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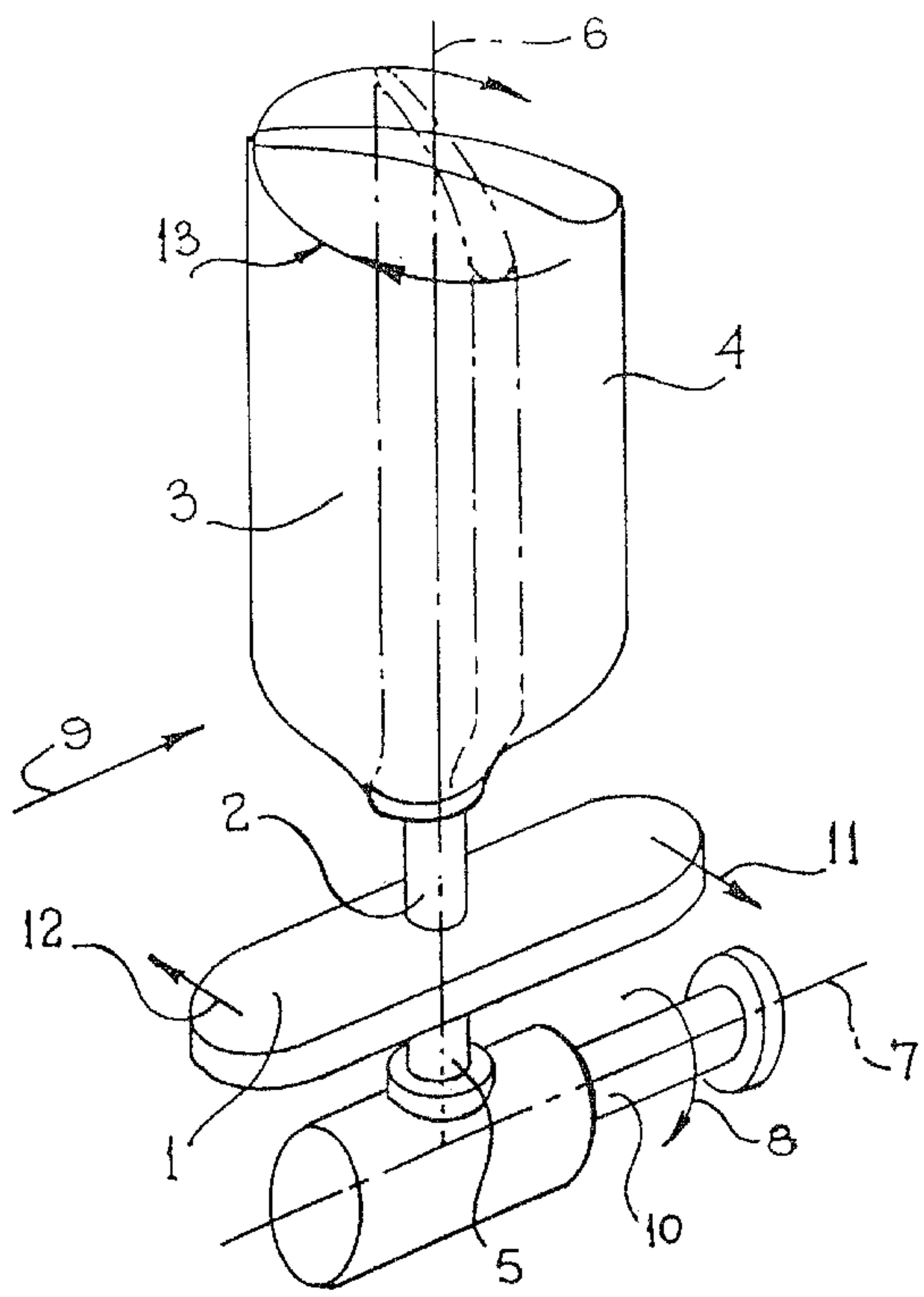

(57) Abrégé/Abstract:
A pitch control mechanism for a ram air turbine blade (4) comprises a mass (1) fixed to the blade shank (2) in a plane at an angle, to a pitch change axis (5). As the turbine rotates about the rotational axis 7, the mass (1) moves in the direction of arrows (11, 12) according to the speed of rotation varying the pitch of the blade (4). By directly coupling the pitch change mass (1) to the blade (4) the need for complicated linkages is eliminated.

ABSTRACT

A PITCH CONTROL MECHANISM

A pitch control mechanism for a ram air turbine blade (4) comprises a mass (1) fixed to the blade shank (2) in a plane at an angle, to a pitch change axis (5). As the turbine rotates about the rotational axis 7, the mass (1) moves in the direction of arrows (11, 12) according to the speed of rotation varying the pitch of the blade (4). By directly coupling the pitch change mass (1) to the blade (4) the need for complicated linkages is eliminated.

Figure 1

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A PITCH CONTROL MECHANISM

This invention relates to a pitch control mechanism for controlling the pitch of a ram air turbine blade.

Ram air turbines (RAT) are designed to be deployed into the slipstream of aircraft in the event of an emergency to generate power to maintain control of the aircraft. RATs generally comprise a plurality of blades radially extending from an axis of rotation about which the blades are driven by the slipstream. The motion is then passed to an electrical generator, or more commonly an hydraulic pump where it is converted to useful power.

It is known to govern the speed at which RATs rotate to produce a consistent power output and to prevent possible catastrophic disintegration of the blades due to centrifugal forces. This control is achieved by varying the pitch of the blades to lessen or increase their interaction with the airflow.

GB 2072271B discloses the use of flyweights which move radially outwards from an axis of rotation of the RAT to generate a pitch changing force which is translated by a levering action to a slider which is displaced axially. The slider interacts with an offset pin in the shank of each blade to convert the axial motion to rotation of the blade about its pitch changing axis. Such an arrangement is complicated, the translations of the various types of movement requiring a number of parts that must be carefully aligned hence making the mechanism expensive to manufacture and service, and prone to failure.

It is an object of the invention to provide a mechanism which is simpler and more reliable.

According to the invention there is provided a pitch control mechanism for controlling the pitch of a ram air turbine blade about a pitch change axis extending along the blade radially outwards from an axis of rotation of the ram air turbine comprising at least one mass moveable in a plane at an angle to the pitch change axis so as to generate a pitch changing force, and coupling means to transfer said pitch changing force to the blade.

By generating a pitch changing force by a mass moving in a plane at an angle to the pitch change axis, the force may be coupled to the blade with the minimum of linkage.

For example, the mass may comprise a bar fixed substantially normally to a shank of the blade. As the RAT rotates the centrifugal force generated has a twisting effect on the shank rotating the blade about its pitch change axis. Preferably, however, the mass will include at least one mass displaceable in the plane or in a plane normal to the bar, away from the pitch change axis in response to the speed of rotation of the RAT to increase the pitch changing force generated.

Alternatively, the mass may be formed as, at least, one bob at the end of a cranked arm, the inner end of which carries a rack in toothed engagement with a cog formed on the shank such that displacement of the mass in the plane causes rotary motion of the shank to change the pitch of the blade.

Preferably, a spring bias is applied to return the mass to its inner stationary position as the speed of rotation falls. The spring may be a compression or extension spring, wound or unwound, torsion spring, a resiliently deformable member, or a gas or fluid spring.

In one aspect, the present invention provides a pitch control mechanism for controlling the pitch of a ram air turbine blade which is mounted on a turbine hub via a shaft so as to extend radially from the hub along a pitch change axis, about which it is adjustable, the mechanism comprising at least one mass rotatable with the hub and rotatable about the pitch change axis so as to apply a pitch changing force to the blade when the hub rotates, said mass mounted on the blade when in use and shaft assembly so as to move radially away from the pitch change axis in response to rotation of the hub.

Specific embodiments of the invention will now be described, by way of example only, with reference to the drawings in which:

Figures 1 to 7 show pitch control mechanisms in accordance with the invention.

The pitch control mechanism shown in Figure 1 comprises a bar like mass 1 fixed to a shank 2 perpendicularly to a face 3 of a ram air turbine blade 4. The associated RAT components are not shown but would include a hydraulic pump, a nose cone and strut. The shank 2 passes through the mass 1 to a journal 5 within which it is retained but permitted to revolve about a blade pitch axis 6. The blade pitch axis 6 extends from an axis of rotation 7 of the ram air turbine, about which the turbine revolves in the direction of arrow 8 under the action of airflow 9, through the shank 2 and along the length of the blade 4. The blade 4 revolves with a main shaft 10 to which the journal 5 is fixed.

As shown in Figure 1, the blade 4 is in a fine pitch position in which it is nearly normal to the airflow 9. The fine pitch position is more clearly shown in Figure 2(a). When in the fine pitch position, the blade is set to absorb the maximum amount of energy from the airflow. It is in this position that the RAT will revolve with the greatest speed.

The mass 1 will, as a consequence of the blades 4 revolving about the axis of revolution 7, tend to move towards a position in which it is tangential to the motion. This causes a twisting movement in the directions of arrows 11 and 12, turning the blade 4 and shaft 2 in the journal 5 about the pitch axis 6 in the direction of arrow 13. The blade thus adopts the position shown in phantom in Figure 1, that is to say a coarse pitch position as more clearly shown in Figure 2(b).

In the coarse pitch position, the blade 4 is nearly parallel to the airflow 9 and in this position absorbs less of the available energy. Consequently the RAT revolves at a lower speed when in this position.

The action of the mass 1 is thus to control the speed at which the RAT rotates, as the speed increases the mass 1 tends to coarsen the pitch to a slow position so preventing disintegration of the blade 4.

A similar embodiment is shown in Figure 3, in which like components have the same reference numerals. This embodiment has the same general form as shown in Figure 1 except that the mass 1 has slidably located in the ends thereof submasses

14 and 15. These submasses 14 and 15 are retained by springs 16 and 17 to the mass 1.

As this arrangement revolves about the axis of revolution, the effect is as before to coarsen the blade pitch. However, in this case the pitch changing force generated by the mass 1 is increased since the submasses 14 and 15 slide away from the mass 1 against the springs 16 and 17 due to the rotation. As the speed decreases, the submasses 14 and 15 will be drawn back to mass 1 by the action of springs 16 and 17, thereby reducing the pitch changing force generated. Thus the speed of revolution of the RAT is maintained within a band of speeds.

In the embodiment shown in Figure 4, the submasses take the form of bob-weights 18 and 19 mounted on the mass 1 by means of pivots 20 and 21. The action of these weights is similar to the earlier described embodiment of Figure 3 with the coil springs 22 and 23 fixed between the bob-weights 18 and 19 and the mass 1 returning the weights.

Figure 5 shows a further pitch control mechanism in which bob-weights 24 and 25 are formed with cranked arms 26 and 27. At the ends of the arms 26, 27 are arcuate toothed surfaces forming racks 28 and 29. These racks 28, 29 mesh with a toothed cog-like portion 30 of the shaft 2. As the RAT revolves, the weights 24 and 25 swing about pivots 31 and 32 in the cranked arms 26 and 27 to rotate the shank 2, thereby varying the pitch of the blade (not shown). To return the bob-weights 24 and 25, a spring arrangement (not shown) is used in a similar manner as before. Because the bob weights act on a common cog, they are interlinked and more symmetrically about the pitch charge axis in synchronisation.

Figure 6 shows a further embodiment of the invention in which the bob-weights are linked. The bob-weights 24 and 25, in this case, have pivot points 31 and 32 by means of which they are connected to mass 1. The end of the shank 2 is formed into a horizontally extending arm 33 having formed in the ends thereof attachment holes 34 and 35. The bob-weights 24 and 25 are linked to the arm 33 by push rods 36 and 37, and extension springs 38 and 39. Upon rotation of the RAT bob weights 24 and 25 move outwards, as before, applying, via the push rods 36 and 37 a pitch changing force to the blade shank 2.

Figure 7 shows a further mechanism in which the bob-weights 40 and 41 move in a plane normal to the bar like mass 1. As the rat revolves, the bob-weights rotate about their pivots 42 and 43 and move away from the pitch change axis thus increasing the pitch change force generated. A decrease in the speed of revolution allows springs 44 and 45 to return the bob-weights towards the pitch change axis thus decreasing the pitch change force generated.

Whilst the pitch control mechanisms have been described in relation to controlling one blade it may be possible in alternative embodiments to control more than one blade from one mechanism.

Furthermore, in the case of a single bladed ram air turbine as disclosed in our co-pending UK

Patent Application (Agents Ref. E.2839), the pitch control mechanism may be located on the opposite side of the axis of rotation of the turbine from the turbine blade to form a counterweight.

We Claim:

1. A pitch control mechanism for controlling the pitch of a ram air turbine blade which is mounted on a turbine hub via a shaft assembly so as to extend radially from the hub along a pitch change axis, about which said turbine blade is adjustable, the mechanism comprising at least one mass rotatable with the hub and rotatable about the pitch change axis so as to apply a pitch changing force to the blade when the hub rotates, said mass coupled to at least one of the blade and shaft assembly so as to move radially away from the pitch change axis in response to rotation of the hub.

2. A mechanism as claimed in claim 1 in which said mass moves radially away from the pitch change axis in a plane substantially normal to the pitch change axis in response to rotation of the hub, thereby to apply an increasing pitch changing force to the blade.

3. A mechanism as claimed in claim 1 or 2 in which said mass is pivotally connected to a member rigid with the blade that projects radially from the pitch change axis.

4. A mechanism as claimed in claim 1 or 2 in which said mass is a linear sliding fit with a member rigid with the blade and projecting radially from the pitch change axis.

5. A mechanism as claimed in claim 3 or 4 in which spring means serves to return said mass to a stationary position as the speed of rotation of the hub decreases.

6. A mechanism as claimed in any one of claims 1 to 5, in which a pair of masses are mounted on the blade and shaft assembly to balance one another about the pitch change axis, each of said pair of masses being mounted in the manner of said at least one mass.

7. A mechanism as claimed in claim 1 in which said mass is pivotally connected to a member that is rotatable relative to the blade about the pitch change axis and in which said mass is connected to the blade via connection means, whereby said pitch changing force is applied to the blade.

8. A mechanism as claimed in claim 7 in which said connection means comprises a rack rigid with the mass and having teeth in engagement with a rack rigid with the blade.

9. A mechanism as claimed in claim 8 in which said mass is carried at one end of a crank arm which carries said rack at its other end.

10. A mechanism as claimed in claim 7 in which said connection means comprises a rigid link pivotally connected between the mass and the blade.

11. A mechanism as claimed in any of claims 7 to 10 in which spring means serves to return said mass to a stationary position as the speed of rotation of the hub falls.

12. A mechanism as claimed in any one of claims 7 to 11 in which a pair of masses are provided and mounted to balance one another about the pitch change axis,

each of said pair of masses being mounted in the manner of said at least one mass.

13. A pitch control mechanism for controlling the pitch of a ram air turbine blade about a pitch change axis extending along the blade radially outwards from an axis of rotation of the ram air turbine, comprising at least one mass adapted to be coupled to the blade so as to be moveable in a plane at an angle to the pitch change axis so as to generate a pitch changing force to the blade, wherein said at least one mass is displaceable in a plane away from the pitch change axis in response to the speed of rotation of the ram air turbine to increase the pitch changing force generated.

14. A mechanism as claimed in claim 13, wherein the mass is formed as, at least one bob at an outer end of a cranked arm, the inner end of which carries a rack in toothed engagement with a cog formed on a shank of the blade such that displacement of the mass in the plane causes rotary motion of the shank to change the pitch of the blade.

15. A mechanism as claimed in claims 13 or 14, wherein a spring bias is applied to return the mass to its inner stationary position as the speed of rotation falls.

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FIG. 1.

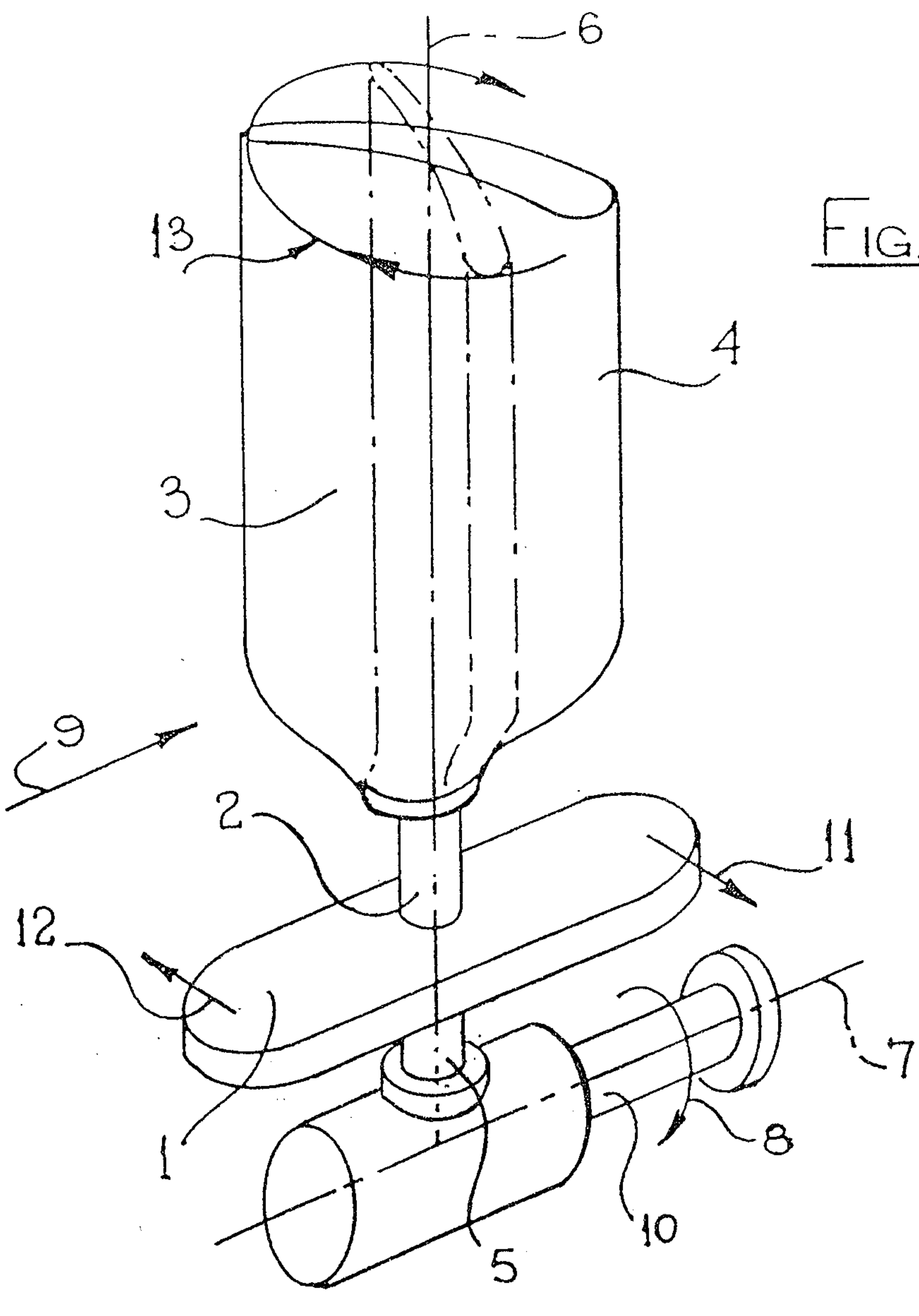

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Fig. 2a.

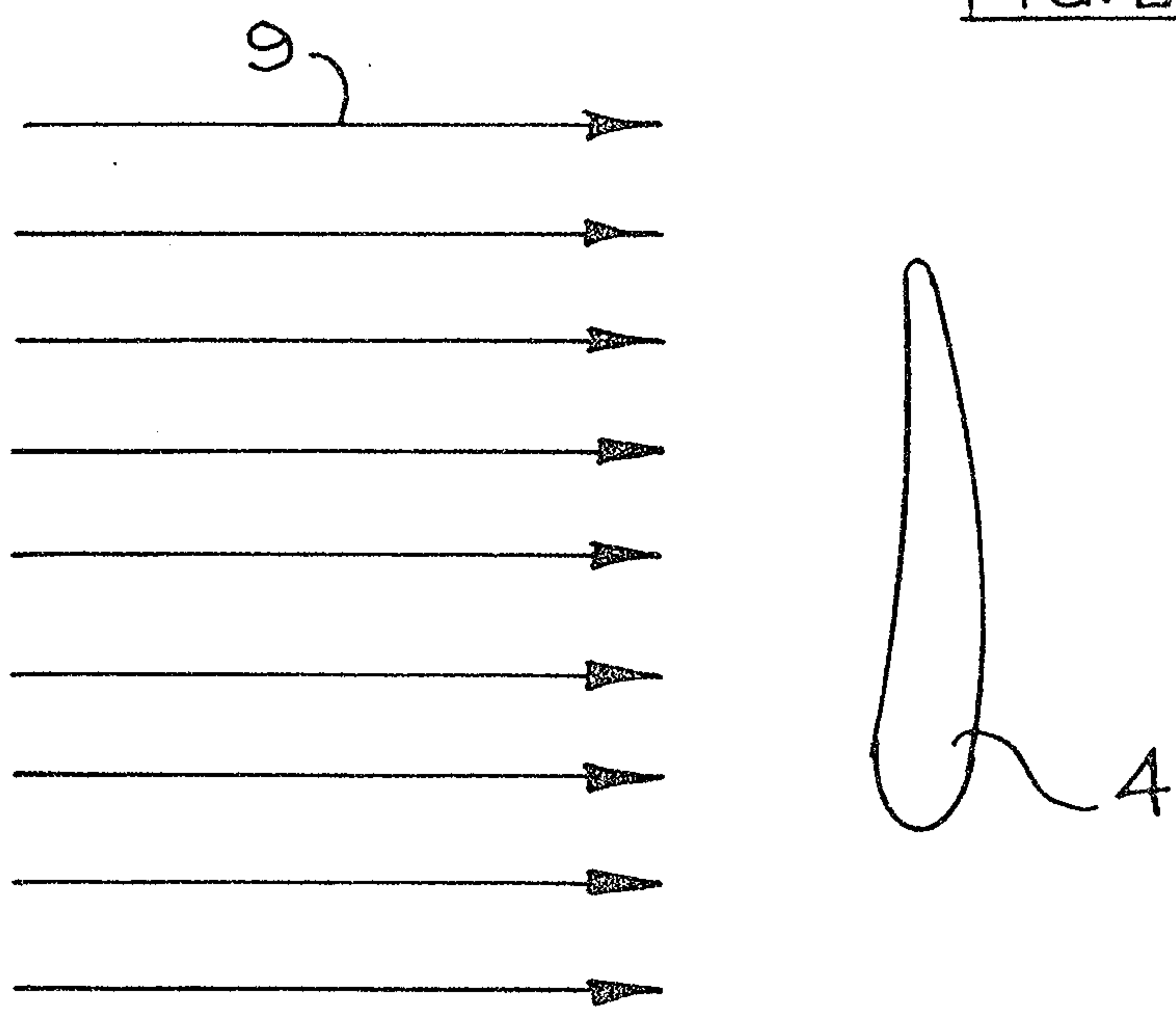

Fig. 2b.

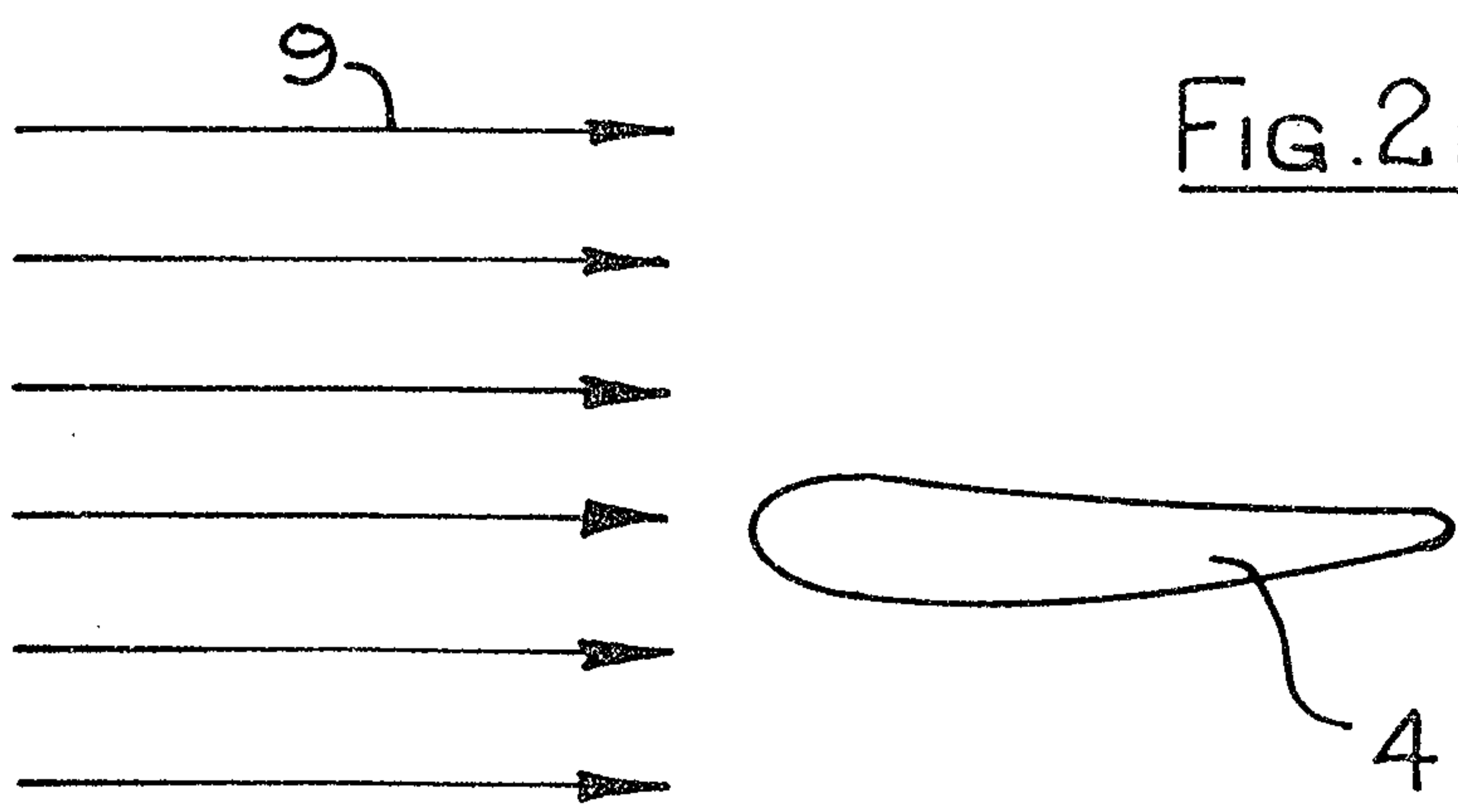

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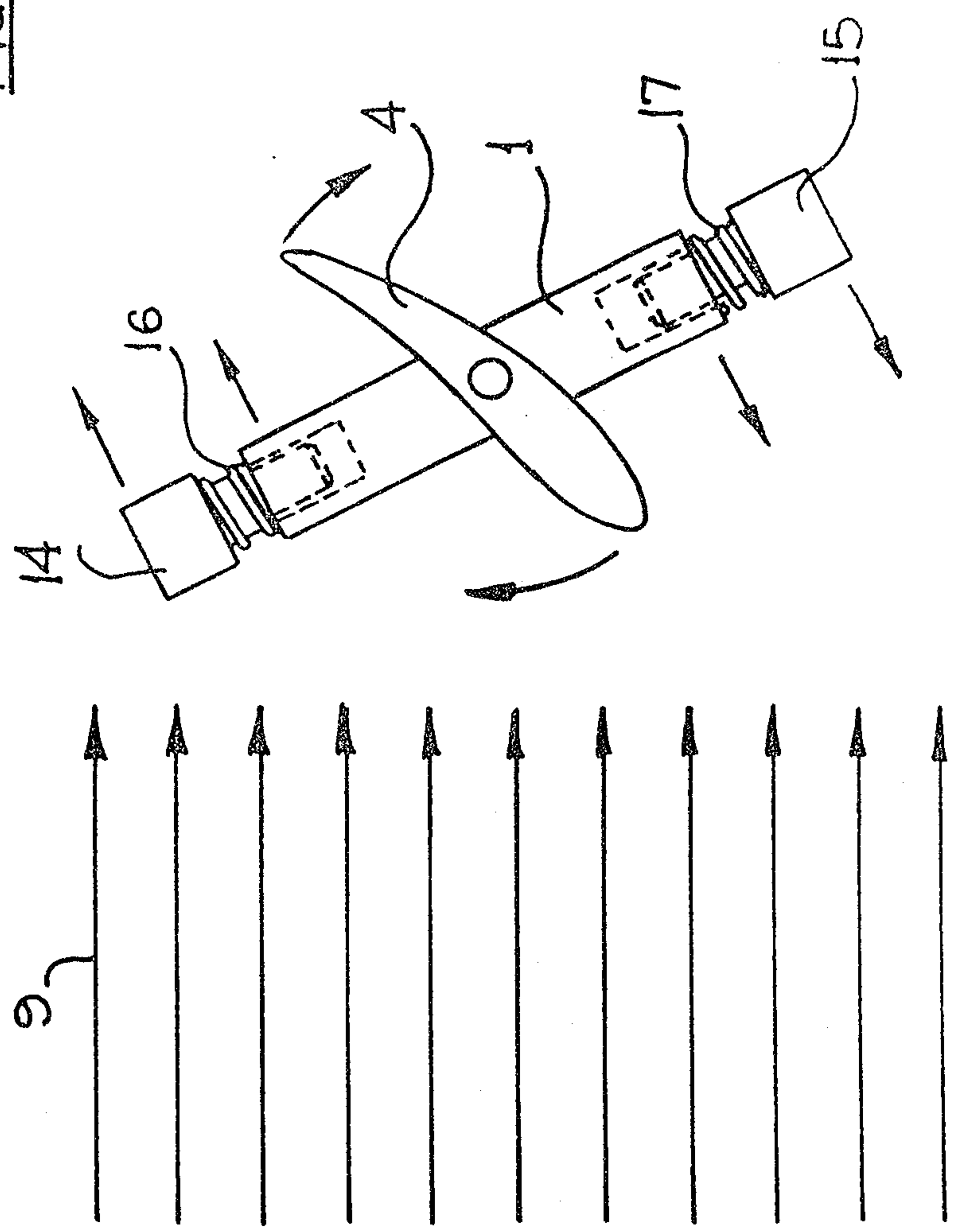
Fig.3.



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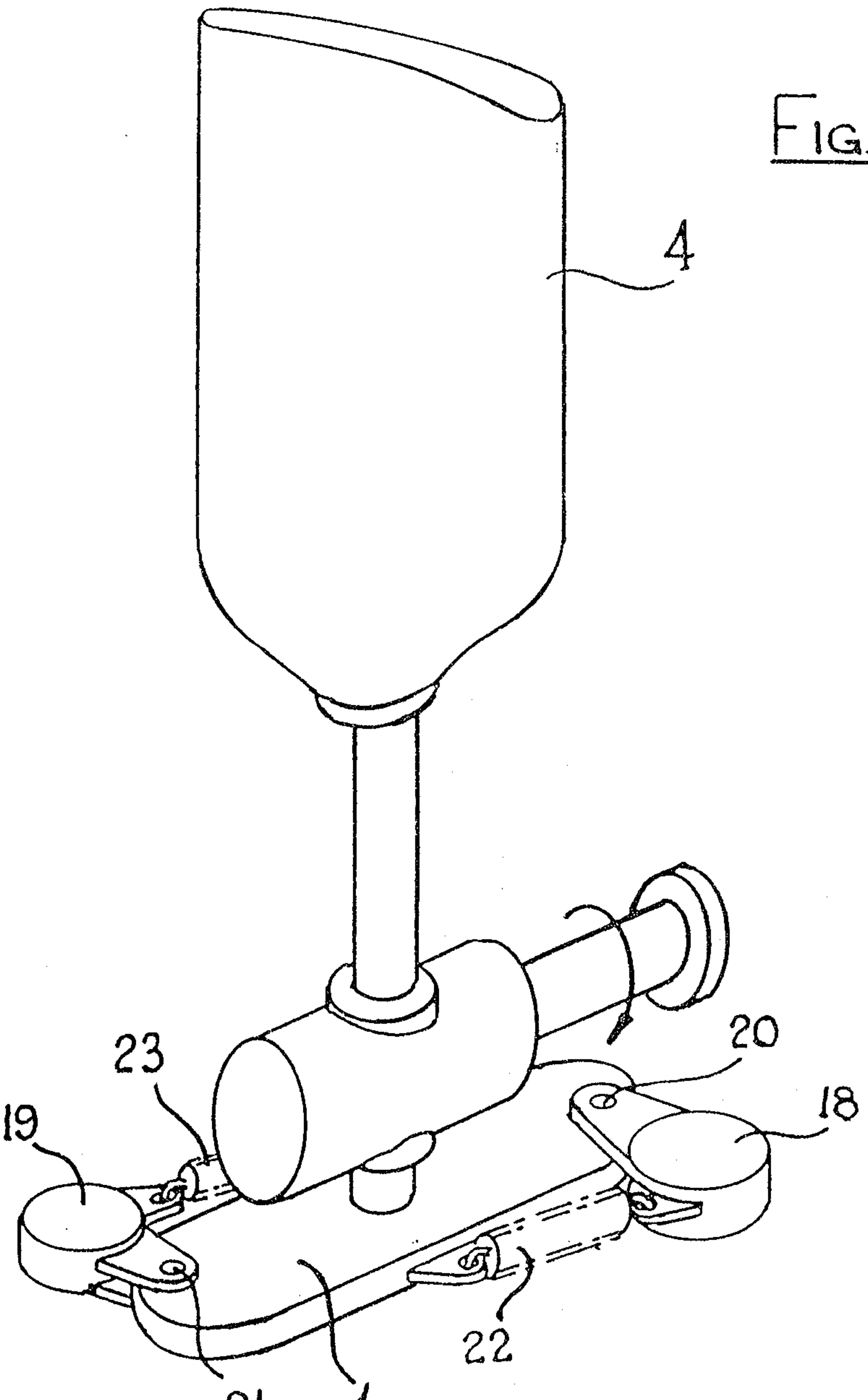

Fig. 4.

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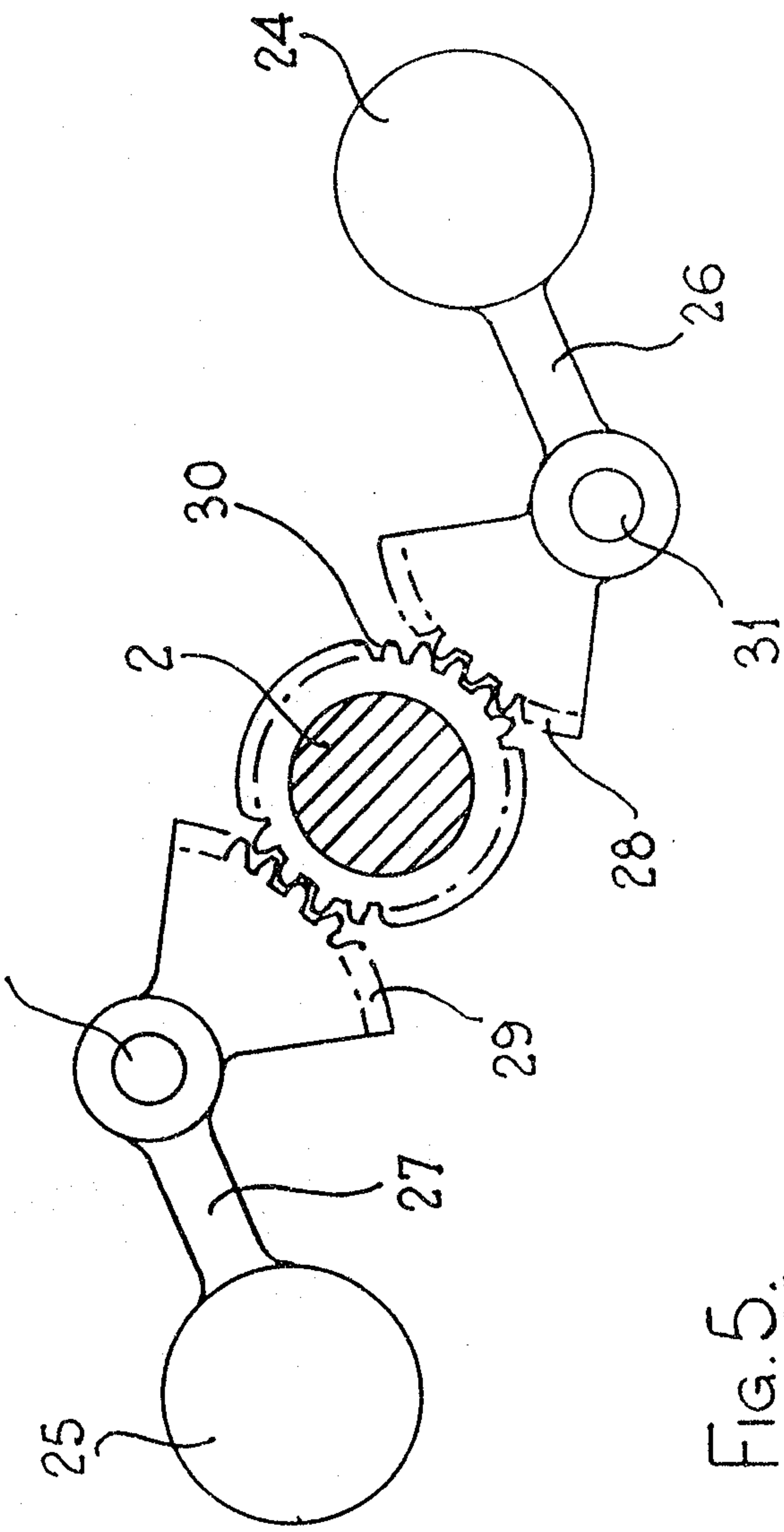

Fig.5.

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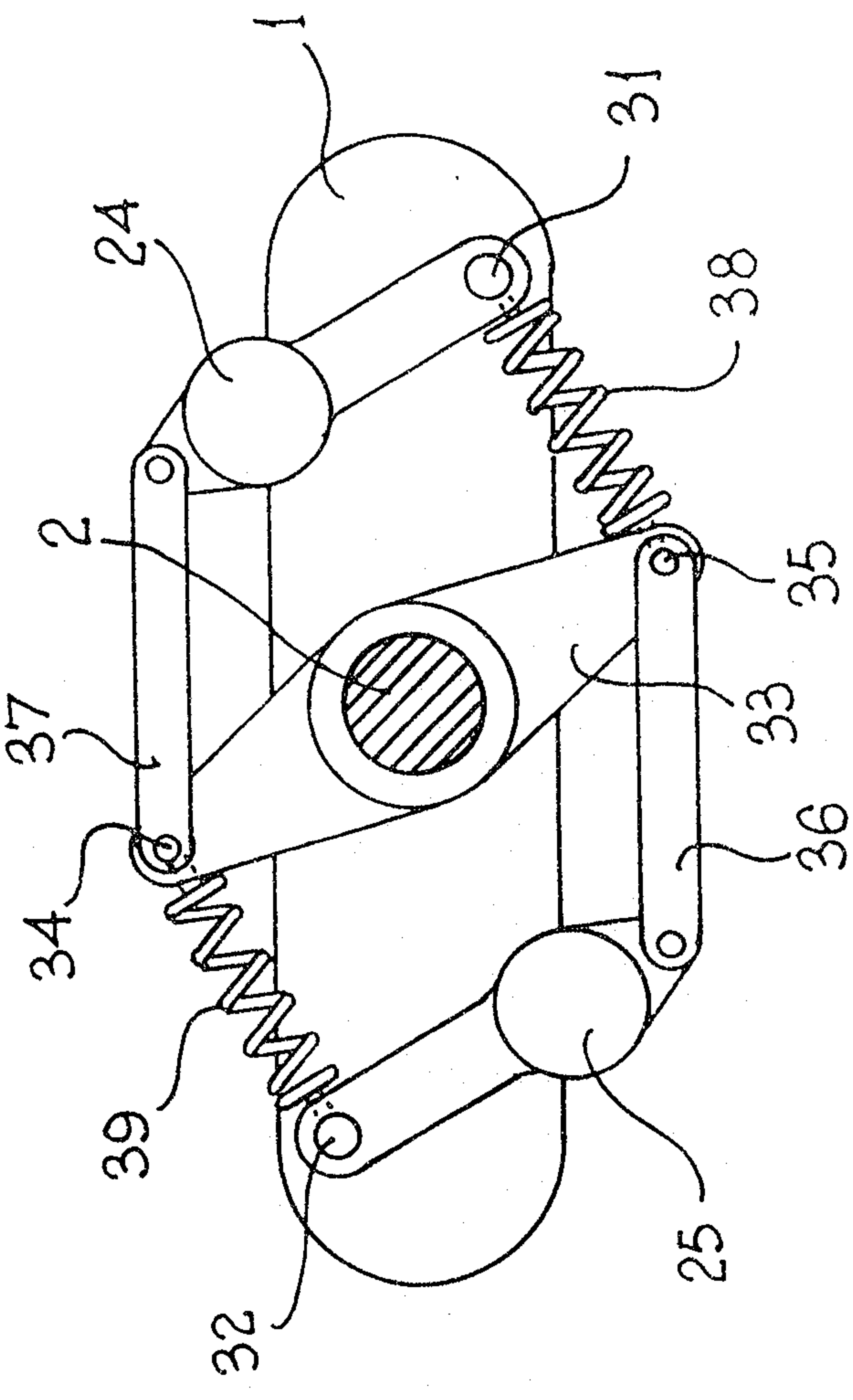

Fig.6.

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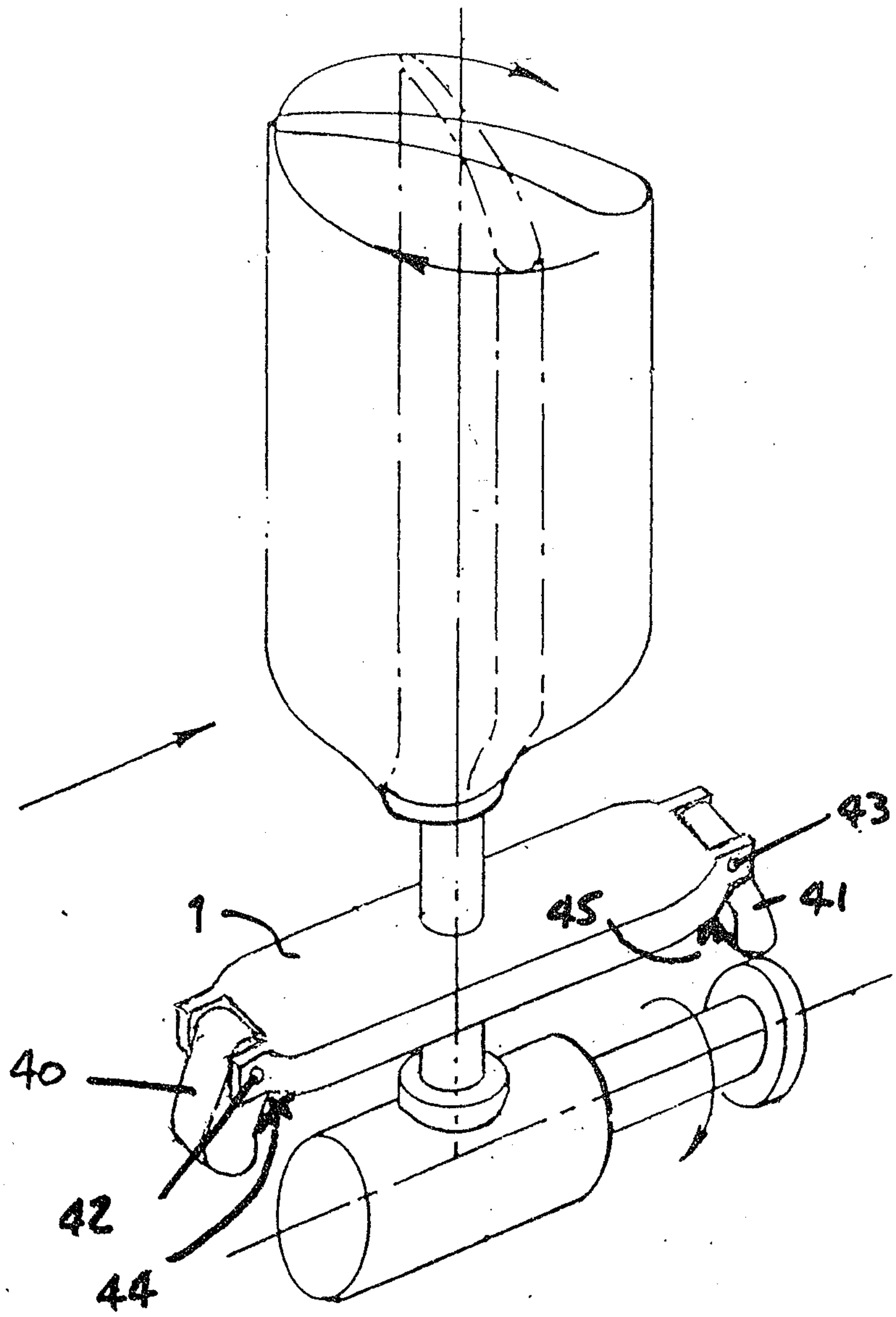

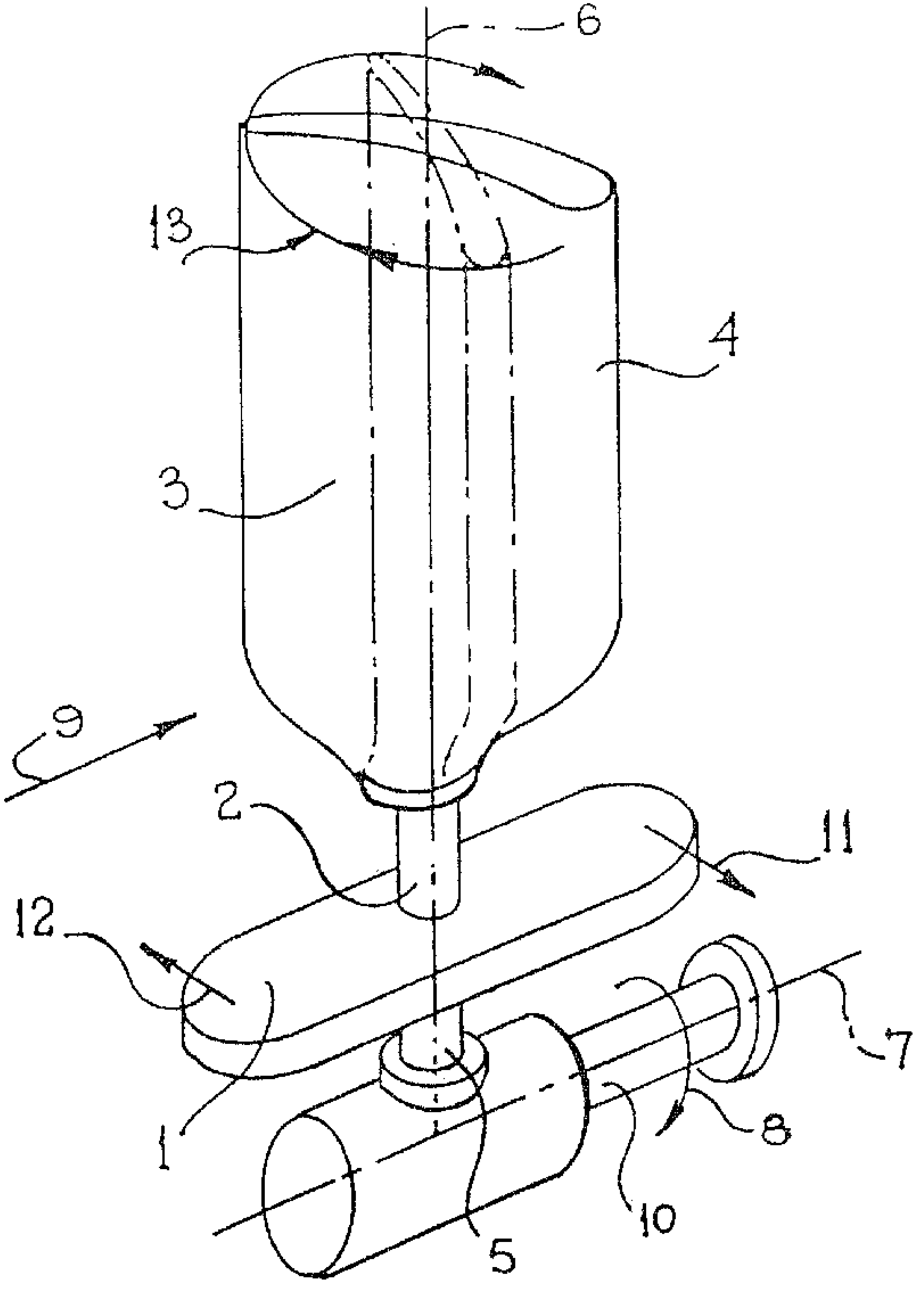

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