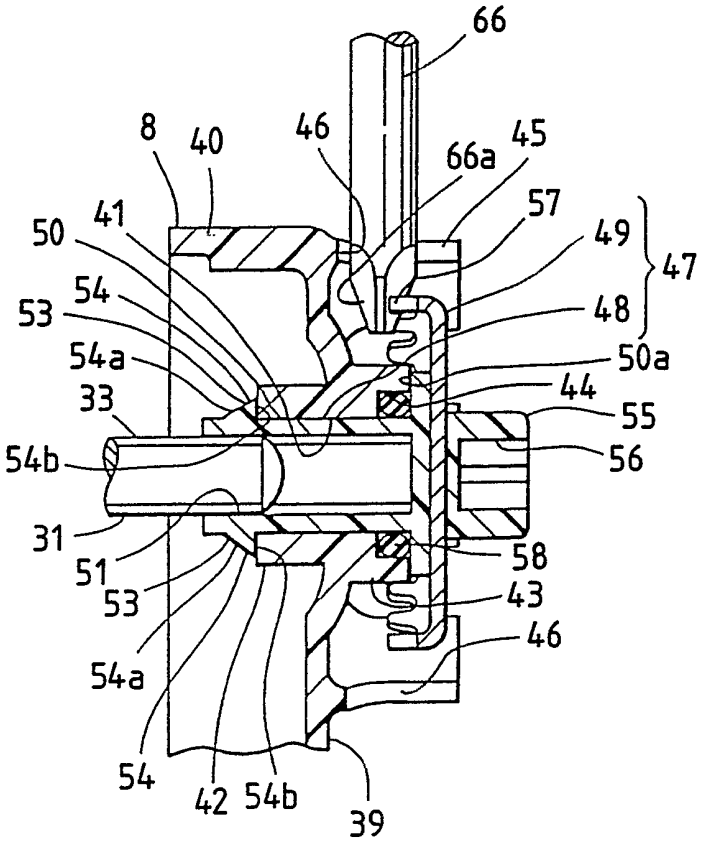
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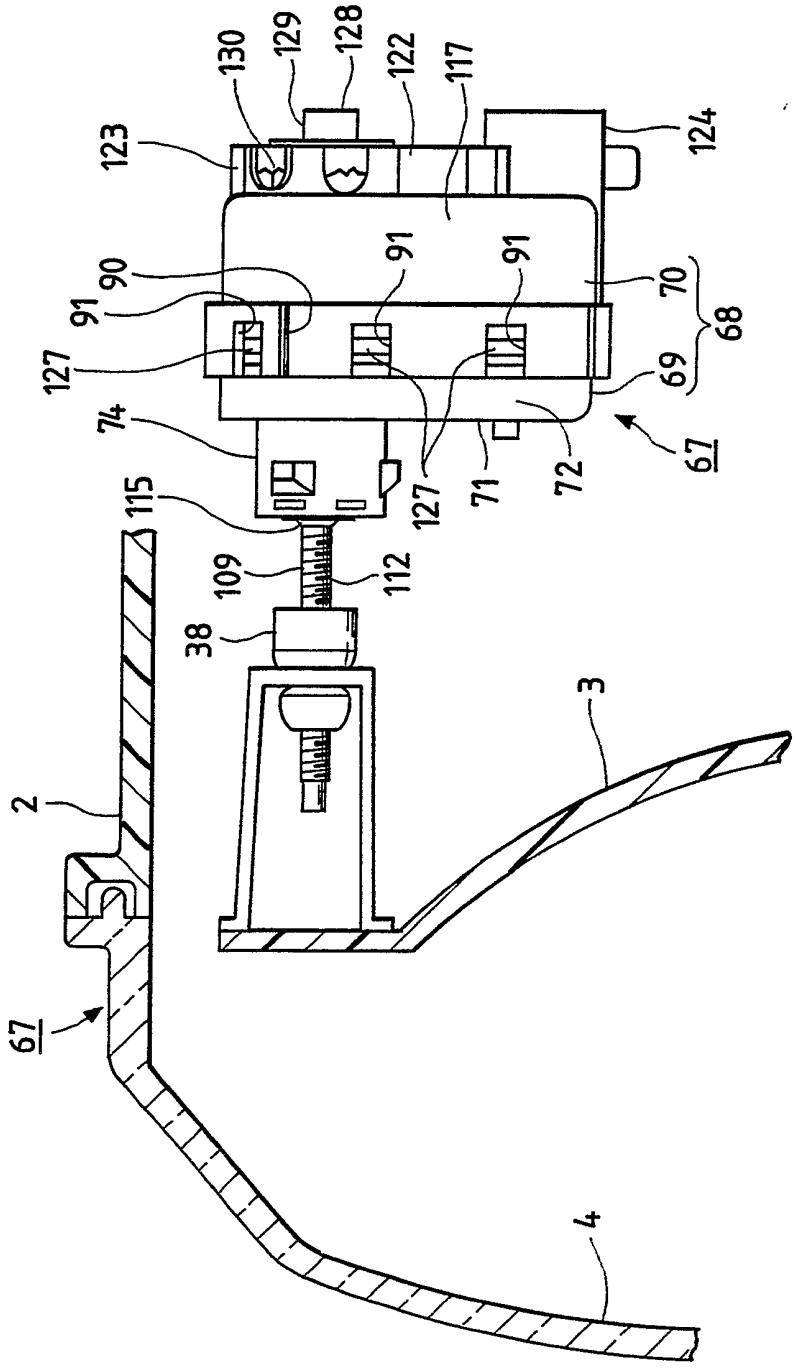
FIG. 15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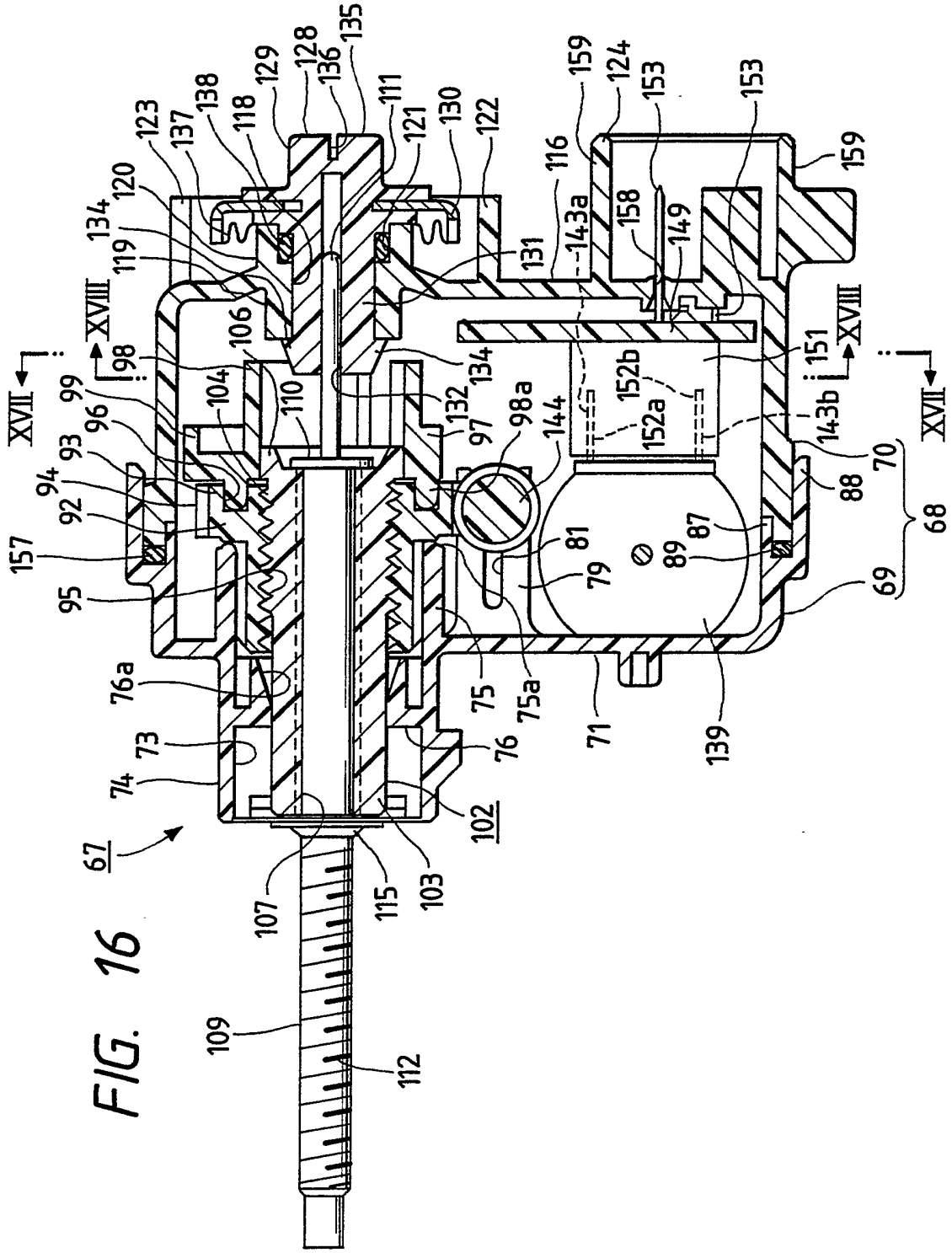
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FIG. 16

FIG. 18

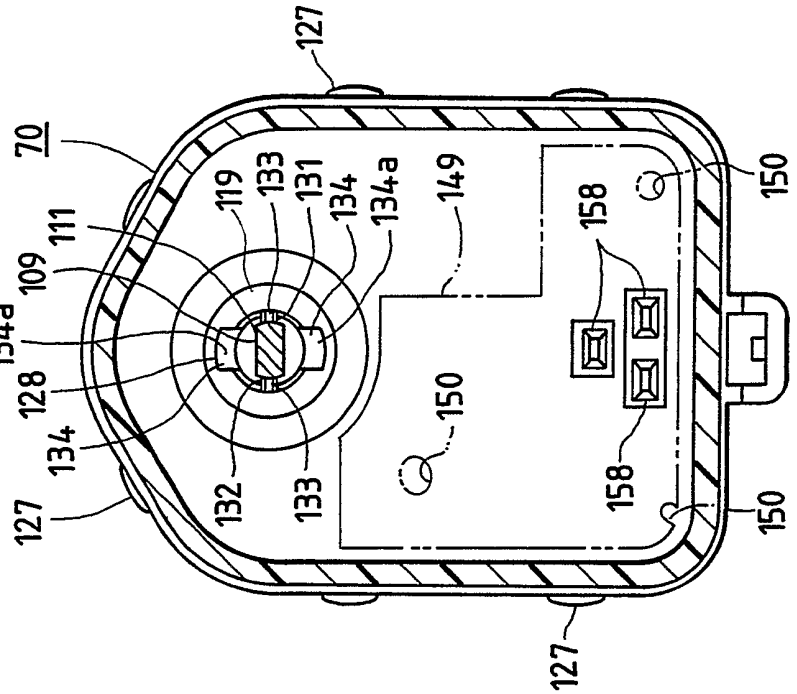
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FIG. 17

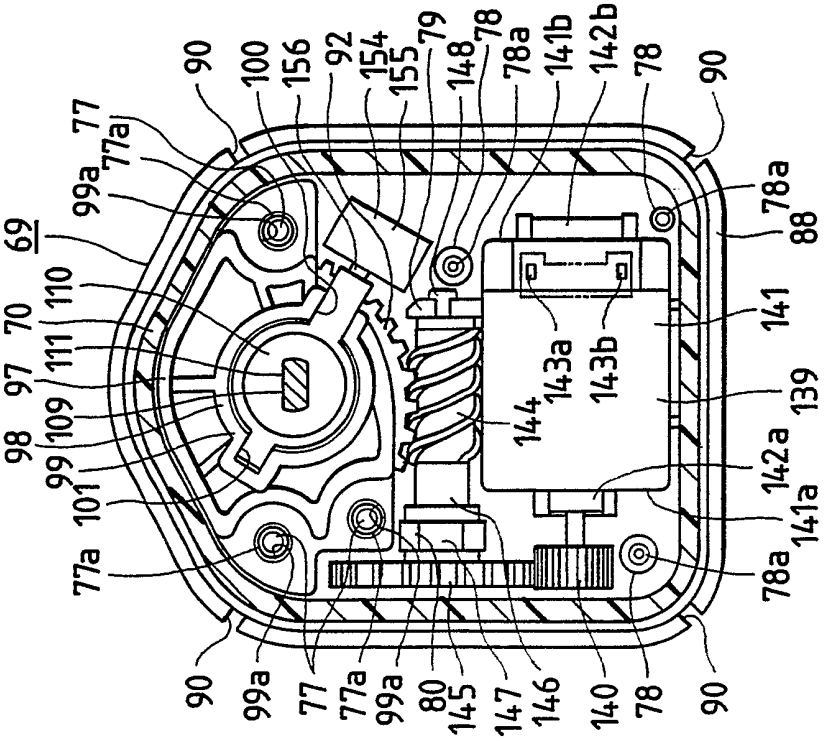
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FIG. 20

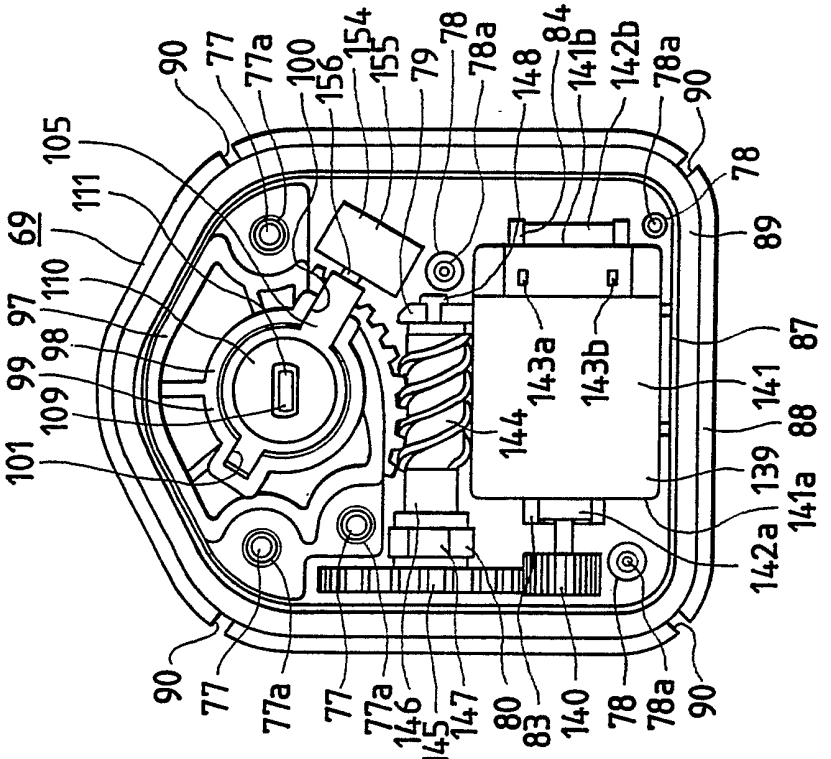
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FIG. 19

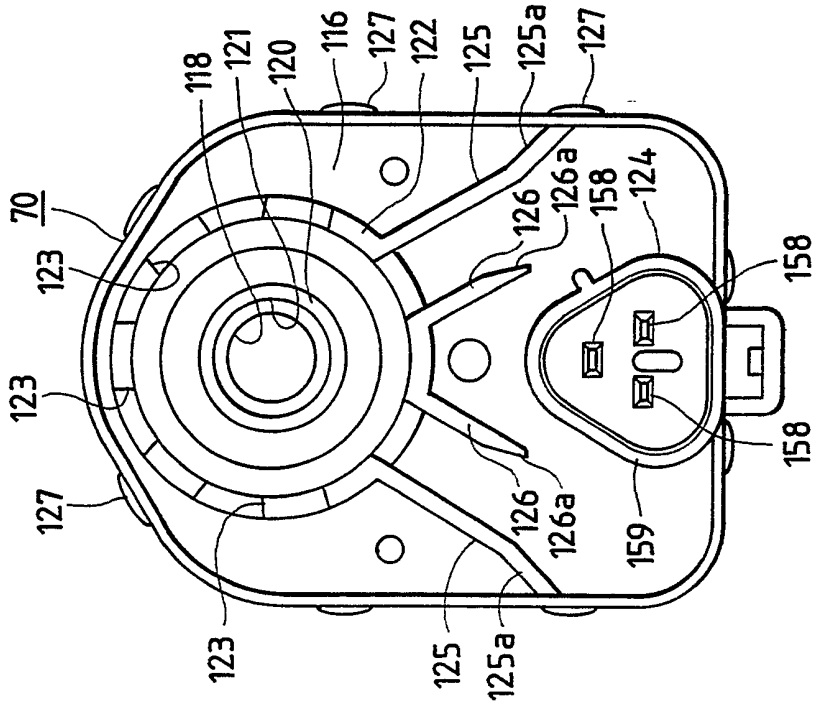
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FIG. 21

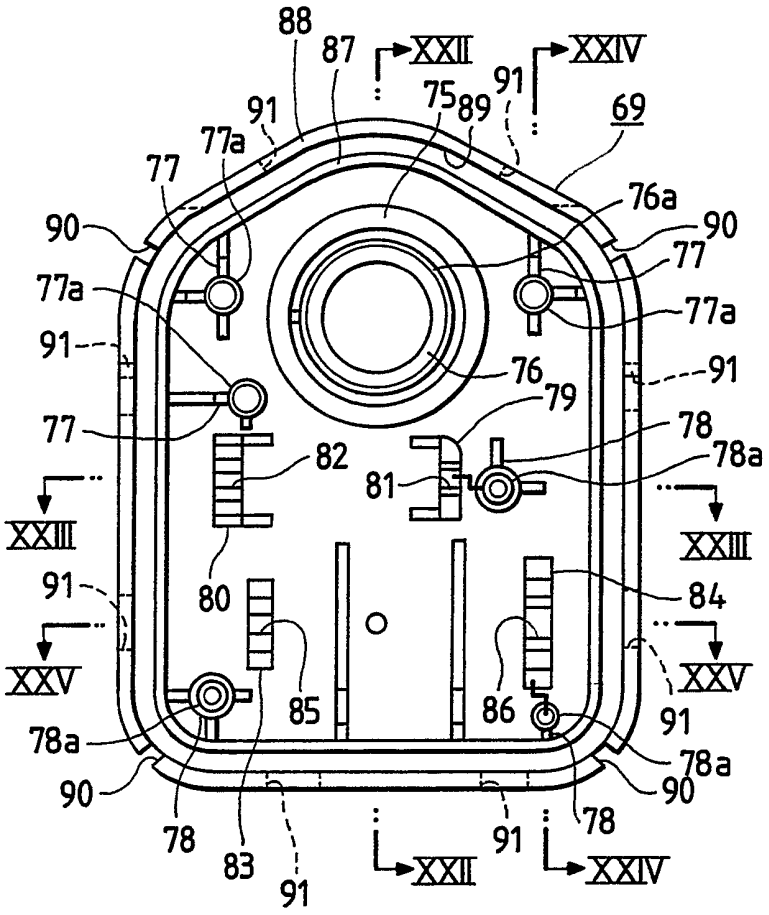
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FIG. 22

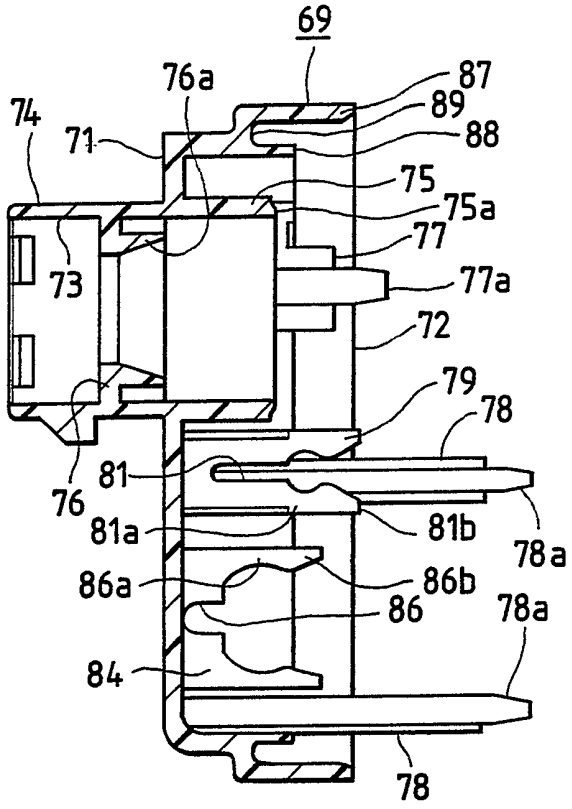
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FIG. 23

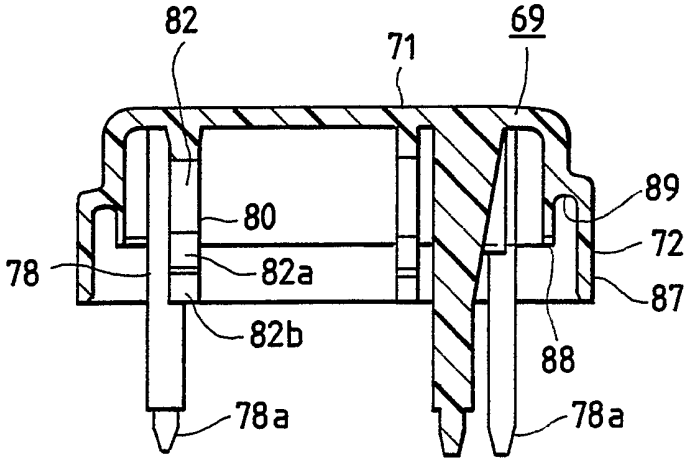
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FIG. 24

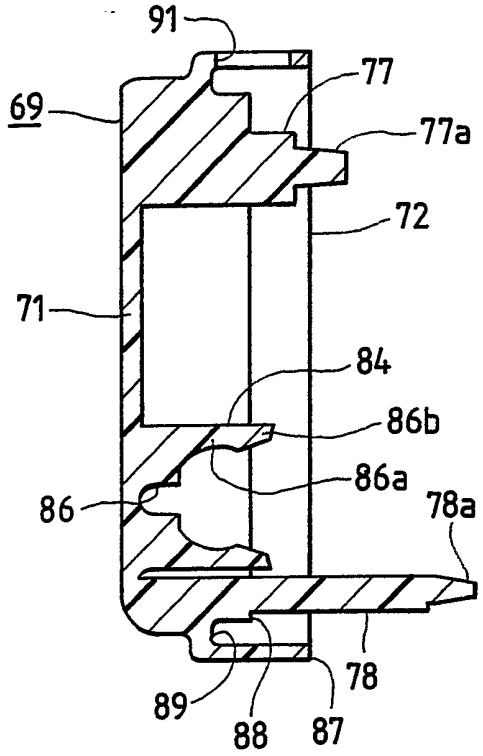
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FIG. 25

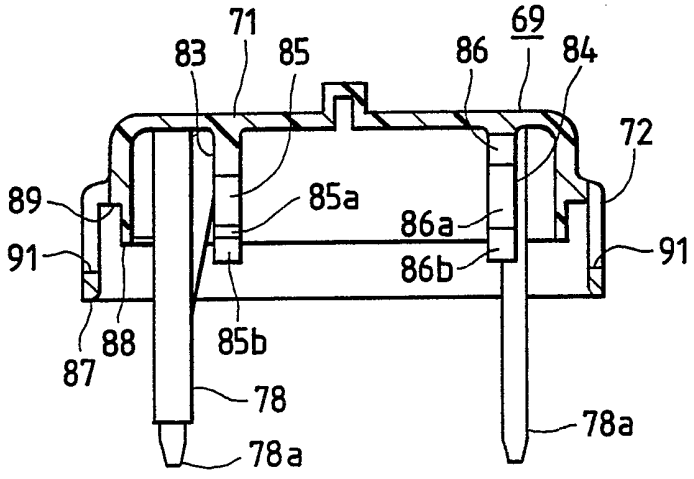
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FIG. 26

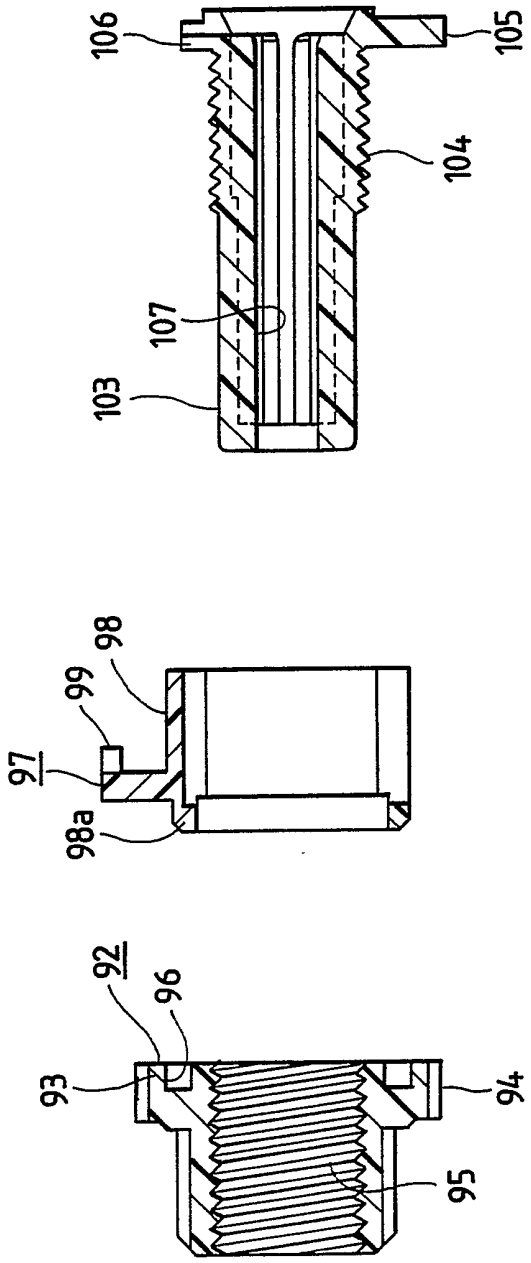
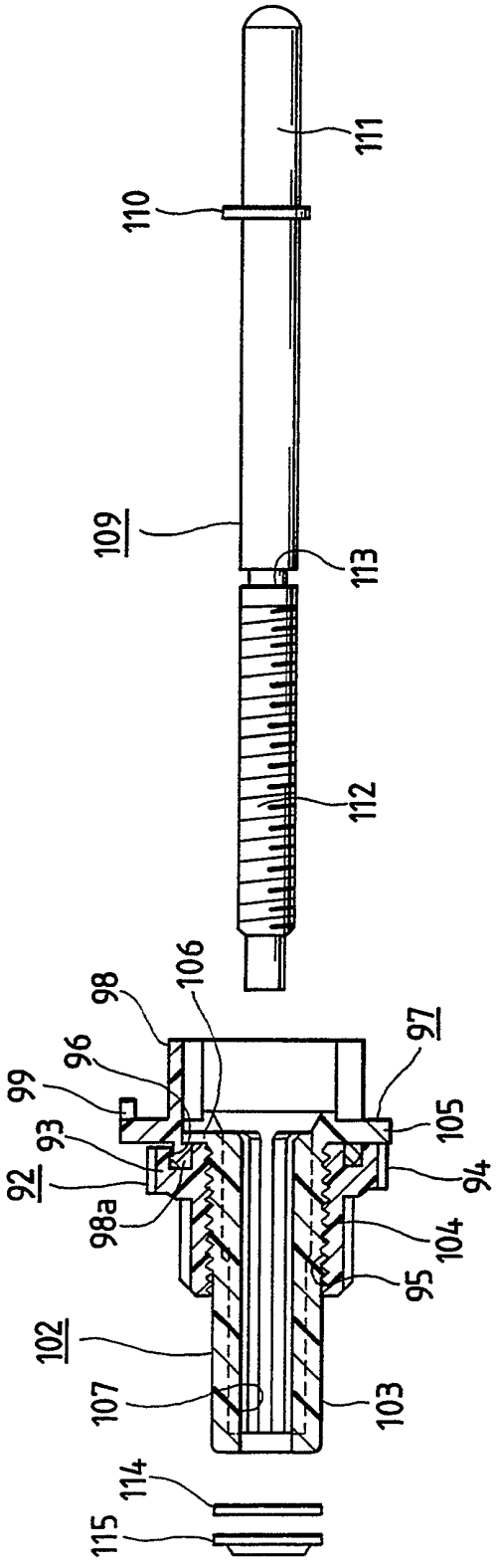


FIG. 27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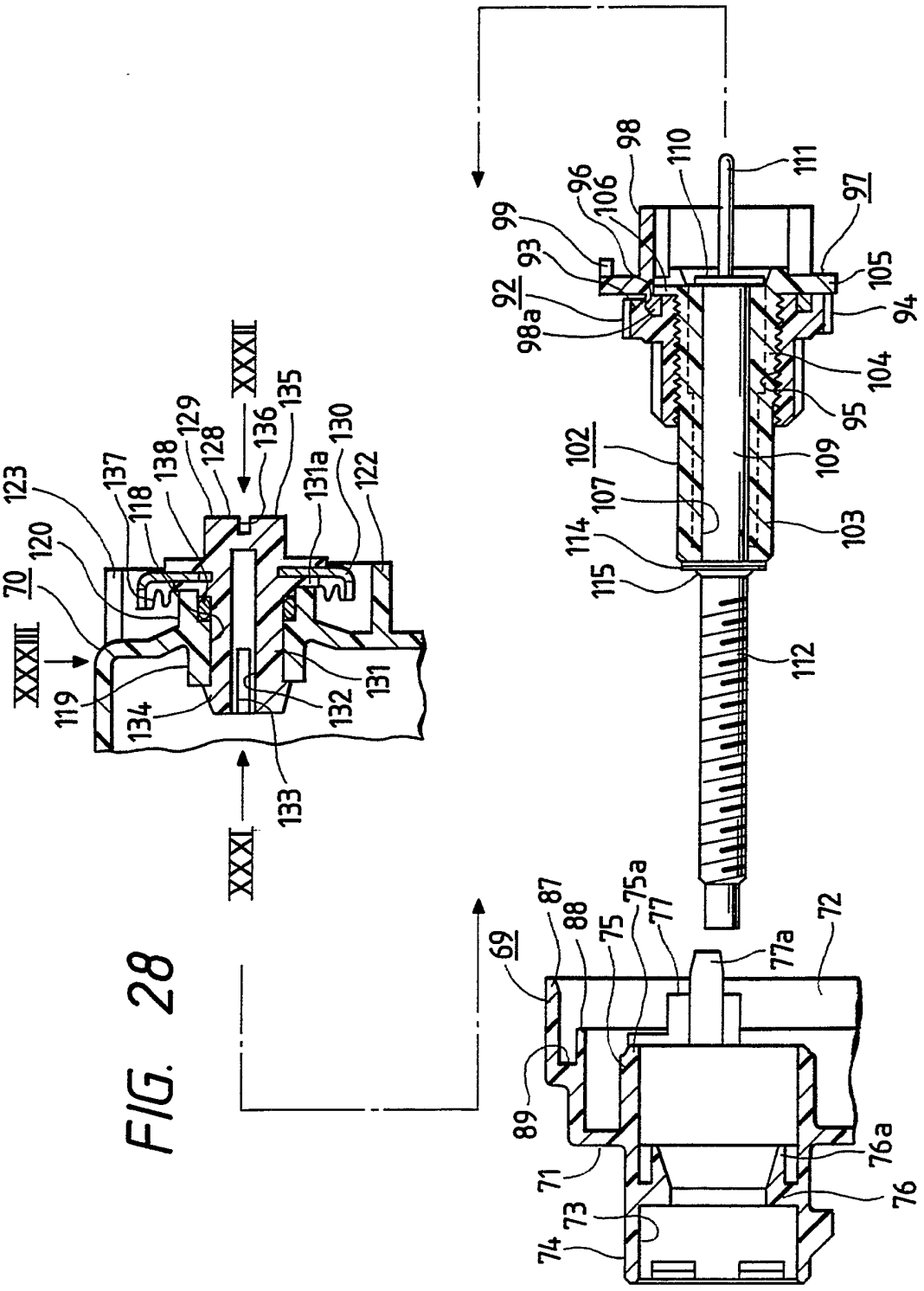
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FIG. 28

FIG. 29

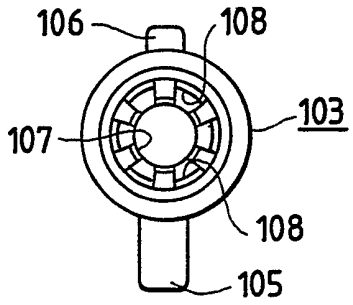

FIG. 30

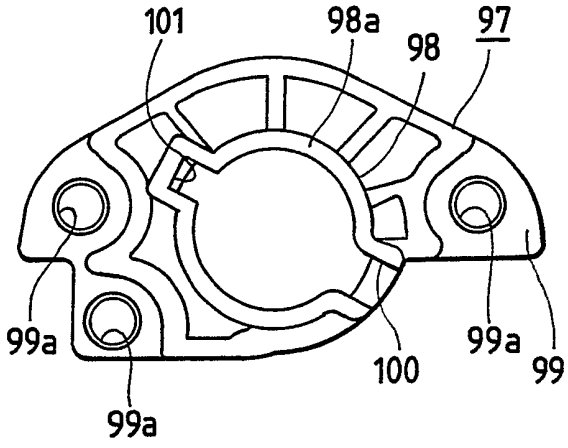

FIG. 31

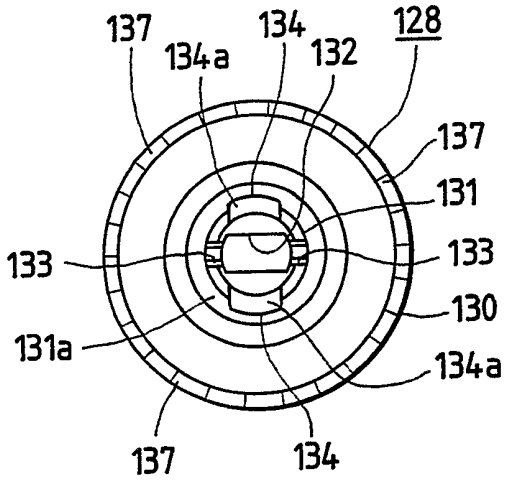
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FIG. 32

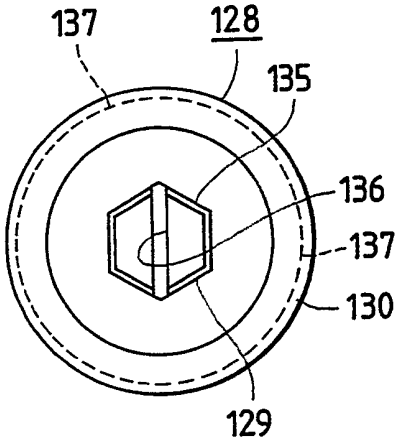
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FIG. 33

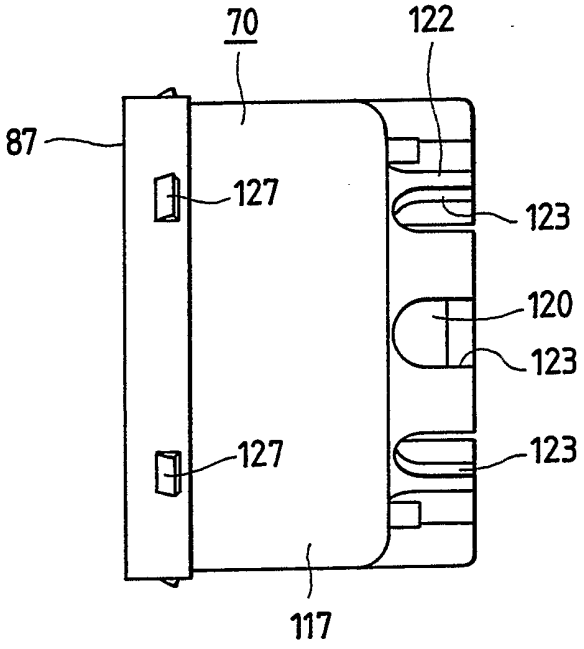
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FIG. 34

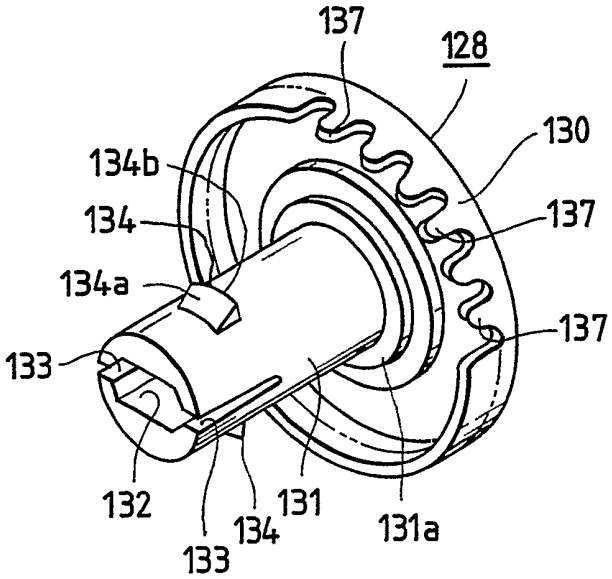
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FIG. 35

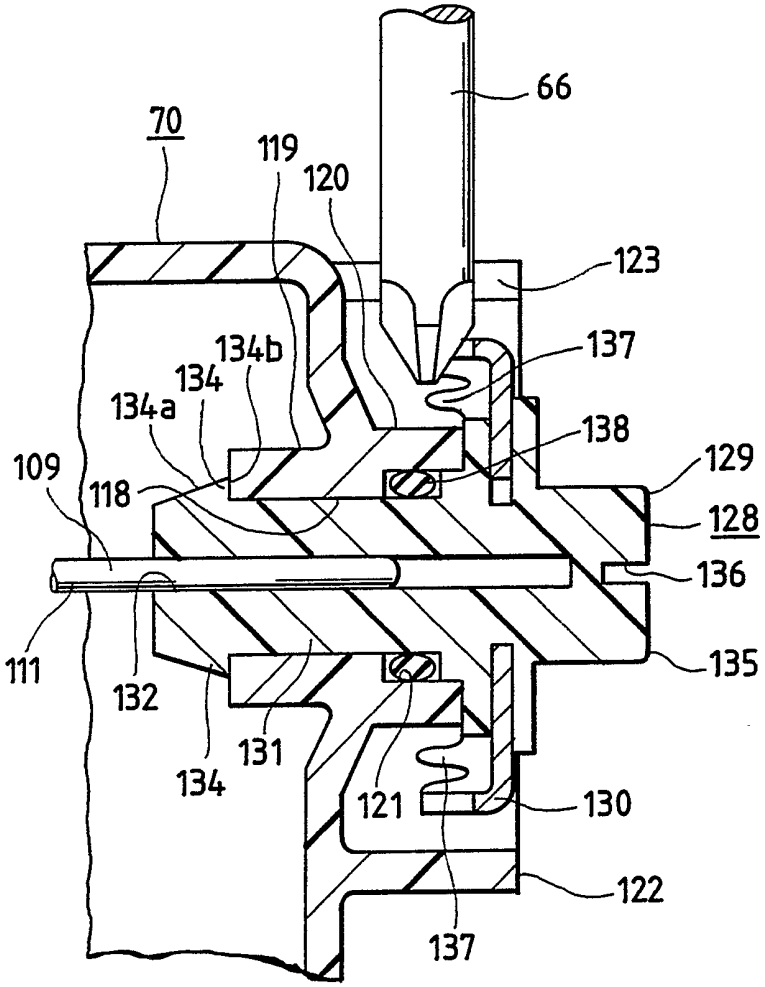
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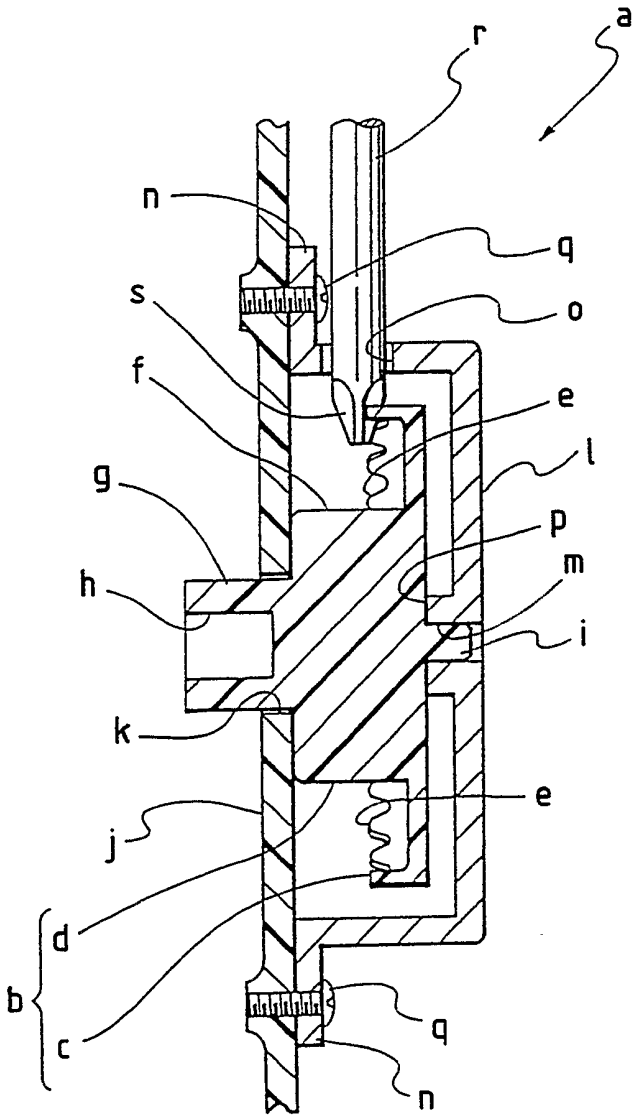
FIG. 36
PRIOR ART



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GEAR ASSEMBLY

An example of a conventional gear assembly is, for example, as shown in Fig 36. Reference symbol b is a gear body comprising a gear section c formed integrally with a supported section d. The gear section c is formed as a crown gear and has gear teeth e formed on an outer peripheral surface thereof. The support section d is provided with a base f and a tubular section g projecting from the front of the base f. The tubular section g has an outer form like a column and is formed with a coupling hole h, having a cross section like an ellipse, opening on the front end face. A small projection i having a circular cross section projects from the center of the rear face of the base f. Reference symbol j is a support formed with a circular support hole k.

Since the tubular section g will easily slip through the support hole k an extra member is required to completely support the gear body b on the support j.

Reference symbol l is a casing formed by pressing a metal plate into a circular shallow cup shape. It has a small circular support hole m formed at the center, fitting pieces n (only two pieces are shown in Fig 36) projecting from the periphery, and an insertion hole o formed on the side. Reference numeral p depicts a ring-like projection formed at the front side of the periphery of the support hole m.

Thus, screws q which pass through the fitting pieces n and are screwed into the support, fix the casing l to the support j. Then, the small projection i of the gear body b is inserted into the support hole m of the casing l for rotation and the projection p of the casing l abuts against the rear face of the gear body b, whereby the gear body b is blocked in a backward direction and is supported by means of the support j for rotation.

Reference symbol r denotes a Phillips (RTM) screwdriver used for rotating the gear body b. That is, a tip s of the

(RTM)
Phillips screwdriver can be inserted into the casing 1 through an insertion hole o and engages with the gear tooth e of the gear section c of the gear body b. Then, when the Phillips screwdriver r is rotated, the gear tooth e is moved and the gear body b is rotated in a predetermined direction in response to the rotational direction of the Phillips driver.

By the way, to support the gear body b on the support j as described above, the casing 1 and several screws q for fixing the casing 1 on the support j are required, requiring a large number of parts, and in addition to the step of inserting the tubular section g of the gear body b into the insertion hole o of the support j, a step of screwing the casing 1 on the support j while inserting the small projection i of the gear body b into the support hole m is required, thereby requiring a large number of steps.

The present invention was made in view of the foregoing difficulties accompanying the conventional gear device. Accordingly, an object of the invention is to provide a gear device which, compared to the prior art, is capable in reducing the number of required parts and improving in operability during the assembly.

According to the present invention, a gear assembly comprises an assembly of a gear device rotatably supported by a support member having an opening, the assembly comprising a gear member and a tubular member secured to the gear member, the tubular member having a substantially cylindrical tubular body extending through the opening, at least one elastic engagement piece, an engagement claw formed on an outer surface of the elastic engagement piece, the engagement claw engaging a front end of the opening in the support member; and an abutment member facing the engagement claw at a distance, and abutting against a rear end of the opening in the support member.

With this gear assembly, simply by inserting the elastic engagement pieces into and through the support hole, the engagement claw(s) formed on the elastic

engagement piece(s) engage(s) with the front end of the support hole and the abutment section abuts against the rear end of the support hole, so that the gear device is rotatably supported on the support section. Thus, the casing and screws required by the conventional device are not necessary, the number of parts is small, and a step of supporting the gear on the support section becomes extremely easy.

In the accompanying drawings:

Fig 1 shows one embodiment of a gear assembly of the invention in a headlamp levelling mechanism, in conjunction with Figs 2 to 14, and is a vertical sectional view showing an outline of a headlamp levelling device;

Fig 2 is a vertical sectional view of a main part on an enlarged scale to that of Fig 1;

Fig 3 is a section taken on the line III-III in Fig 2;

Fig 4 is a section taken on the line IV-IV in Fig 2;

Fig 5 is an exploded sectional view of a worm wheel, a shaft body, and a retainer;

Fig 6 is a partially exploded sectional view of a worm wheel, a shaft body, and a retainer;

Fig 7 is a sectional view showing a state in which the worm wheel, shaft body, and retainer are assembled in conjunction with a part of a front case and a back case supporting an aiming rod;

Fig 8 is a rear view of the retainer;

Fig 9 is a rear view of the main part of the front case;

Fig 10 is an enlarged view of the aiming rod when viewed from X in Fig 7;

Fig 11 is an enlarged view of the aiming rod when viewed from XI in Fig 7;

Fig 12 is an enlarged view of the back case when viewed from XII in Fig 7;

Fig 13 is an enlarged perspective view of the aiming rod;

Fig 14 is an enlarged sectional view of the main part showing a state in which the aiming rod is rotated;

Fig. 15 is a vertical sectional view schematically showing a head lamp levelling device incorporating a gear assembly in accordance with a second embodiment of the present invention;

Fig. 16 is an enlarged, vertical sectional view showing a key portion of the head lamp levelling device;

Fig. 17 is a cross sectional view taken on the line XVII-XVII in Fig. 16;

Fig. 18 is a cross section taken on the line XVIII-XVIII in Fig. 16;

Fig. 19 is a plan view showing the head lamp levelling device;

Fig. 20 is a rear view showing the head lamp levelling device when the back case is removed;

Fig. 21 is a rear view showing the front case;

Fig. 22 is a cross section taken on the line XXII-XXII in Fig. 21;

Fig. 23 is a cross section taken on the line XXIII-XXIII in Fig. 21;

Fig. 24 is a cross section taken on the line XXIV-XXIV in Fig. 21;

Fig. 25 is a cross section taken on the line XXV-XXV in Fig. 21;

Fig. 26 is a cross sectional view showing a worm wheel, a holder shaft, and a holder, separately;

Fig. 27 is a cross sectional view showing the worm wheel, a shaft member, and the holder, separately;

Fig. 28 is a cross sectional view showing an assemble of the worm wheel, the shaft member, and the holder, and the front case and a part of the back case supporting an aiming rod;

Fig. 29 is a rear view showing the holder shaft;

Fig. 30 is a rear view showing the holder;

Fig. 31 is an enlarged view showing the aiming rod when viewed in the direction of arrow XXXI in Fig. 28;

Fig. 32 is an enlarged view showing the aiming rod when viewed in the direction of an arrow XXXII in Fig. 28;

Fig. 33 is an enlarged view showing the aiming rod when viewed in the direction of an arrow XXXIII in Fig. 28;

Fig. 34 is an enlarged, perspective view showing the aiming rod;

Fig. 35 is an enlarged, cross sectional view showing a key portion when the aiming rod is turned; and,

Fig 36 is a sectional view showing one example of a conventional gear device.

In the embodiments shown, a gear assembly of the invention is applied as a gear device for use in an illumination angle adjustment apparatus for a vehicular headlamp.

The headlamp apparatus includes, as partly and briefly shown in Fig. 1, a headlamp 1, a lamp body 2 thereof, a reflector 3 supported on the lamp body 2 for vertical rotation, and a lens 4 covering a front opening of the lamp body 2. The apparatus further includes a headlamp levelling mechanism 5, i.e., a gear assembly of the present embodiment, fixed to a car body (not shown).

The headlamp levelling mechanism 5 is provided with a casing 6 divided into a front casing 7 and a back casing 8 each made of synthetic resin. A worm wheel 9 is rotatably supported on the casing 6 so that it does not move axially back and forth. The worm wheel 9, made of synthetic resin, is formed substantially cylindrical and provided with a flange 10 integrally extending outward on the rear end thereof and gear teeth 11 formed on the outer peripheral surface of the flange 10. A screw thread 12 is formed on the inner peripheral surface of the flange 10 and a recess 13 is formed on the rear face of the flange 10.

The front casing 7 includes a front wall 14 and side walls 15 projecting backward from the periphery of the front wall 14. The front wall 14 is formed with an insertion hole 16 and integrally with a tubular section 17

projecting forward from the outer opening fringe of the insertion hole 16 and a support tube 18 projecting inward from the inner opening fringe of the insertion hole 16. An integral flange 19 projects radially inwardly from the middle portion of the inner peripheral surface of the tubular section 17, and a stopper projection 19a projects backwards from the flange 19.

Fitting projections 20 formed integrally with the inner face of the front wall 14 has clamping pins 20a projecting backwards and formed integrally with the rear faces of the fitting projections 20. A retainer 21 is fixed to the front wall 14. The retainer 21 is integral with a fitting piece section 23 extending outward from the portion to the front end of a main section 22. The fitting piece section 23 is formed with fitting holes 23a. A guide notch 24 extends from front to rear in the main section 22. A guide recess 25 extending from front to rear is formed in the portion facing the guide notch 24 on the inner face of the main section 22.

The worm wheel 9 is rotatably supported on the front wall 14 and unmovably in the axial direction as described below:

First, the worm wheel 9 has the portion in front of flange 10 fitted internally in the support tube 18 of the front wall 14 and the rear end 18a of the support tube 18 abuts against the front face of the flange 10. Then, in the condition in which the front end portion 22a of the main section 22 of the retainer 21 slidably engages with the recess 13 formed on the rear face of the flange 10 of the worm wheel 9, the clamping pins 20a of the fitting projections 20 of the front wall 14 are inserted into the fitting holes 23a of the fitting piece section 23 and the portions of the clamping pins 20a projecting to the rear of the fitting piece section 23 are clamped for fixing to the front case 14. The worm wheel 9 is thus supported on the front case 14 for rotation and unmovably in the axial direction because the flange 10 is sandwiched between the

rear end 18a of the support tube 18 of the front case 14 and the front end 22a of the main section 22 of the retainer 21.

A shaft body 26 consists of a retention shaft 27 and an adjusting shaft 31 supported by the retention shaft for rotation. The retention shaft 27 is made of synthetic resin, and is substantially cylindrical. It is formed with a screw thread 28 on the outer peripheral surface of its rear portion and is integral with diametrically oppositely projecting press piece and a guide projection 30.

The adjusting shaft 31 is formed like a rod made of metal and is integral with a flange 32 projecting radially outwards at a position near to its rear end, a rear portion 33 behind the flange 32 defining a sliding coupling section having a cross section formed substantially like an ellipse. A front portion 34, substantially half portion in front of the flange 32 is a screw threaded section with an engagement groove 35 at the rear of the section 34. The length of the portion from the rear edge of the engagement groove 35 to the front of the flange 32 is substantially the same as the length of a central hole in the retention shaft 27.

Thus, the adjusting shaft 31 is inserted into the central hole of the retention shaft 27 from the rear thereof a spring washer 36 is externally fitted into the portion projecting from the front end of the retention shaft 27, and a fixing circlip 37 is engaged into the engagement groove 35, whereby the adjusting shaft 31 is supported by the retention shaft 27 for mutual rotation while relatively unmovable in the axial direction. Thus, the adjusting shaft 31 is supported by the retention shaft 27 for forming the shaft body 26.

The screw thread 28 of the retention shaft 27 engages with the screw thread 12 of the worm wheel 9 and further the guide projection 30 of the retention shaft 27 slidably engages with a guide recess 25 of the retainer 21 and the press piece 29 of the retention shaft 27 slidably engages

with the guide notch 24 of the retainer 21, so that the shaft body 26 is supported so that it can move in the axial direction as the worm wheel 9 rotates. The tip of the press piece 29 is inserted into the guide notch 24 and projects outside the retainer 21.

The front end of the retention shaft 27 is inserted into the insertion hole 16 and the tubular section 17 of the front casing 7 and the screw section 34 of the adjusting shaft 31 meshes with a nut 38 supported on the side of the reflector 3 which moves most when the reflector rotates.

The back casing 8 includes a rear wall 39 and side walls 40 projecting forwards from the periphery of the rear wall 40, and an insertion hole 41 is formed in the rear wall 39 at the position facing the insertion hole 16 of the front casing 7. The rear wall 39 is formed integrally with a tubular section 42 projecting forwards from the front opening fringe of the insertion hole 41, and a tubular section 43 projecting backwards from the rear opening fringe of the insertion hole 41, and an annular groove 44 is formed in the inner fringe of the rear end of the rear tubular section 43. An integral wall 45 projects largely surrounding the tubular section 43 on the rear face of the rear wall 40, and is formed with several notches 46 distant from each other in the circumferential direction.

An aiming rod 47 comprises a main body 48 formed of synthetic resin and a crown gear section 49 formed of metal and integrated into the main body 48 by an outsert molding at the rear end of the main body 48. The aiming rod forms part of the gear assembly according to the invention. The main body and the gear section may be integrally formed not only by the outsert molding, but also by appropriate means, such as the following method: a clamping pin is projected from the main body and is inserted into a hole formed in the gear section, then the insertion part is clamped by thermal clamping, etc., thereby integrating the main body and the gear section.

The portion in front of the crown gear section 49 of the main body 48 defines a tubular section 50 having an outer form like a column and formed with a coupling hole 51 opening at the front end thereof. The coupling hole 51 has an elliptical cross sectional shape so that the sliding coupling section 33 of the adjusting shaft 31 can be inserted slidably but non-rotatably into the coupling hole 51.

The tubular section 50 is formed with pairs of slits 52 reaching a front end face at two positions around the coupling hole 51, and elastic engagement pieces 53 are each formed between a respective pair of the slits 52. Engagement claws 54 project from the ends of the engagement pieces 53. The front faces 54a of the engagement claws 54 are inclined and rear faces 54b are made as locking faces perpendicular to the axial direction of the tubular section 50.

The rear portion from the crown gear section 49 of the main body 48 defines a head 55 having a cross section formed like a regular hexagon and a cross-shaped engagement groove 56 is formed in the rear face of the head 55. The crown gear section 49 is made of a circular metal plate and its edge is bent forward and provided with gear teeth 57.

Upon assembly, the tubular section 50 of the aiming rod 47 is inserted into the insertion hole 41 of the back casing 8 from the rear side. Then, the engagement claws 54 of the elastic engagement pieces 53 of the aiming rod 47 are pressed by the tubular sections 43 and 42 of the back casing 8 and the inner face of the insertion hole 41, so that the elastic engagement pieces 53 of the aiming rod 47 are flexed inwardly. When the engagement claws 54 exit the front end of the tubular section 42, the elastic engagement pieces 53 are restored to the former state and the lock faces 54b of the engagement claws 54 engage with the front edge of the tubular section 42, preventing the aiming rod 47 from slipping back out of the back casing 8. At the same time, the front face of an abutment section 50a

extending from the rear end of the tubular section 50 abuts against the rear end of the pipe section 43 on the rear of the back casing 8, so that the aiming rod 47 is rotatably supported on the back casing 8.

An O ring 58 is externally fitted into the base of the tubular section 50 of the aiming rod 47 and positioned in the groove 44 formed on the inner face of the rear end of the tubular section 43 of the back casing 8 with the aiming rod 47 supported on the back casing 8, serving a water-proof function in the portion.

Thus, when the front casing 7 and the back casing 8 are coupled in the condition in which the rear opening face of the front casing 7 and the front opening face of the back casing 8 are butt-joined, the sliding coupling section 33 of the adjusting shaft 31 supported on the front casing 7 engages with the coupling hole 51 of the aiming rod 47 slidably in the axial direction, but not rotatably.

As best shown in Fig. 3, a motor 59 fixed in the casing 6 has a rotating shaft 59a to which a pinion gear 60 is fixed. A worm 61 engaging with the worm wheel 9 is rotatable via a spur gear 62 engaging with the pinion gear 60 with a shaft of the worm 61 parallel to the axial direction of the motor 59 in the casing 6. When the motor 59 turns, the worm wheel 9 is rotated through this gear arrangement.

A resistor type sensor 63 has a mobile element 65 supported on a casing 64 movably in the backward and forward direction. A resistance value varies depending on the relative position of the element 65 and the casing 64. The mobile element 65 is associated with spring means (not shown) for applying an elastic force to the mobile element 65 toward the front, so that the mobile element 65 of the sensor 63 has an end urging against the press piece 29 of the retention shaft 27 of the shaft body 26 from the rear. Thus, as the shaft body 26 moves forwards or backwards, the position of the element 65 of the sensor 63 changes, thereby causing the resistance value of the sensor to

change. Therefore, the position of the shaft body 26 is detected by detecting the resistance value, from which a tilt angle of the reflector 3 is detected.

An initial aiming adjustment by the headlamp levelling mechanism 5 is made by rotating the aiming rod 47. That is, when the aiming rod 47 is rotated, the adjusting shaft 31 having the sliding coupling section 33 on the rear end engaged slidably into the coupling hole 51 is rotated within the retention shaft 27. In response to the rotation direction of the adjusting shaft 31, the screw section 34 is screwed into or loosened from the nut 38 supported on the reflector 3, thereby changing the space between the nut 38 support portion of the reflector 3 and the lamp body 2, so that the reflector 3 is inclined with respect to the lamp body 2.

The aiming rod 47 is rotated, for example, with a Phillips (RTM) screwdriver 66. When a tip 66a of the driver is inserted through one of notches 46 formed on the protective wall 45 of the back casing 8 into the protective wall 45, the tip 66a engages with the gear tooth 57 of the crown gear section 49 of the aiming rod 47. Then, if the Phillips (RTM) screwdriver 66 is turned, the gear tooth 57 of the crown gear section 49 is advanced by the operation of the tip 66a for rotating the aiming rod 47.

A plurality of notches for inserting an operation member such as the Phillips (RTM) screwdriver are formed spaced apart in the circumferential direction of the protective wall 45, thus enabling adjustments from a plurality of angles.

The aiming rod 47 may also be rotated by using the head 55 thereof, with a hexagon wrench, or engaging the tip of the Phillips (RTM) screwdriver into the engagement groove 56.

The levelling is adjusted by operation of the motor 59. That is, when the motor 59 turns, the worm wheel is rotated as described above. When the worm wheel 9 rotates, the screw thread 28 is advanced by the screw thread 12 and the retention shaft 27 is moved forward or backward in

response to the rotation direction of the worm wheel 9, thereby moving the adjusting shaft 31 supported on the retention shaft 27 forward or backward. As the adjusting shaft 31 moves forward or backward, the space between the nut 38 support portion of the reflector 3 and the lamp body 2 is changed, so that the reflector 3 is inclined with respect to the lamp body 2.

Figs. 15 through 35 show the use of a second embodiment of a gear assembly according to the present invention. In this embodiment, the gear assembly is used as a gear device in an aiming shaft adjusting device for a motor vehicle head lamp.

A head lamp levelling mechanism 67 is fastened to a car body, not shown. A case body 68 includes a front case 69 and a back case 70, both made of synthetic resin, are coupled to form the case body 68. The front case 69 is provided with a front wall 71 and a side wall 72 extending rearwards from the circumferential edge of the front wall 71. An insertion hole 73 is formed in the front wall 71. A tubular portion 74 projects out of the outside opening of the insertion hole 73. A support tube 75 protrudes from the inside of the insertion hole 73. The rear end face of the support tube 75, is semispherical in cross section, and serves as a holder portion 75a.

A flange 76 extends inwards from the inner surface of the tubular portion 74. The flange 76 is located approximately in the middle of the tubular portion 74. A stopper 76a protrudes rearwards from the inner edge of the flange 76. Mounting protrusions 77 protrude from the inner surface of the front wall 71. Caulking pins 77a protrude rearwards from the back faces of the mounting protrusions 77. On the other hand, mounting protrusions 78 protrude from the inner surface of the front wall 71. Caulking pins 78a protrude rearwards from the back faces of the mounting protrusions 78.

Reference numeral 79 and 80 indicate worm gears protruding rearwards from horizontally separated locations

on the inner surface of the front wall 71. These locations are substantially in the middle (as viewed in the vertical direction) on the inner surface of the front wall 71. The worm gears 79 and 80 are shaped like horizontally directed plates. Slits 81 and 82 of the worm gears 79 and 80 extend from the positions close to the bases (on the front wall 71 side) to the rear ends thereof, respectively. The slits 81 and 82 have substantially circular, large diameter portions 81a and 82a, located closer to the rear ends thereof, respectively. The rear portions of the slits 81 and 82 (as viewed with respect to the large diameter portions 81a and 82a) serve as introducing portions 81b and 82b, the distance between them being expanded gradually toward the rear.

Motor receiving portions 83 and 84 protrude rearward from horizontally separated locations on the lower part of the inner surface of the front wall 71. The motor receiving portions 83 and 84 are shaped like plates directed horizontally. Slits 85 and 86 of the motor receiving portions 83 and 84 extend from the positions closer to the bases (on the front wall 71 side) to the rear ends thereof, respectively. The slits 85 and 86 have substantially circular, large diameter portions 85a and 86a, located closer to the rear ends thereof, respectively. The rear portions of the slits 85 and 86 (as viewed with respect to the large diameter portions 85a and 86a) serve as introducing portions 85b and 86b. The distance between them is gradually expanded toward the rear.

The rear end portion of the side wall 72 of the front case 69 is constructed with an inner wall 87 and an outer wall 88 located outside the inner wall 87. A fitting groove 89 is formed between the inner wall 87 and the outer wall 88. The width (as viewed longitudinally) of the outer wall 88 is substantially twice as long as that of the inner wall 87. Accordingly, the outer wall 88 is extended to a point closer to the rear than the inner wall 87.

Slits 90 are formed at the four corners of the outer wall 88. The slits 90 extend longitudinally and reach the rear end. The outer wall 88 further includes rectangular engagement holes 91. A worm wheel 92 is rotatably supported by the case body 68 and immovable in the axial direction. The worm wheel 92 is made of synthetic resin and is substantially tubular in shape. A flange 93 extendes from the rear end of the worm wheel 92. The flange 93 with gear teeth 94 formed in the outer surface thereof forms a worm wheel.

A screw thread part 95 is formed on the inner surface of the worm wheel 92. A ring-like groove 96 is formed on the rear end face of the flange 93. A holder 97 is fastened to the front case 69. A mounting part 99, integral with holder 97, extends outwards from the fore end portion of a tubular main portion 98 made of synthetic resin. Mounting holes 99a are formed in the mounting part 99. The rear opening edges 99b of the mounting holes 99a are tapered outward to have enlarged diameters.

A guide cut 100 ranges from the fore end part of the main portion 98 to the rear end thereof. A guide concavity 101, longitudinally extending, is formed in the portion of the inner surface of the main portion 98, where it confronts with the guide cut 100. The fore end of the main portion 98, half-sphere in cross section, serves as a holder portion 98a.

The worm wheel 92 is rotatably but axially immovably supported by the front case 69 in the following way. The fore end part of the worm wheel 92 (as viewed with respect to the flange 93 is inserted into the support tube 75 of the front case 69. The holder portion 75a of the support tube 75 abuts on the fore end of the flange 93. To fasten the holder 97 to the front case 69, the caulking pins 77a of the mounting protrusions 77 of the front case 69 are inserted into the mounting holes 99a of the mounting part 99, in a state that the holder portion 98a of the main portion 98 slidably engages the ring-like groove 96 formed

in the rear surface of the flange 93. The portions of the caulking pins 77a, which protrude to the rear side of the mounting part 99, are caulked. The worm wheel 92 is rotatably but axially immovably supported by the front case 69 in a state that the flange 93 of the worm wheel 92 is nipped by the holder portion 75a of the support tube 75 of the front case 69 and the holder portion 98a of the main portion 98.

The holder portion 75a and the holder portion 98a nipping the flange 93 of the worm wheel 92 are shaped semi-spherically in cross section. This shape of those portions ensures a smooth rotation of the worm wheel 92 with small frictional resistance. The rear opening edges 99b of the mounting holes 99a of the holder 97 are tapered outward to have enlarged diameters. Molten parts of the caulking pins 77a fill in those tapered portions, thereby eliminating a play of the holder 97 after it is assembled.

A shaft member 102 comprises a tubular holder shaft and an adjusting shaft rotatably supported in the holder shaft. A holder shaft 103 is made of synthetic resin. The outer surface of the rear part of the holder shaft 103 is threaded to form a screw thread part 104. The rear end of which is outwardly expanded to form a pressure part 105. A guide protrusion 106 protrudes outwardly from the holder shaft, diametrically opposed to the location where the pressure part 105 is formed. A plurality of axially extending cuts 108 are formed in the inner surface of the holder shaft 103.

An adjusting shaft 109 is a rod made of metal, and a rear end portion of the adjusting shaft 109 is radially expanded to form a flange 110. A rear part of the adjusting shaft, behind the flange 110, is shaped with an oval cross section. This oval rear part serves as a slide coupling part.

The first half 112 of a fore part of the adjusting shaft, in front of the flange 110, forms a screw threaded shaft. An engaging groove 113 is circumferentially formed

at the rear end of the shaft 112. The length of the portion between the rear end of the engaging groove 113 and the front face of the flange 110 is substantially equal to the length of the central hole 107 in the holder shaft 103.

Upon assembly the adjusting shaft 109 is inserted into the central hole 107 of the holder shaft 103 from its rear. A spring washer 114 is fitted to the portion of the adjusting shaft protruding from the fore end of the holder shaft 103. A fixing circlip 115 is fitted to the washer 114. In this way, the adjusting shaft 109 is rotatably but axially immovably supported by the holder shaft 103.

The axially extending cuts 108 are formed in the inner surface of the central hole 107 of the holder shaft 103. With provision of the axially extending cuts, a contact area of the holder shaft and the adjusting shaft 109 is reduced, thereby reducing the rotation load on the adjusting shaft 109 at the time of the aiming adjustment. In this way, the adjusting shaft 109 is supported by the holder shaft 103, thereby forming the shaft member 102.

The screw threaded part 104 of the holder shaft 103 of the shaft member 102 is screwed into the screw thread part 95 of the worm wheel 92. The guide protrusion 106 of the holder shaft 103 is slidably coupled with the guide concavity 101 of the holder 97. The pressure part 105 of the holder shaft 103 is slidably coupled with the guide cut 100 of the holder 97. In this way the shaft member 102 is not rotated upon the rotation of the worm wheel 92 but is axially movable. Further, the fore end part of the pressure part 105 protrudes out of the holder 97 through the guide cut 100.

The fore end part of the holder shaft 103 is inserted into the insertion hole 73 of the front case 69 and the tubular portion 74. The screw part 112 of the adjusting shaft 109 is screwed into a nut 38 supported by the turning end of the reflector 3.

The back case 70 includes a rear wall 116 and a side surface wall 117 extending forward from the peripheral edge

of the rear wall 116. An insertion hole 118 is formed in the rear wall 116, in alignment with the insertion hole 73 of the front case 69. The rear wall 116 includes a tubular portion 119 extending forward from the fore end opening of the insertion hole 118 and a tubular portion 120 protruding rearwards from the rear end opening of the insertion hole 118. An annular notch 121 is formed in the inner edge of the rear end of the rear tubular portion 120. A protecting wall 122 extendes from the rear surface of the rear wall 116 so as to surround the tubular portion 120. The protecting wall 122 includes a plurality of spaced cutouts 123.

A surrounding wall 124 protrudes from a portion in the vicinity of the center of the lower portion of the rear surface of the rear wall 116. When viewed from the rear side thereof, the corners thereof are curved to provide a triangle shape.

Guide walls 125 and 126, which extend downward from the edges of the right and left openings of the two cuts 123 located in the right and left lower portions of the protecting wall 122, protrude from the rear surface of the rear wall 116. The outer guide walls 125 are longer than the inner guide walls 126. The top ends 125a of the outer guide walls 125 are bent somewhat outward to reach the side edge of the rear wall 116. The inner guide walls 126 terminate before these reach the position of the surrounding wall 124. The surfaces 126a of the fore end portions thereof, which face the outer guide walls 125, are inclined gradually apart from the outer guide walls 125 toward their top ends. A guide path is formed between the guide walls 125 and 126. With provision of these paths, the top tip of an operating tool, such as a screw driver, may easily be inserted through the paths to the protecting wall 122. Since the top ends 125a of the inner guide walls 126 are slanted as described above, the tip top of the operating tool is received at this slanted top ends when it is inserted. Therefore, the insertion of the operating

tool is easy. Further, the side surface of the surrounding wall 124 also extendes in the same direction as that of the outer guide walls 125 and 126. Then, the surrounding wall 124 also guides the operating tool when it is inserted into the inside defined by the protecting wall 122.

Engaging pawls 127 stand upright on the outer surface of the side surface wall 117 at locations thereof corresponding to the engaging holes 91 of the front case 69. An aiming rod 128 includes a body portion 129 made of synthetic resin and a crown gear 130 made of metal. The crown gear 130 is formed at a location close to the rear end of the body portion 129 by an out-insert molding method. A gear assembly according to the present invention is applied to this aiming rod 128.

To integrally couple the main body with the gear means, any other suitable method than the out-insert molding method may be used. For example, caulking pins may protrude from the main body, holes correspondingly formed in the gear means, these pins of the main body inserted into the holes of the gear means and the inserted portions of the pins are then thermally caulked.

The portion of the body portion 129, located further fore than the crown gear 130, serves as a tubular portion 131. The tubular portion 131 is cylindrical in shape. A coupling hole 132 formed in the tubular portion 131 opens at the fore end thereof. The coupling hole 132 is oval in cross section. The slide coupling part of the adjusting shaft 109 is inserted into the coupling hole whereby the inserted adjusting shaft is slidable but nonrotational relatively to the coupling hole.

In the tubular portion 131, slits 133 are formed at two locations facing each other in the major axial direction in the oval cross section of the coupling hole 132. The slits 133 reach the fore end of the tubular portion. Engaging pawls 134 and 134 protrude outward from the fore end of the tubular portion 131 at the locations thereof facing each other in the minor axial direction of

the oval cross section of the coupling hole 132. The front faces 134a of the engaging pawls 134 are tapered, while the rear ends 134b thereof are perpendicular to the axial direction of the tubular portion 131, thereby forming stopper faces.

The portion of the body portion 129, located further rear than the crown gear 130, is a head portion 135, hexagonal in cross section. An engaging slit 136 is formed in the rear face of the head portion 135. The engaging slit 136 is extended in the direction orthogonal to the major axial direction of the oval cross section of the coupling hole 132.

The crown gear 130 made of metal is circular in shape. The circumferential edge of the crown gear 130 is bent forward. Gear teeth 137 are formed in the forward bent portion. The tubular portion 131 of the aiming rod 128 is inserted into the insertion hole 118 of the back case 70 from its rear side. When inserted, the engaging pawls 134 and 134 of the tubular portion 131 of the aiming rod 128 are compressed to be deflected inwardly by the inner surfaces of the tubular portions 120 and 119 of the back case 70 and the insertion hole 118. After passing therethrough, the compressed engaging pawls 134 and 134 are restored to their original state. The stopper faces 134b of the engaging pawls 134 abut on the fore end of the tubular portion 119, thereby preventing the aiming rod 128 from slipping off the back case 70. The front face of a contact part 131a protruding from the rear end of the tubular portion 131 comes in contact with the rear end of the rear tubular portion 120 of the back case 70. With this arrangement, the aiming rod 128 is rotatably supported by the back case 70.

An O ring 138 is fitted to the base part of the tubular portion 131 of the aiming rod 128, and positioned in the ring-like cut 121 formed in the inner face of the rear end of the tubular portion 120 of the back case 70. With this structure, water-proof is ensured.

When the front case 69 is coupled with the back case 70 in a state that the rear opening face of the front case 69 is put face to fact with the front opening face of the back case 70, the slide coupling part 111 of the adjusting shaft 109 supported by the front case 69 is coupled with the coupling hole 132 of the aiming rod 128, axially slidably but nonrotationally. Thus, the slide coupling part 111 is inserted into the coupling hole 132. As a result, the tubular portion 131 of the aiming rod 128 is prevented from being deflected to be reduced in its diameter. When the front case 69 is coupled with the back case 70 for assembling, the aiming rod 128 will never slip off the back case 70. Further, it is noted that in the aiming rod 128, the coupling hole 132 and the engaging slit 136 are oriented in a fixed relationship, as described above. With this orientation relationship, it is easy to align the slide coupling part 111 of the adjusting shaft 109 with the coupling hole 132 of the aiming rod 128 when the former is inserted into the latter.

Additionally, it is noted that in the second embodiment, unlike the first embodiment, only two slits 133 are formed in the tubular portion of the aiming rod 128. With this feature, the rigidity of the tubular portion 131 is increased for firmly gripping the slide coupling part 111 of the adjusting shaft 109.

Reference numeral 139 designates a motor fastened to the inside of the case body 68; numeral 140 a pinion gear fastened to a rotary shaft 139a of the motor 139. A case 141 of the motor 139, oval in cross section, has two flat faces 141a and 141b oppositely located. Portions 142a and 142b protrude from both sides of the case 141 conform in shape to the large diameter portions 85a and 86a of the slits 85 and 86 of the motor receiving portions 83 and 84 formed in the front case 69. Numerals 143a and 143b designate terminal pieces projecting from one side of the flat face 141b of the case 141 of the motor 139.

In assembling, the protruded portion 142a of the case 141 of the motor 139 is put on the introducing portion 85b of the motor receiving portion 83 and the protruded portion 142a is put on the introducing portion 86b of the motor receiving portion 84. Thereafter, the motor 139 is pushed toward the front wall 71. Then, the protruded portions 142a and 142b push the slanted edges of the introducing portions 85b and 86b to open the slits 85 and 86. In turn, the protruding portions 142a and 142b are received by the large diameter portions 85a and 86a of the motor receiving portions 83 and 84, respectively. In this way, the motor 139 is supported by the front case 69. And the flat face 141a of the case 141 of the motor 139 abuts against the inner surface of the front wall 71.

A worm 144 has a shaft which is rotationally supported in parallel with the axial direction of the motor 139, and in mesh with the worm wheel 92. A spur gear 145 integral with the worm 144 is in mesh with the pinion gear 140. Accordingly, when the motor 139 is driven, the worm 92 is turned.

A coupling part 146 couples the worm 144 with the spur gear 145. A location of the coupling part 146 closer to the spur gear 145 serves as a circumferentially elongate, indented supported part 147. A thin supported shaft 148 projects from the end of the worm 144, not coupled with the spur gear 145. The supported part 147 is brought into contact with the introducing portion 81b of the worm 79 of the front case 69. The supported shaft 148 is brought into contact with the introducing portion 82b of the worm 80. Thereafter, the worm 144 is pushed toward the front wall 71 to open the slits 81 and 82 of the worms 79 and 80. The supported part 147 and the supported shaft 148 are received by the large diameter portions 81a and 82a of the worms 79 and 80, respectively. As a result, it is rotationally supported by the front case 69. Incidentally, provision of the supported part 147 on the inner side of the spur gear 145 realizes an effective use of the space thereof.

A printed circuit board 149 includes circuitry formed thereon and mounting holes 150. Reference numeral 151 designates a connector 151 formed in front of the printed circuit board 149. Receiving holes 152a and 152b are formed in the fore end portions of the connector 151. Terminal pieces 153 project rearwards from the rear side of the printed circuit board 149.

The caulking pins 78a of the mounting protrusions 78 formed on the front case 69 are inserted into the mounting holes 150 of the printed circuit board 149 from its front side, respectively. The portions of the caulking pins 78a projecting from the printed circuit board 149 to its rear side, after inserted, are caulked, whereby the printed circuit board 149 is supported by the front case 69. At this time, the terminal pieces 143a and 143b of the motor 139 are respectively inserted into the receiving holes 152a and 152b of the connector 151, so that the motor 139 is connected to the circuit of the printed circuit board 149.

The holder 97 and the printed circuit board 149 are caulked by the caulking pins 77a and 78a arranged in the same direction on the printed circuit board 149. Therefore, those may be assembled automatically by an assembling machine.

In a resistor type sensor 154, a sliding member 156 is longitudinally movably supported by a case 155. A relative position of the sliding member 156 to the case 155 determines a resistance of the sensor. A spring means (not shown), provided in connection with the sliding member 156, urges the sliding member 156 forward. The end of the sliding member 156 of the resistor type sensor 154 resiliently contacts the back side of the pressure part 105 of the holder shaft 103 of the shaft member 102.

With the movement of the shaft member 102 in the longitudinal direction, the sliding member 156 of the resistor type sensor 154 moves to change a resistance of the sensor. The detected resistance may indicate a

position of the shaft member 102. Further, the detected position may indicate a tilt angle of the reflector 3.

The front edge of the side surface wall 117 of the back case 70 is fitted into the fitting groove 89. Before the fitting, an O ring 157 is fitted into the fitting groove 89. As the fore end of the side surface wall 117 is progressively fit into the fitting groove 89, the engaging pawls 127 on the outer surface of the side surface wall 117 comes into engagement with the rectangular engagement holes 91 of the outer wall 88 of the front case 69. As a result, the front case 69 is coupled with the back case 70, thereby forming the case body 68. The slide coupling part 111 of the adjusting shaft 109 is coupled with the coupling hole 132 of the aiming rod 128 . The terminal pieces 153 of the printed circuit board 149 are inserted into insertion holes 158 formed in an area of the rear wall 116 of the back case 70, which is surrounded by the surrounding wall 124, and projected to within the surrounding wall 124. In this way, a connector 159 is formed.

A plurality of slits 90 are formed in the outer wall 88 of the front case 69. Therefore, to separate the front case 69 from the back case 70, the rectangular engagement holes 91 may easily be disengaged from the engaging pawls 127 of the back case 70 by fingering outward the portion of the outer wall 88 between the slits 90 to deflect it.

If two slits are formed on both sides of each of the rectangular engagement holes 91 their disengagement is easy, but the front case 69 is easy to be broken at the slits. For this reason, the slits 90 are formed only at the corners. Thus, the initial aiming adjustment of the head lamp levelling mechanism 67 is carried out by turning the aiming rod 128.

When the aiming rod 128 is turned, the adjusting shaft 109 of which the slide coupling part 111 at the rear end thereof is slidably coupled with the coupling hole 132. The screw shaft 112 is screwed into or out of the nut 38 depending on the turning direction. With this movement of

the screw shaft, a distance between the lamp body 2 and the portion of the reflector 3 where the nut 38 is supported, is varied to tilt the reflector 3 with respect to the lamp body 2. The aiming rod 128 is turned by a screw driver, for example.

The tip 66a of a plus driver 66 with a cross tip is inserted to within the protecting wall 122 through one of the cutouts 123 of the protecting wall 122 of the back case 70. Then, the tip top 66a thereof reaches the gear teeth 137 of the crown gear 130 of the aiming rod 128. In this state, when the plus driver 66 is turned, its tip top 66a moves the gear teeth 137 of the crown gear 130 to turn the aiming rod 128.

A plurality of cutouts 123 which allow the operating tool, such as a plus driver, to pass therethrough, are circumferentially formed in the protecting wall 122. Therefore, the access for the aiming adjustment is allowed in a plural number of directions. If the guide path defined by the outer guide walls 125 and 126 is used for the access, a smooth insertion of the operating tool is possible. The head portion 135 of the aiming rod 128 may be used to turn the aiming rod 128. The aiming rod 128 may also be turned by means of a hexagonal wrench or putting the tip top of a minus driver into the engaging slit 136, for example. The levelling adjustment is carried out through the turn of the motor 139.

When the motor 139 rotates, the worm wheel 92 turns as described above. When the worm wheel 92 turns, the screw thread part 104 is fed forward by the screw thread part 95, the holder shaft 103 is longitudinally moved depending on the turning direction of the worm wheel 92, and the adjusting shaft 109 supported by the holder shaft 103 is longitudinally moved. Through the longitudinal movement of the adjusting shaft 109, the distance between the lamp body 2 and the portion of the reflector 3 where the nut 38 is supported, is varied to tilt the reflector 3 with respect to the lamp body 2.

As described above, the gear device of the present invention includes the gear section, the elastic engagement pieces being formed integrally with the gear section and having engagement claws on the outer face thereof, and the abutment section facing the engagement claws at a distance. The engagement claws engage the front end of a support hole made in a support member and the abutment section abuts against the rear end of the support hole, so that the gear is supported on the support member for rotation.

Therefore, with the gear device of the invention, simply by inserting the elastic engagement pieces into the support hole, the engagement claws formed on the elastic engagement pieces engage the front end of the support hole and the abutment section abuts against the rear end of the support hole, whereby the gear is supported on the support member for rotation. Thus, since no extra casing and screws conventionally required is required, the number of parts decreases, and a step of supporting the gear on the support member becomes extremely easy. Although the number of the elastic engagement pieces are two in the foregoing embodiment, more or less of the elastic engagement pieces may be applicable.

In the foregoing embodiments, although the gear assembly of the invention is applied as a gear device in the illumination angle adjustment apparatus for a vehicular headlight, the invention is not limited thereto but can be applied to various types of gears, needless to say. Further, in the above embodiment, the gear section is shown as the gear section having the crown gear, but the gear provided in the gear section is not limited to the crown gear and may be any other type of gear, such as a bevel gear.

CLAIMS

1. An assembly of a gear device rotatably supported by a support member having an opening, the assembly comprising a gear member and a tubular member secured to the gear member, the tubular member having a substantially cylindrical tubular body extending through the opening, at least one elastic engagement piece, an engagement claw formed on an outer surface of the elastic engagement piece, the engagement claw engaging a front end of the opening in the support member; and an abutment member facing the engagement claw at a distance, and abutting against a rear end of the opening in the support member.

2. An assembly according to claim 1, wherein the tubular member is formed of a synthetic resin and the gear member is formed of metal.

3. An assembly according to claim 2, wherein the tubular member and the gear member are integrated together as an outsert molding.

4. An assembly according to claim 2, wherein the tubular member and the gear member are integrated together in such a manner that a clamping pin projecting from the tubular pipe member is inserted into a hole formed in the gear member, and then the insertion part is clamped by thermal clamping.

5. An assembly according to any one of the preceding claims, wherein the interior of the tubular member has an elliptical shape in cross section.

6. An assembly according to any one of the preceding claims, wherein the tubular member is formed with a plurality of slits for defining elastic engagement piece(s).

7. An assembly according to any one of the preceding claims, wherein the number of the slits is four.

8. An assembly according to any one of claims 1 to 6, wherein the number of the slits is two.

9. An assembly according to any one of the preceding claims, wherein the engagement claw comprises a inclined front face and a rear face which is perpendicular to the axis of the tubular member.

10. An assembly according to any one of the preceding claims, wherein the tubular member further comprises a head extending rearwardly of the gear member, the head presenting a regular hexagon in cross section, and providing at its rear face thereof a cross-shaped engagement groove.

11. An assembly according to any one of the preceding claims, wherein the gear member is formed of a substantially circular metal plate, a periphery of which is bent forward, and gear teeth being formed in the bent portion.

12. A gear assembly, substantially as described with reference to Figures 1 to 14, or to Figures 15 to 35, of the accompanying drawings.

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Relevant Technical Fields (i) UK Cl (Ed.M) F2U, F4R (RMA, RMC) (ii) Int Cl (Ed.5) F16H 57/00, 57/02; B60Q 1/06, 1/064, 1/068, 1/072, 1/076 **Databases** (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ON-LINE DATABASES: WPI	Search Examiner T S SUTHERLAND Date of completion of Search 5 DECEMBER 1994 Documents considered relevant following a search in respect of Claims :- 1 TO 11

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A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1481283	(MOULINEX) Figure 2	1
A	EP 0129519 A	(FIAT) Figures 1 and 3	

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