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(54) Magnetic monorail

(57) A magnetic monorail train that comprises one or more lightweight wagons, which surround the rail except for a small lengthwise channel at the bottom, and uses rotary permanent magnet wheels which attract the track or rail of ferromagnetic, iron, etc., along the sides of the lower base, having said wheels their symmetrical plane cutting them at their central circle, at right angles to the rail and parallel to its longitudinal axis.

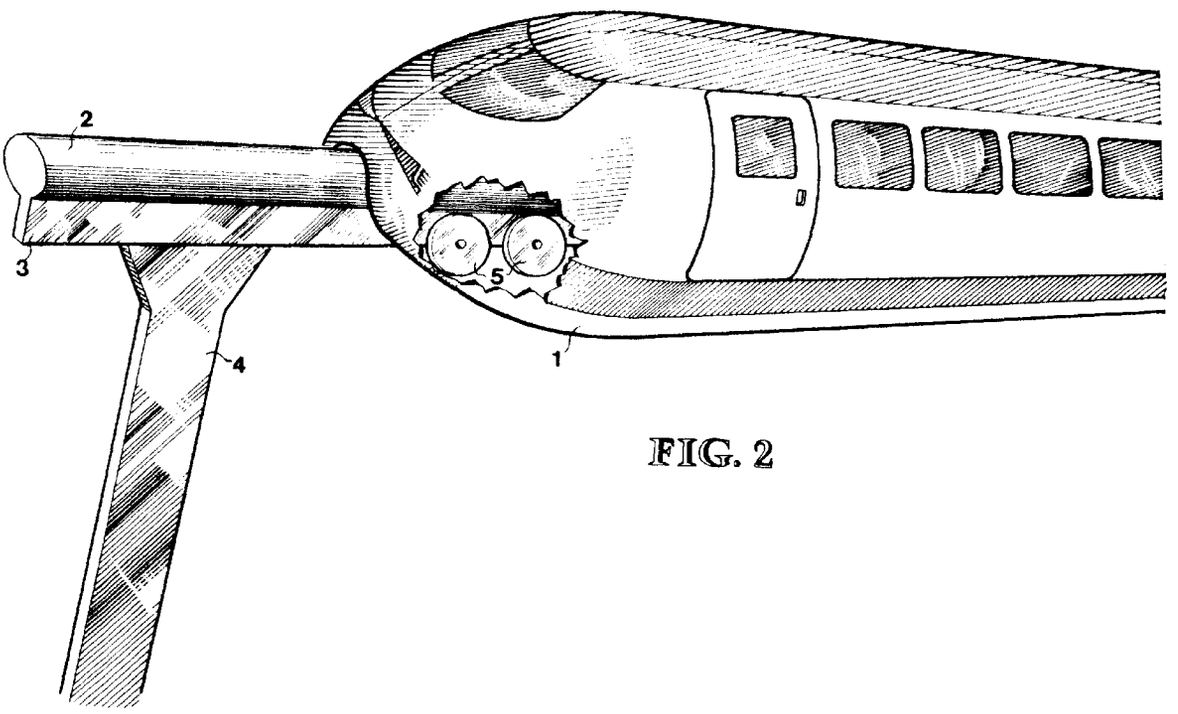

FIG. 2

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

Non-conventional magnetic trains.

2. State of the Art

Non-conventional magnetic trains employing magnetic repulsion (levitation) or the electromagnetic type employing attraction (suspension) are under study or experimentation, as are others less connected with this invention. Such trains require costly track and complex levitation or suspension systems and/or high energy consumption.

BRIEF DESCRIPTION OF THE INVENTION

The monorail train in this invention reduces the weight of the vehicle to the minimum, using one or more lightweight wagons which surround the rail except for a small lengthwise channel at the bottom, and has a number of complementary suspension systems, some of which do not require energy use, enabling the train to operate in the following varied manners:

A) A main magnetic attraction type suspension system using rotary permanent magnet wheels which attract the track or rail, of magnetic or ferry-magnetic material, rolled steel, iron, etc., along the sides of the lower face. Said wheels, with their symmetrical plane cutting them at their central circle, are at right angles to the rail and parallel to its longitudinal axis. A secondary or complementary adherence or wheel suspension system, around the rail, carries the small or virtually zero resulting weight.

B) A main magnetic attraction type suspension system as under (A) above, and a secondary or complementary suspension system using air jets nozzle, which expel air from the wagon or train or vehicle over and/or around the rail, bearing the small or virtually zero resulting weight, generating a greater reaction the closer the rail. The suspension may even be slightly greater than the weight of the vehicle.

C) A main magnetic attraction type suspension system as under (A) or (B) above, and a secondary or complementary suspension system using small electromagnets on the wagon around the rail, bearing the small or virtually zero resulting weight, powered by variable currents in inverse function to their distance or separation from the rail.

D) A main magnetic adherence type suspension system using three or more wheels whose symmetrical plane, cutting them at their central circle, is at right angles to the rail and parallel to its longitudinal axis.

The adherence suspension system uses various types of wheels, e.g. a) a group of three independent wheels with the overall external form of a pulley, on a single shaft; b) independent wheels with two or more bearings in series; c) pulley-type wheels; d) wheels of rectangular cross-section and; e) special wheels consisting of a hollow, flexible ring rubber-coated on the outside extreme, with a taut rubber disc on the inside on its symmetrical plane and, in the center of said disc, one or two metal plates or discs with holes through which to secure the shaft to the wheel. This provides very good shock absorption, is noiseless and does not require inflation. In all cases, the symmetrical plane of these wheels, cutting them through their central circle, is at right angles to the rail surface and parallel to its longitudinal axis.

To prevent the vehicle from inclining unnecessarily, wheels are used which may be retracted, as well as air jets orvariable-current-powered electro-magnets. In all cases, these are arranged at right angles on each side of the support beam; the wheels, with their symmetrical plane cutting them at their central circle, are at right angles to the rail and parallel to its longitudinal axis.

Types A, B and C can also employ flat magnets or rotary magnetic fields which operate in the same way as magnetic wheels, though with major energy consumption in suspension and/or traction.

Type A is the most energy efficient both for the suspension and for the suspension and traction assembly. It also enables high speeds due to the limited weight once magnetic attraction is applied and as a result of the very low-level friction to be overcome for the traction.

In all cases, particularly in comparison with magnetic types, this is the most economical approach.

While these systems do operate together, they can also be run separately.

The rail is largely a tubular design of circular cross-section with a support beam laid out and attached longitudinally and mounted on columns on the ground. Optionally, the tubular rail may be of oval or rectangular cross-section. It may also have a rectangular cross-section which is compact, broad and of limited thickness.

System C with the electro-magnets allows a variant just with electro-magnets in the upper part of the rail and over it; they are fed a current of an intensity which attracts the rail from above, depending on the distance to it. Said upper electro-magnets can be wheel-shaped and so powered as in the previous case.

Additionally, magnetic wheels can use the form of a pulley or a semi-pulley.

An additional system of sloping surfaces on the nose and under the tail can provide additional aerodynamic suspension or lift.

With weight reduced to a minimum, any type of a drive is possible, without energy waste, requiring little power and enabling high speeds. Linear or any other type of motors can be used, turbines, etc.

The magnetic wheels may be fed magnetism periodically through coils forming part of them. The polarities of the magnets, which are generally arranged in radial form, or parallel to their rotary axles, allow for a variety of designs or layouts. The wheel shafts may be freewheel or driven by small electrical motors. The magnetic wheels are covered in a layer of rubber or plastic. Magnetic materials are used with high coercive force and residual induction, particularly rare earth magnets, samarium-cobalt, neodymium and ferrite types, etc. During operation, these wheels may or may not be in contact with the rail. When these magnetic wheels are used, braking usually produced by the magnetic field at the air gap or between poles is avoided.

Power pick-up may be through several conductive wheels whose pick-up surface is made up of a large number of flexible filaments: the rail itself or the support beam provides one of the poles while the other is an insulated side strip running parallel to the support beam.

Curves are taken on a rail on an inclined support beam and columns; the inclination depends on the speed of the vehicle, to prevent the centrifugal displacement of the passengers. The vehicle can also be inclined by action on the side stabilizing wheels, moving them toward the inside of the curve.

The support beam may have two lengthwise rolled steel perpendicular fins each of which, at the bottom, admits magnetic wheels also connected to the vehicle, so as to increase the total area in contact with magnetic wheels.

The air jets may also be directed on to these fins, so that they do not need to be magnetic.

Braking may be by locking the magnetic wheel shaft or by stopping or braking the electrical motors, etc.

Wagons may be very light since, because they surround the rail, the vehicle is held in place without a need for weight to secure it on the rail.

The equipment must also be lightweight.

The fuselage is lighter than an aircraft fuselage since it is not called upon to bear large inertia forces.

Advantages

The invention is economical, simple, safe and cannot derail, if electrically powered, it does not affect the environment, guidance is automatic, high speeds are possible, some wheels are noiseless, friction is very limited so that the energy required for traction is also limited, and it is not particularly affected by curves and inclines. This is the only system which uses both economical track and a low-energy system with permanent magnets and the resulting additional saving. The combination of high speed, safety and high performance make it highly competitive with aircraft transport.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective view of the monorail of the invention.

FIG. 2 shows a perspective view of the monorail and its magnetic wheels.

FIG. 3 shows a transversal cross-section view of a cylindrical rail magnetic wheels attached to a train (not shown in this figure).

FIG. 4 shows a transversal cross-section view of a cylindrical rail and the nozzles which expel air as a secondary control system of separation from the rail.

FIG. 5 shows a transversal cross-section view of a cylindrical rail and the secondary electro-magnets control systems of separation from the rail.

FIG. 6 shows a transversal cross-section view of a cylindrical rail and some multiple wheels with the overall external form of a pulley.

FIG. 7 shows a transversal cross-section view of the whole wagon and rail and a type of wheels which are perpendicular to the surface of the rail.

FIG. 8 shows a transversal cross-section view of a cylindrical rail using special wheels.

FIG. 9 shows a transversal cross-section view of an oval cross-section rail.

FIG. 10 shows a transversal cross-section view of a rectangular cross-section rail.

FIG. 11 shows a transversal cross-section view of a reduced thickness rectangular cross-section rail.

FIG. 12 and FIG. 13 show partial perspective views of the nose and the tail of a wagon which add some aerodynamic improvements.

FIG. 14 shows a transversal cross-section view of a cylindrical rail and a variant using magnetic wheels.

FIG. 15 shows a transversal cross-section view of a cylindrical rail and a variant of pulley-type wheels.

FIG. 16 shows a transversal cross-section view of a cylindrical rail showing the electrical power pick-up by means of pick-up conductive wheels.

FIG. 17 shows a transversal cross-section view of a cylindrical rail and a possible way of inclined support beam and columns in the curve.

FIG. 18 and FIG. 19 show a transversal cross-section view of a cylindrical rail, whose support beam have two perpendicular fins.

FIG. 20 shows a transversal cross-section and perspective view of a cylindrical rail using electro-magnets in the upper part.

FIG. 21 shows a transversal cross-section view of a cylindrical rail using electro-magnetic wheels.

FIG. 22 shows a transversal cross-section view of a reduced thickness rectangular cross-section rail, having electro-magnetic wheels in the upper part.

FIG. 23 shows a transversal cross-section view of a rail and a wheel with bearings in series.

MORE DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 consists of the wagon 1, the cylindrical rail 2, the support beam of the rail and the columns 4 and 4'.

FIG. 2 shows the monorail train in this invention whose lightweight wagon 1, uses a main magnetic attraction type suspension system by means of rotary magnetic wheels 5 of permanent magnets which generate most of the suspension, said magnetic wheels attract the track or cylindrical rail 2, of magnetic or ferromagnetic material, iron, etc., along the sides of the lower face, said rail is disposed with a support beam 3, laid out and attached longitudinally and mounted on columns 4.

FIG. 3 shows the cylindrical rail 2, the support beam of the rail 3, the magnetic wheels 5 and 5' their shafts 6 and 6'.

FIG. 4 consists of the rail 2, the support beam of the rail 4, and the expel air jet nozzles 7 and 7'.

FIG. 5 consists of the rail 2, the support beam of the rail 3 and the magnets 8 and 8'.

FIG. 6 consists of the rail 2, the support beam of the rail 3 and the multiple wheels whose overall external form of a pulley 9 and 9'.

FIG. 7 consists of wagon 1, the rail 2, the support beam of the rail 3, the rectangular transversal cross-section wheels 10 and 10', the rail cover 11, the retractable side stabilizing wheels 12 and 12', and the shafts 13 and 13'. This is the method used when some degree of roll freedom in the curves is desired when inclined support beams are not used.

FIG. 8 consists of the rail 2, the support beam 3, the taut rubber disc of the wheel 14, the ring or rim of the wheel 15 and 15', the rubber 16 and 16', the metal plates 17 and the shaft 18.

FIG. 9 consists of the oval cross-section rail 2, the support beam 3, the column 4, the pulley-type magnetic wheels 5 and 5' and shafts 6 and 6'.

FIG. 10 consists of the rectangular cross-section rail 2, the support beam 3, the column 4, the magnetic wheels 5 and 5', and the shafts 6 and 6'.

FIG. 11 consists of the reduced thickness rectangular cross-section rail 2, the support beam 3, the column 4, the magnetic wheels 5 and 5' and the shafts 6 and 6'.

FIG. 12 and FIG. 13 consist of the wagon 1, the rail 2, the support beam 3, the column 4, the magnetic wheels 5 and the drive electrical motors 19, the sloping surface on the nose and under the tail provide complementary aerodynamic suspension lift.

FIG. 14 consists of the rail 2, the support beam 3, the special magnetic wheels 20 and 20' where N and S are their respective poles and 6 and 6' their shafts.

FIG. 15 consists of the rail 2, the support beam 3, the magnetic pulley-type wheels 21 and 21', and the shafts 6 and 6'.

FIG. 16 consists of the rail 2, the support beam 3, the insulating side strip 22, the conductive plate of one of the poles 23 and the conductive and current pick-up wheels 24 and 24' whose surface is made up of a large number of flexible filaments.

FIG. 17 consists of the rail 2, the support beam of the rail 3, the support column 4 and the side stabilizing wheels 12 and 12'.

FIG. 18 consists of the rail 2, the support beam 3, the magnetic wheels 5 and 5' and the perpendicular fins 25 to the support beam.

FIG. 19 consists of the beam of the rail 2, the support beam 3, the air jet nozzles 7 and 7' and the perpendicular fins to the beam 25.

FIG. 20 consists of the rail 2, the support beam 3, the main magnetic wheels 5 and 5', the upper electro-magnets 8 and the poles N and S of the main wheels or magnets, this allows by means of the two upper small electro-magnets, to attract the rail and therefore compensate the final degree of suspension, so that it can be as low as possible.

FIG. 21 is similar to FIG. 20, but instead of the fixed electro-magnets uses the rotary electro-magnets 27 and 27' which are equipped on the wheels 26 and 26' whose rotary shafts are 6 and 6'.

FIG. 22 is similar to FIG. 21 but it uses a thin rectangular cross-section rail 25.

FIG. 23 consists of the rail 2, the wheels 10, and the bearing 28 and 28', one placed between the shaft and the wheel and the other two at the ends of the shafts.

Operation: The high attraction of the permanent magnet wheels, between 95 and 105 percent of the vehicle weight, produces most of the suspension. The difference with the 100 percent is supported or compensated by small wheels, small air jets, small electro-magnets or small electromagnet wheels, which compensate for the difference of excess or defect of suspension. The electric motor can be applied to the magnet wheels shafts or otherwise using another wheel type directly on the rail.

Claims

1. A magnetic train, comprising one or more lightweight wagons, which surround a track or rail on a support beam except for a small lengthwise channel at the bottom, said train having rotary permanent magnetic wheels which attract to said rail, of ferromagnetic steel or iron, said wheels contact said rail along the lower sides of its base, the symmetrical plane of said wheels cuts the rail at right angles to said rail and are parallel to the longitudinal axis of said rail.

2. A magnetic monorail train according to Claim 1, having a secondary or complementary suspension system of air jets nozzles on the wagon around the rail.

3. A magnetic monorail train according to Claim 1, having a secondary or complementary suspension system using small electromagnets on the wagon around the rail, powered by variable currents in inverse function to their distance or separation from the rail.

4. A magnetic monorail train according to Claim 1, having a main adherence type suspension system and three or more wheels with their respective symmetrical planes intersecting at their central circle, at right angles to the rail and parallel to their longitudinal axis.

5. A magnetic monorail train according to Claim 1, having a group of three independent wheels with the overall external form of a pulley on a single shaft.

6. A magnetic monorail train according to Claim 1, having perpendicular wheels arranged on each side of said support beam.

7. A magnetic monorail train according to Claim 1, wherein said rail is a tubular design of circular cross-section having a support beam laid out and attached longitudinally and mounted on columns on the grounds.

8. A magnetic monorail train according to Claim 1, wherein rail is a tubular design of rectangular cross-section.

9. A magnetic monorail train according to Claim 1, wherein said magnetic wheels are freewheel.

10. A magnetic monorail train according to Claim 1, wherein said magnetic wheels are driven by small electrical motors.

11. A magnetic monorail train according to Claim 1, wherein said magnetic wheels are covered in a layer of rubber or plastic.

12. A magnetic monorail train according to Claim 1, having magnetic wheels in the form of a pulley.

13. A magnetic monorail train according to Claim 1, having pick-up surface conductive wheels, whose pick-up surface is made up of a large number of flexible filaments, providing the rail itself or the support beam one of the poles while the other is an insulating side strip running parallel to said support beam.

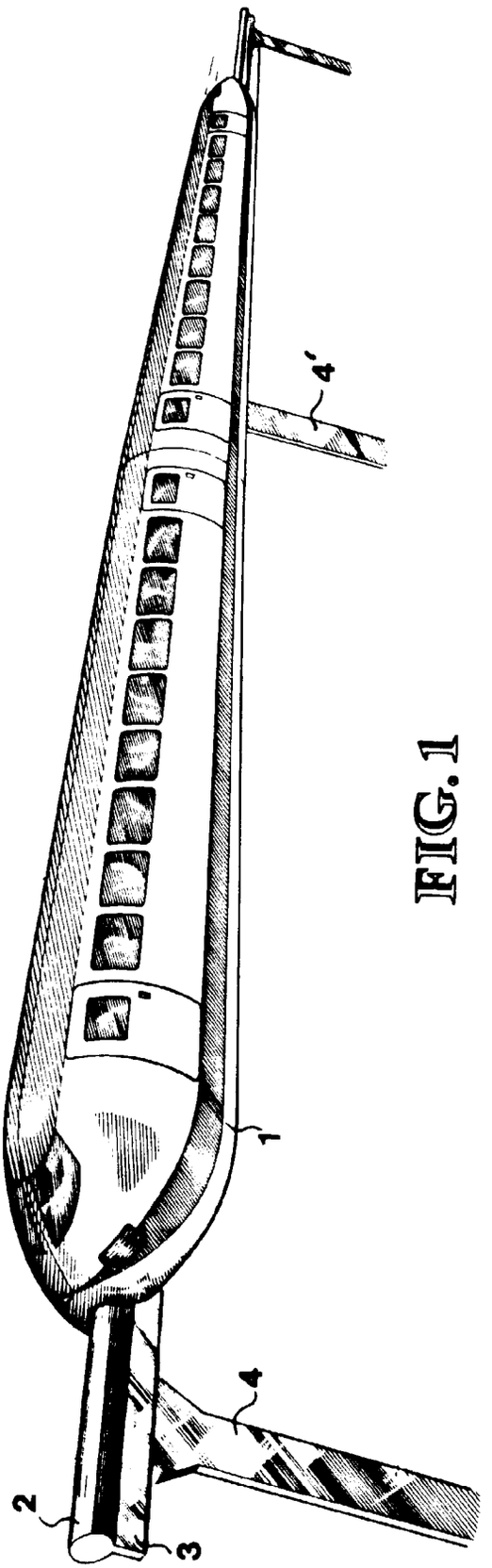

FIG. 1

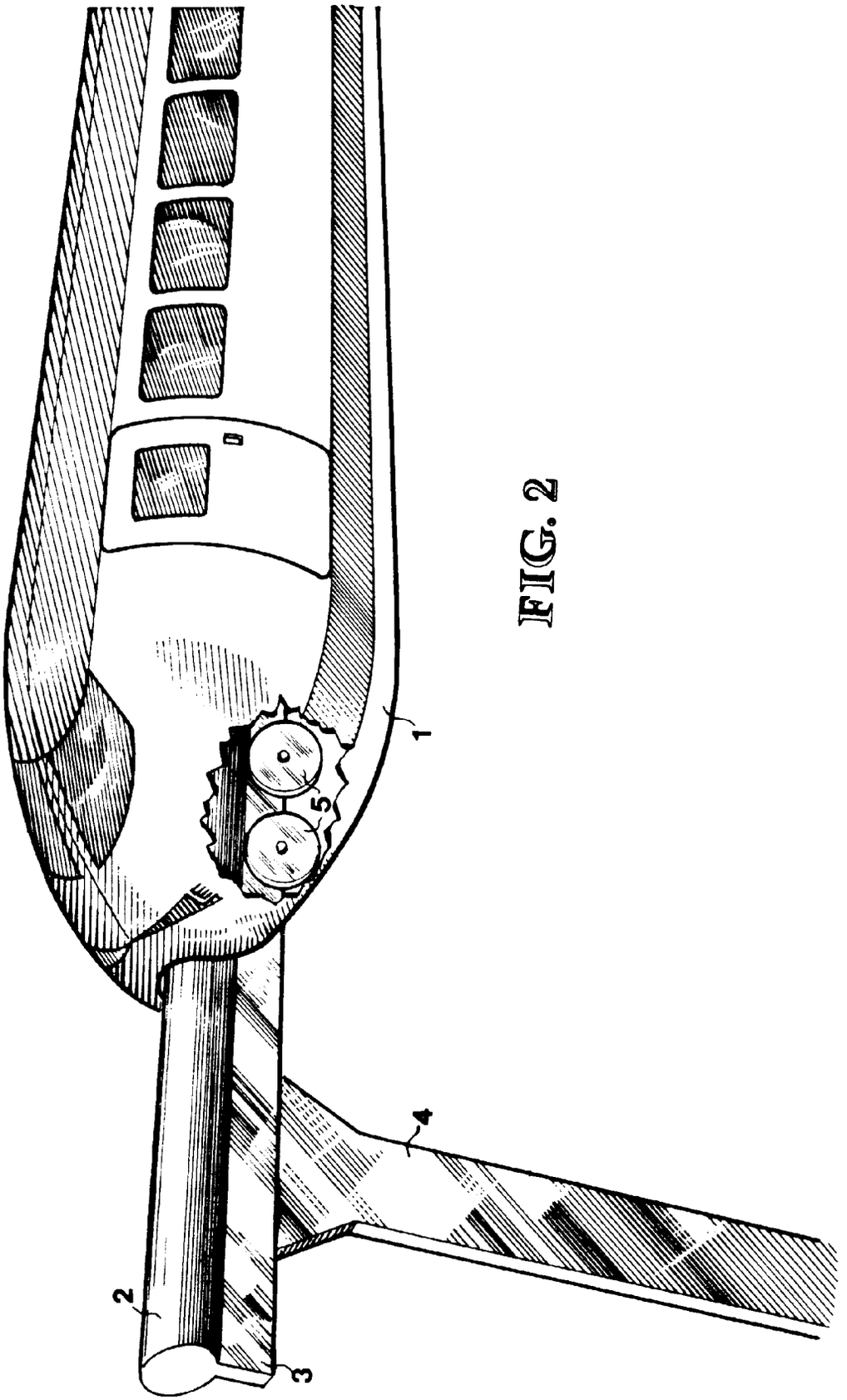

FIG. 2

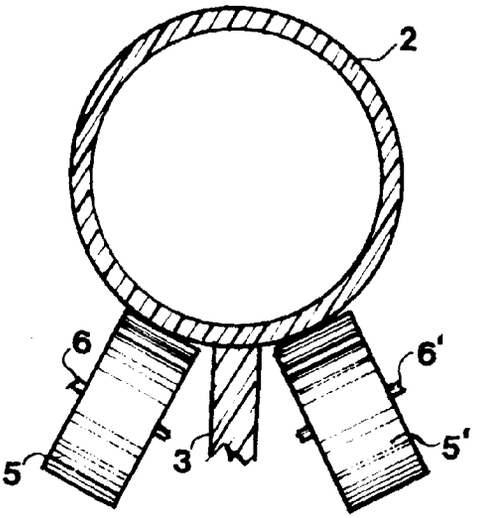

FIG. 3

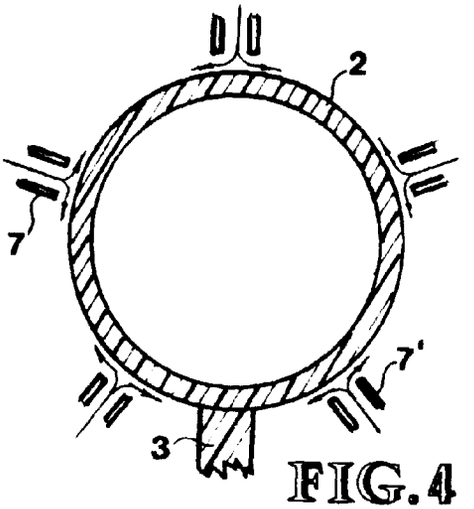

FIG. 4

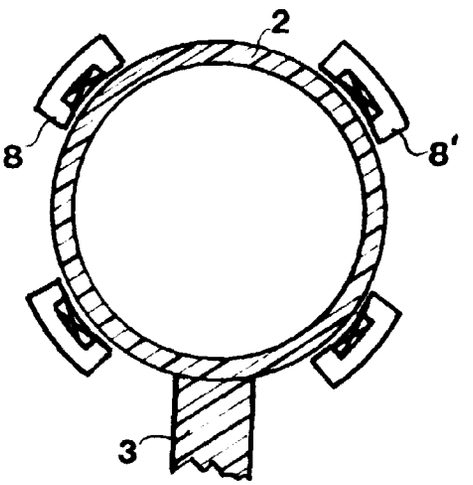

FIG. 5

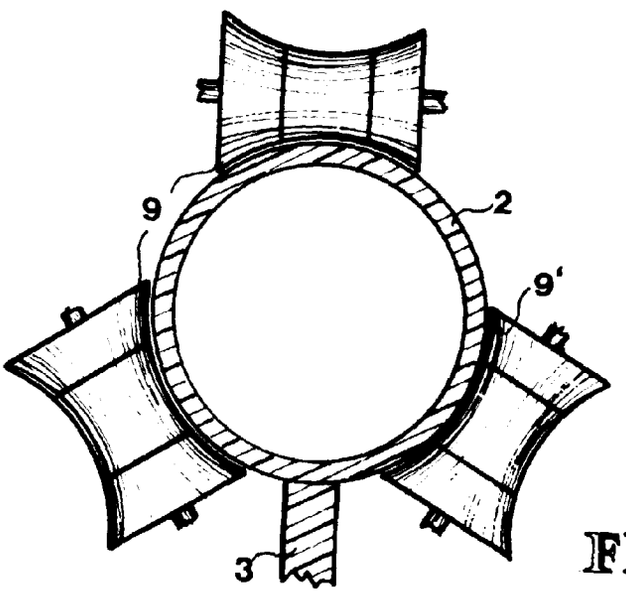

FIG. 6

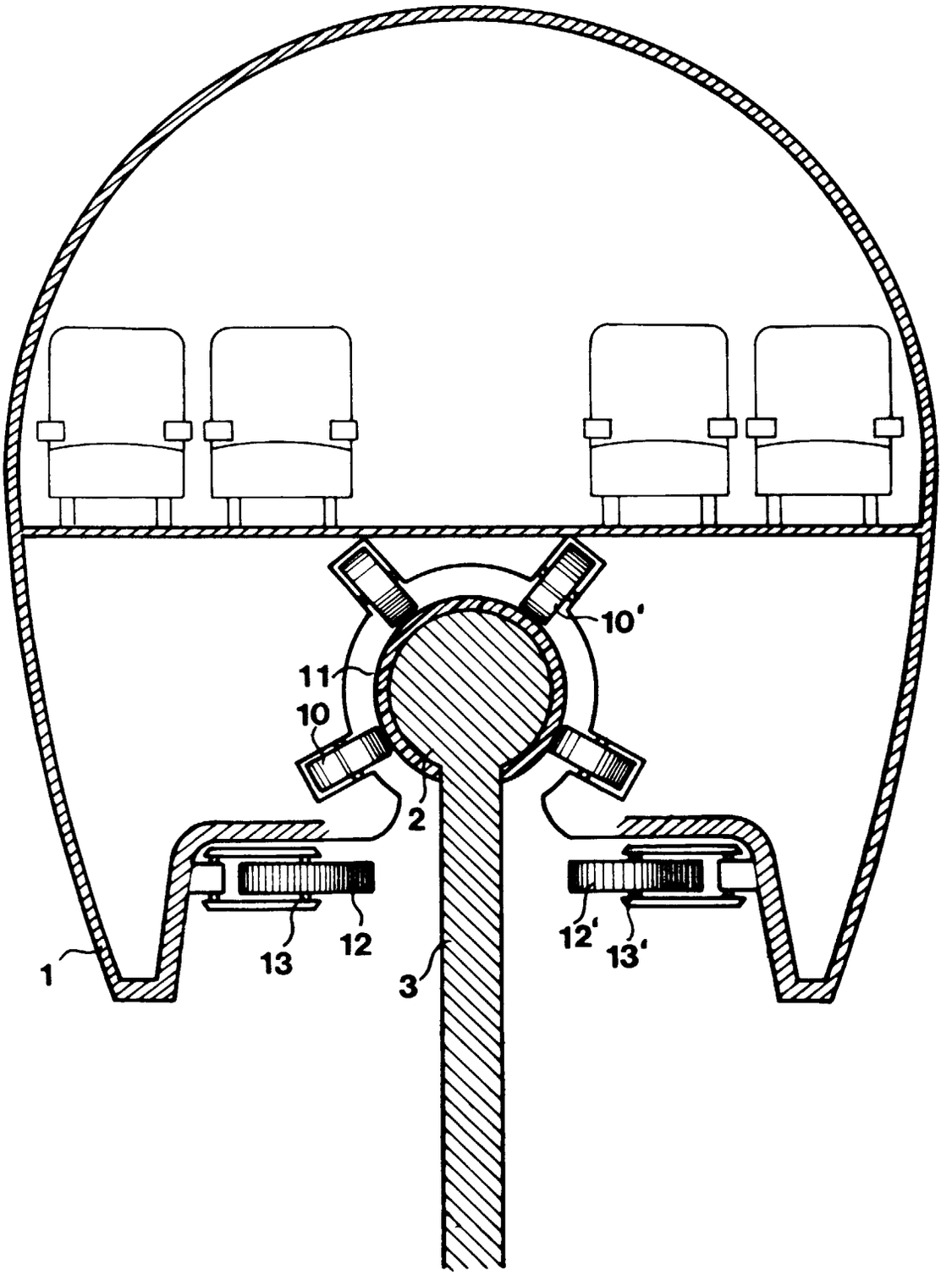

FIG. 7

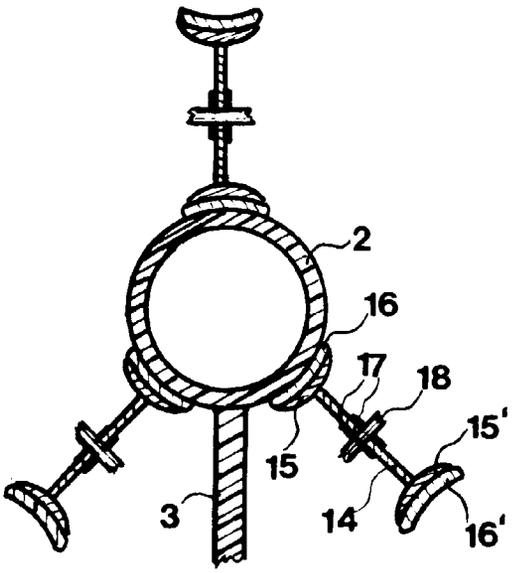

FIG. 8

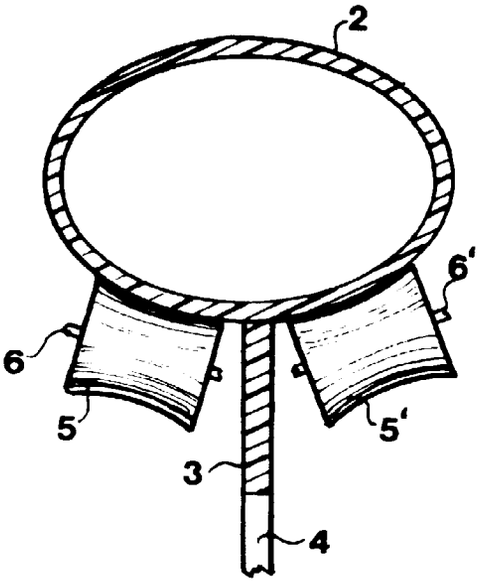

FIG. 9

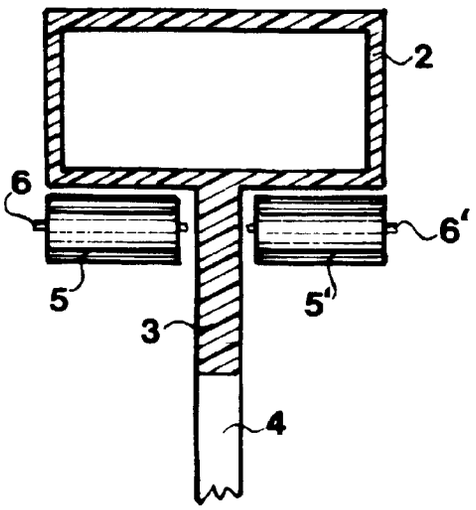

FIG. 10

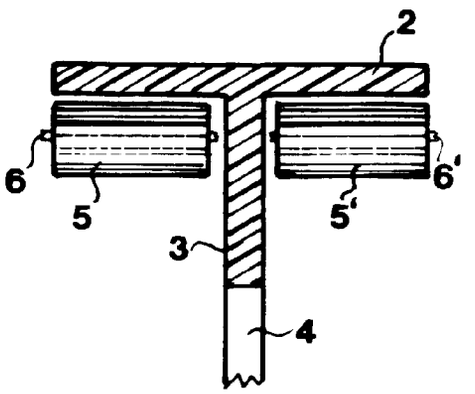

FIG. 11

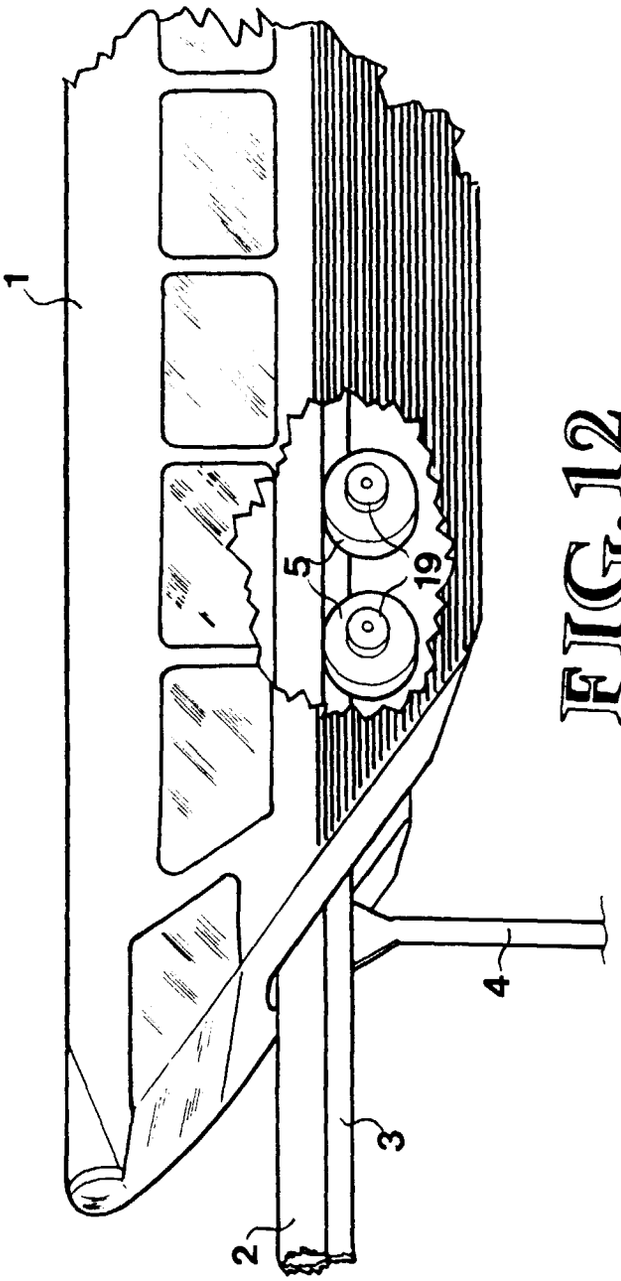

FIG. 12

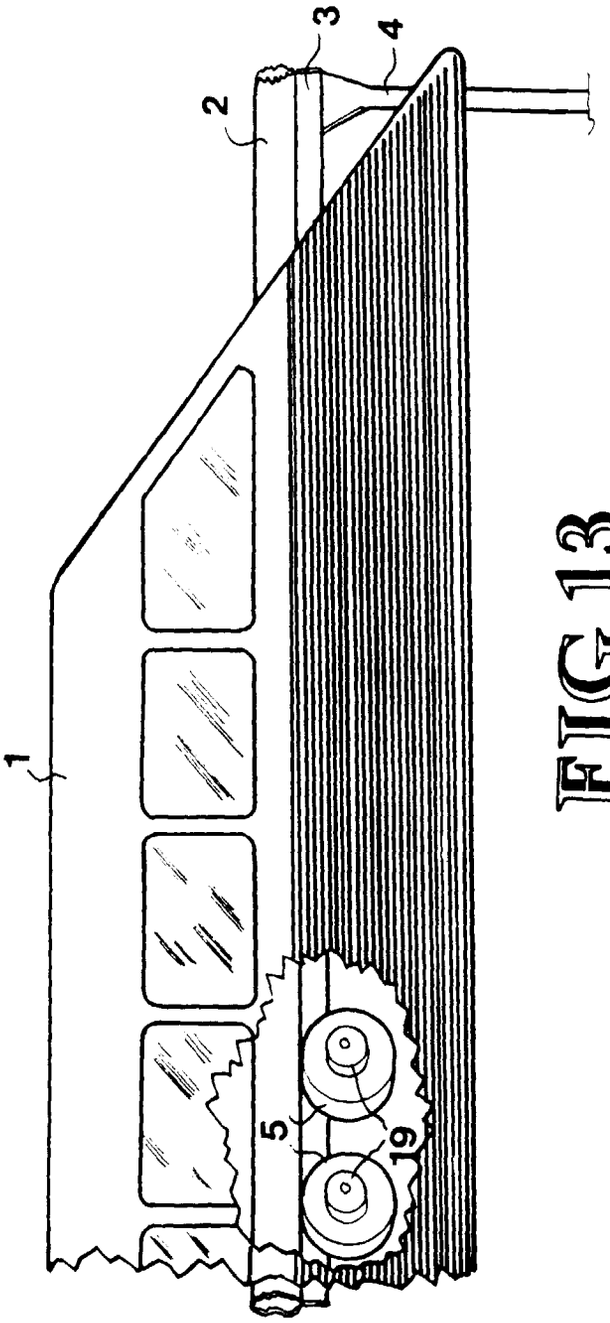

FIG.13

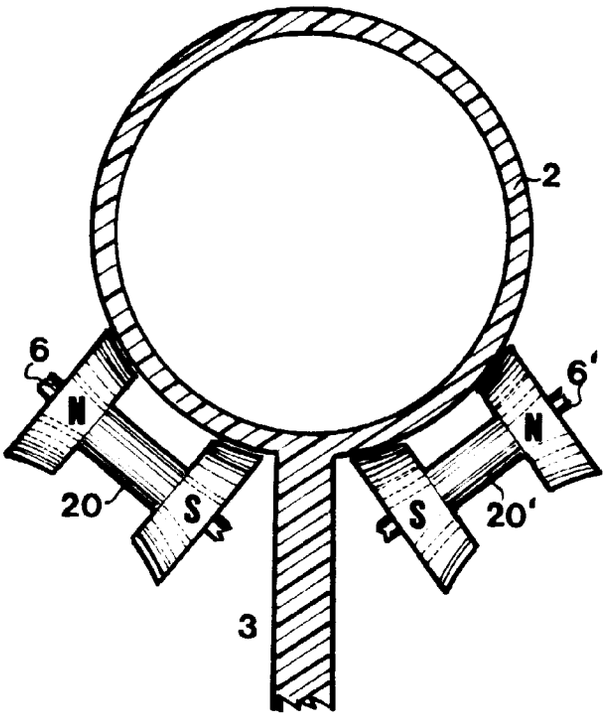

FIG. 14

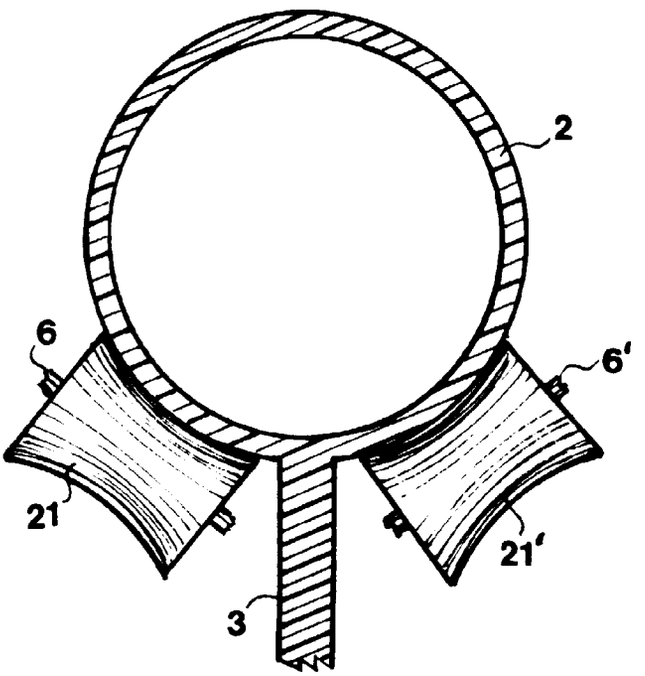

FIG. 15

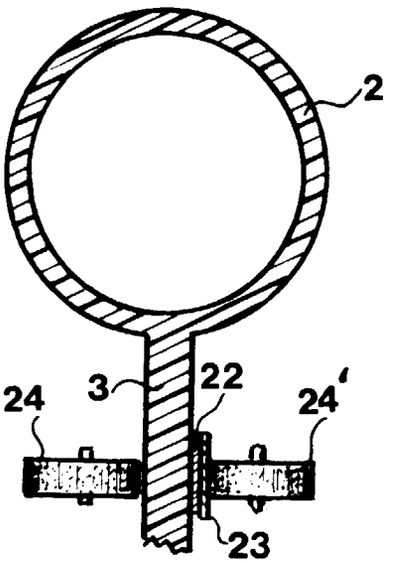

FIG.16

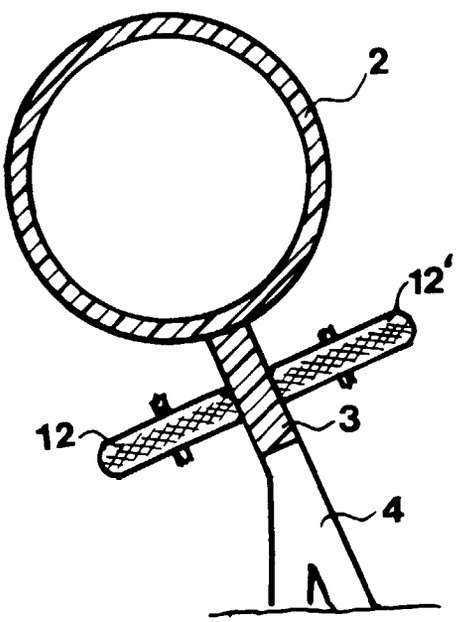

FIG.17

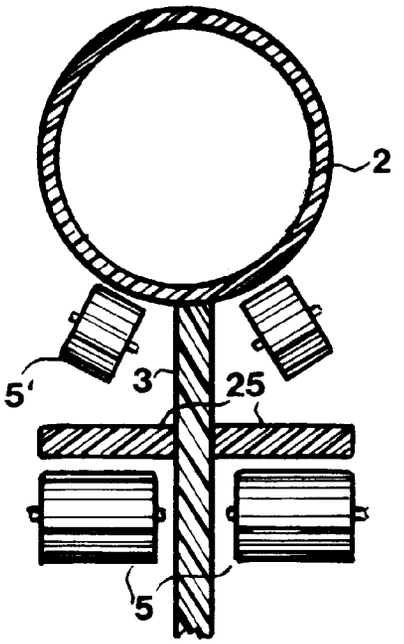

FIG. 18

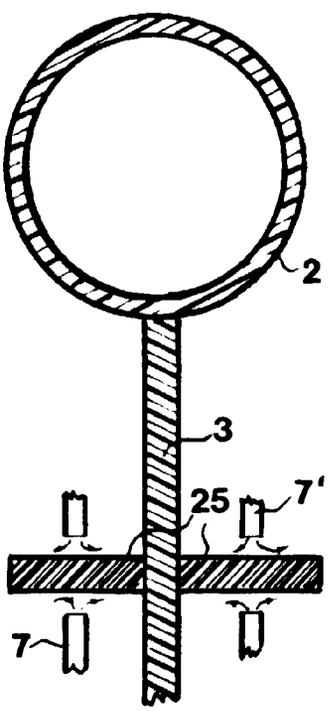

FIG. 19

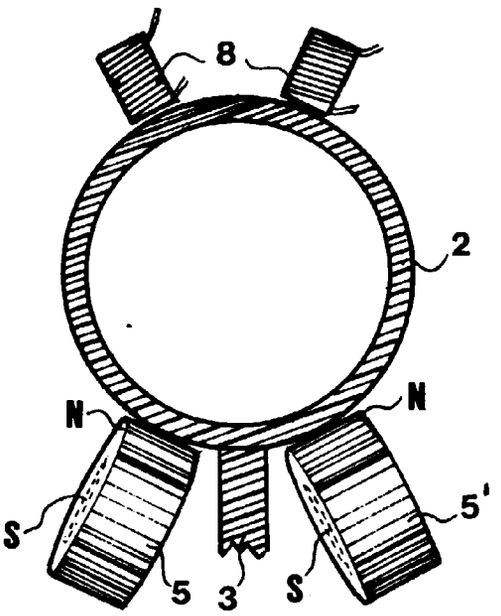

FIG. 20

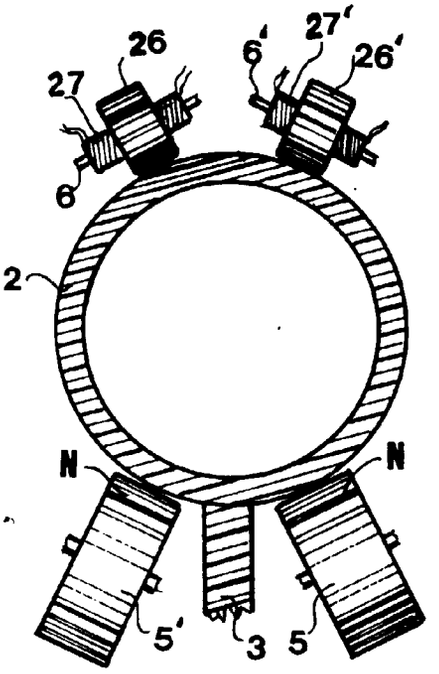

FIG. 21

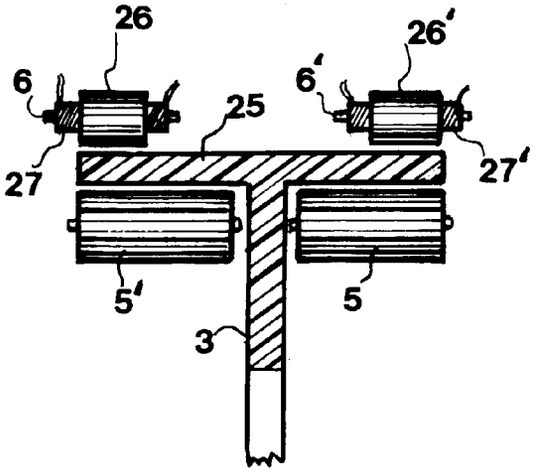

FIG. 22

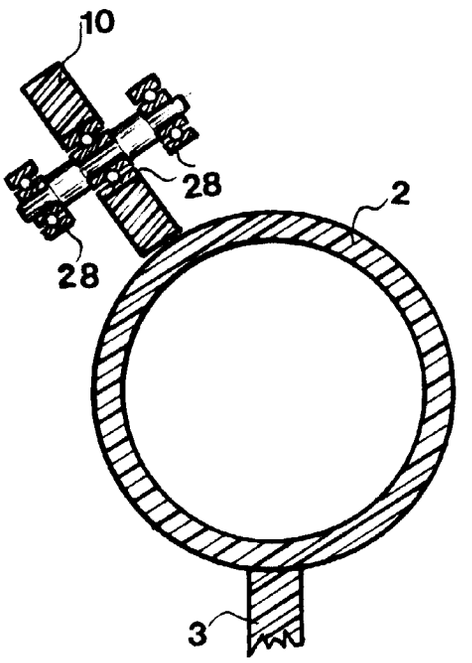

FIG. 23

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 50 0003

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	DE 22 52 272 A (M.E. BORDES) * the whole document *	1 2	B61B13/06 B61B13/08
Y A	GB 2 170 023 A (MESSERSCHMITT-BOLKOW-BLOHM GMBH) * the whole document *	1 3-6,9-12	
A	US 4 763 578 A (G. STEINMETZ) * the whole document *	1	
A	JP 08 230 664 A (HITACHI METALS) * figures 1-12 *	1	
A	DE 34 28 684 C (H. WEH) * the whole document *	1,9-13	
A	DE 41 17 885 A (MAGNET-BAHN GMBH) * the whole document *	9-13	
A	GB 2 209 318 A (M.M. SALZ) * the whole document *	1,6-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) B61B B60B B60L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 January 1998	Kusardy, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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