United States Patent

[11] **3,630,347**

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[33] **Great Britain**
[31] **18,973/67**
Continuation of application Ser. No. 722,964, Apr. 22, 1968. This application Oct. 16, 1970, Ser. No. 81,501

[54] **SKID-SENSING DEVICES**
42 Claims, 16 Drawing Figs.

[52] **U.S. Cl.** **200/61.46,** 188/181, 303/21
[51] **Int. Cl.** **H01h 29/02**
[50] **Field of Search** ..... 200/61.46; 188/181 A, 134; 303/21 CG

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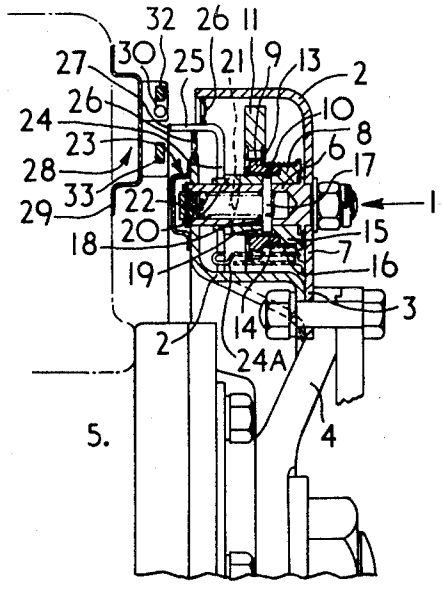
Primary Examiner—David Smith, Jr.
Attorney—Jeffers and Young

ABSTRACT: A skid-sensing device for a vehicle antiskid braking system, comprising an annular flywheel mounted for rotation within an annular housing, the housing being arranged to extend coaxially around a rotatable drive shaft of a vehicle for rotation therewith, and sensing means responsive to overrunning of the flywheel, of which the following is a specification.



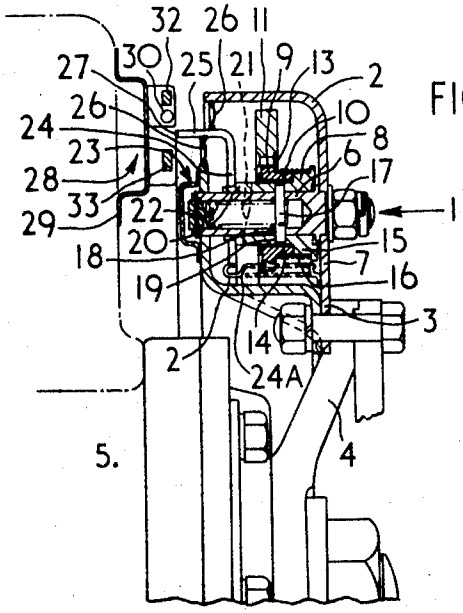

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FIG. 2

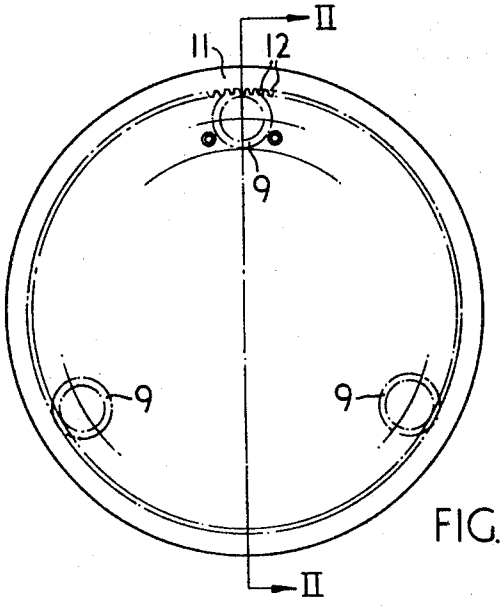
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FIG. 1

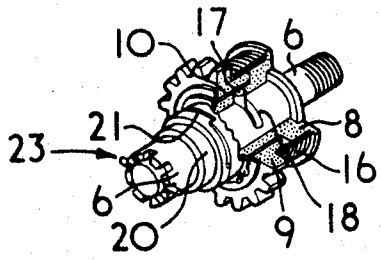


FIG. 3

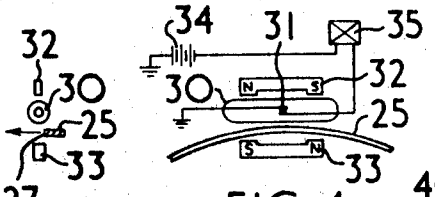
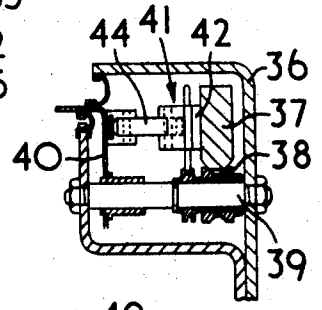


FIG. 4

FIG. 5

FIG. 6



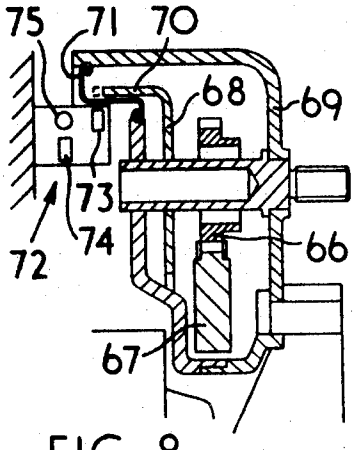


FIG. 8

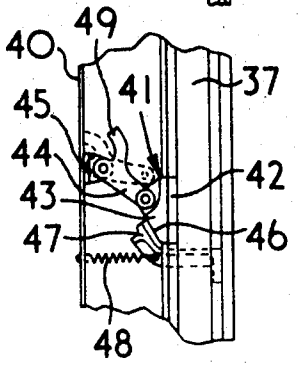


FIG. 7

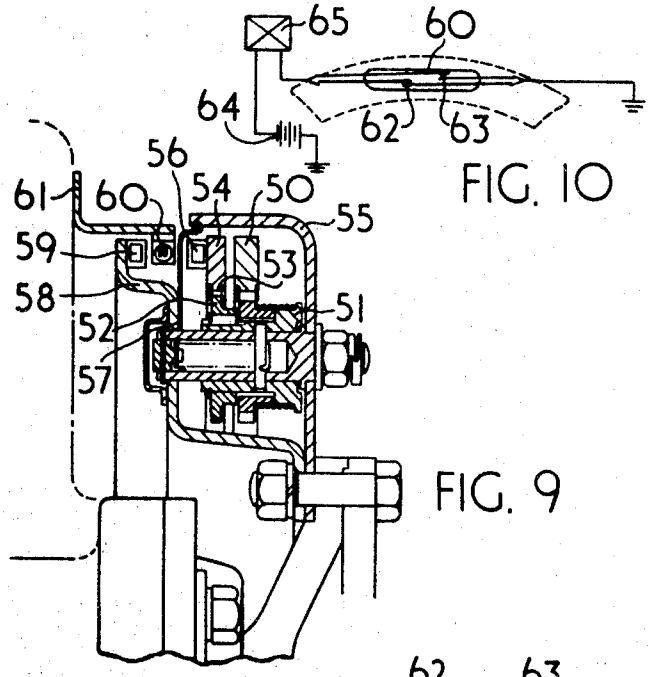


FIG. 10

FIG. 9

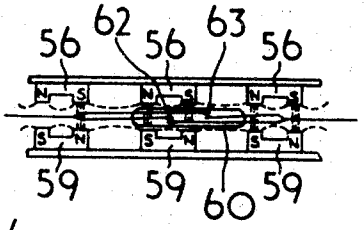


FIG. 11

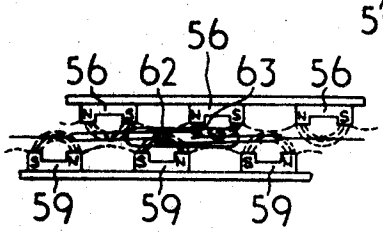


FIG. 12

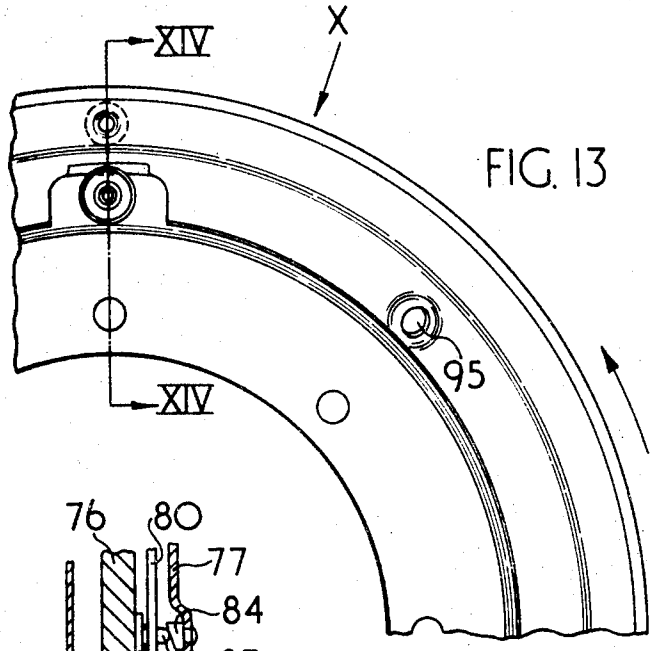


FIG. 13

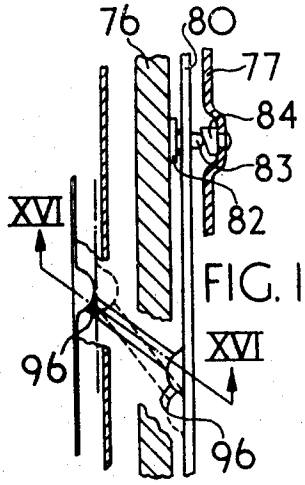


FIG. 15

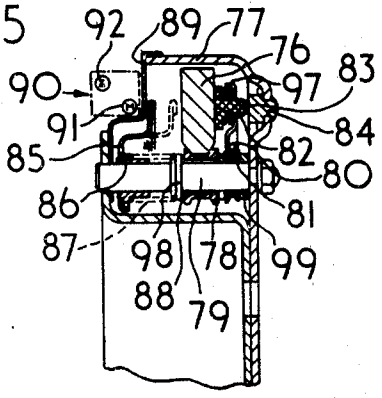


FIG. 14

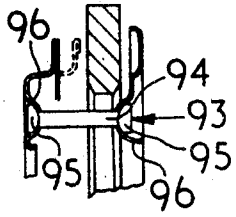


FIG. 16

SKID-SENSING DEVICES

This application is a continuation in whole of application Ser. No. 722,964, filed Apr. 22, 1968, and entitled "IMPROVEMENTS IN AND RELATING TO SKID-SENSING DEVICES".

This invention relates to acceleration-responsive control devices and to improvements in or relating to vehicle antiskid braking systems.

In vehicle antiskid braking systems it is necessary for an acceleration-responsive control device in the form of a rotary-inertia skid-sensing device to be driven from a vehicle wheel or other rotatable drive transmission member, and it has been proposed to employ belt or chain drives to transmit the drive from the rotatable member to the skid-sensing device. Such drives are expensive to install and may give difficulties in operation.

One object of the present invention is to provide a skid-sensing device for a vehicle antiskid system which does not require to be driven by means of a belt or chain drive.

According to one aspect of the invention, an acceleration-responsive device comprises a housing arranged to be mounted on a rotatable member, an annular flywheel within the housing, a plurality of roller members associated with the housing and rotatably mounted therein to provide a mounting on which the flywheel is rotatable, and sensing means associated with the flywheel and arranged to respond to a difference in speed between the flywheel and the housing.

According to another aspect of the invention a skid-sensing device for a vehicle antiskid braking system comprises a housing arranged to be mounted on a rotatable drive transmission member of a vehicle, an annular flywheel within the housing, a plurality of roller members associated with the housing and rotatably mounted therein to provide a mounting on which the flywheel is rotatable, and sensing means associated with the flywheel and arranged to respond to an overrunning condition thereof.

In one embodiment, the roller members may take the form of gear wheels having teeth which mesh with corresponding teeth formed on the inner circumference of the flywheel, the gear wheels being mounted on spindles parallel to the axis of the flywheel and being arranged to transmit an operating torque to cam mechanisms associated one with each gear wheel when the flywheel is in the overrunning condition. The cam mechanisms are arranged to actuate an electrical switch or other signalling device whenever such an overrunning condition arises and produces a torque on the cam mechanisms greater than a predetermined amount.

In an alternative construction the gear wheels may be replaced by freely rotatable rollers in the form of pulleys and a thrust mechanism may be provided to be actuated by frictional engagement of a friction member with the flywheel to operate the mechanism whenever a sufficient speed difference between the flywheel and the housing arises in the overrunning condition.

In alternative constructions the freely rotatable roller members may engage the outer periphery of the flywheel instead of the inner periphery.

The skid-sensing device according to the invention may be arranged to operate a vehicle antiskid braking system in a number of ways. For example, a direct mechanical connection between a switching member contained in the skid-sensing device and an electrical switch or fluid pressure valve may be provided to effect release of the brakes, but it is preferred to employ an arrangement in which no mechanical contact arises between a rotatable member of the skid-sensing device and a stationary member associated with the vehicle frame, and several devices of this kind will be described.

Three embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 shows a diagrammatic representation of part of a skid-sensing device according to the invention viewed in an axial direction with respect to the housing thereof;

FIG. 2 shows an axial cross-sectional view of part of a skid-sensing device according to the invention, taken on the line II—II in FIG. 1;

FIG. 3 shows a perspective view of part of the skid-sensing device of FIG. 2;

FIGS. 4 and 5 show radial and axial cross-sectional views respectively through the signalling device of FIG. 2 illustrating its association with a switching member;

FIG. 6 shows a scrap axial cross-sectional view similar to that of FIG. 2 through a skid-sensing device according to the invention, incorporating alternative sensing means;

FIG. 7 shows a scrap view of the skid-sensing device of FIG. 6 with part of the housing thereof removed, the device being viewed radially inwardly with respect to the housing;

FIG. 8 shows a scrap axial cross-sectional view similar to that of FIG. 2 through a similar skid-sensing device according to the invention illustrating an alternative method of mounting the flywheel thereof, with part of the sensing means thereof omitted for clarity;

FIG. 9 shows an axial cross-sectional view similar to that of FIG. 2 of part of a skid-sensing device forming another embodiment of the invention;

FIG. 10 shows the arrangement of the contacts of the reed switch of the device of FIG. 9 and their electrical connections in a brake release circuit;

FIGS. 11 and 12 show the relative positions of the magnets of the device of FIG. 9 under normal and skidding conditions respectively;

FIG. 13 shows part of another embodiment of the invention, viewed in an axial direction with respect to the housing thereof;

FIG. 14 shows an axial cross-sectional view of part of the skid-sensing device of FIG. 13 taken on the line XIV—XIV in FIG. 13;

FIG. 15 shows a developed view of part of the device of FIG. 13 in the direction of arrow X in FIG. 13, and

FIG. 16 shows a cross-sectional view taken on the line XVI—XVI in FIG. XV.

In the first embodiment, shown in FIGS. 1–5 a skid-sensing device 1 comprises a sheet metal housing 2 in the form of a hollow annular body having a hollow rectangular cross section. The housing 2 is provided with a radially inwardly projecting flange 3 to enable it to be secured to a coupling flange 4 on a vehicle gear box output shaft 5, the arrangement being such that the housing 2 encircles and is rotatable coaxially with the output shaft.

Three hollow spindles 6 are secured to one radially extending wall 7 of the housing 2 in equally angularly spaced positions in a common pitch circle around the axis of the housing. Each hollow spindle 6 is mounted with its axis parallel to the axis of the housing and carries a first hollow cylindrical cam member 8 rotatably mounted on the spindle. A roller member in the form of a gear wheel 9 is rotatably mounted on the first cam member, a low friction bush 10 being provided between the gear wheel and the cam member.

An annular flywheel 11 having teeth 12 in its inner periphery corresponding to those on the three gear wheels 9 is mounted coaxially within the housing 2 so that the flywheel is supported for rotation on the three gear wheels, axial movement of the flywheel relative to the gear wheels being prevented by radially inwardly extending flanges 13 provided on the flywheel 11. The cam member 8 forms part of a cam mechanism which itself forms part of a sensing means associated with the flywheel 11 and arranged to respond to an overrunning condition thereof.

Each gear wheel 9 is located against axial movement relative to the first cam member and comprises an axially extending cylindrical portion 14 which abuts a corresponding cylindrical portion 15 of equal diameter formed on the first cam member 8. A coiled clutch spring 16 is wound tightly around the abutting cylindrical portions 14,15 to provide a drive connection between the gear wheel 9 and the first cam member 8 in the rotational sense required to produce acceleration of the

flywheel 11 as the housing 2 is driven by the output shaft 5 of the gear box, and to provide a slipping frictional drive connection in the overrunning condition of the flywheel when the gear box output shaft is decelerated.

Angular movement of the first cam member 8 relative to the spindle 6 is limited by means of a transverse peg 17 passing through clearance holes 18 formed in the spindle and located at its ends in radial bores 19 formed in the cam member. A second cylindrical cam member 20 is axially slidably mounted on the spindle 6 and the two cam members 8,20 engage one another along a cam surface 21 suitably shaped to produce axial movement of the second cam member 20 whenever the first cam member 8 is rotated relative to the second cam member about the axis of the spindle 6 as a result of an overrunning condition of the flywheel 11. A coiled torsion and return spring 22 is secured at one end to the transverse peg 17 and at the other end to an adjustable support 23 at one end of the hollow shaft so as to provide tension to draw the two cam members towards one another and an adjustable amount of torsion to resist relative rotation of the two cam members.

The second cam members 20 are each secured to an axially movable member in the form of an annular steel plate 24 coaxial with the housing 2 and having a movable switching member in the form of an axially extending flange 25 which projects through an annular gap formed in the wall of the housing opposite to the wall 7 in which the spindles 6 are secured, the gap being sealed by rubber seals 26. A coiled return spring 24A for the annular steel plate 24 is provided to bias the plate towards the flywheel 11.

The axially outer edge 27 of the flange 25 is arranged in close proximity to a signalling device 28 which is mounted on a fixed part 29 of the vehicle frame and comprises an electrical reed switch 30 connected in an electrical circuit including a battery 34 and brake release means 35 (see FIG. 4) for effecting release of the brakes (not shown) whenever the switch 30 is operated. The switch 30 is of a kind which includes a pair of contacts 31 (see FIG. 4) which are induced to close whenever they are subjected to a magnetic field of a predetermined strength and direction, and in this embodiment a first magnet 32 is placed on the radially outer side of the switch 30 relative to the axis of the skid-sensing device 1 and the effect of its magnetic field on the switch is counteracted by a second magnet 33 placed in a position radially inwardly of the switch 30. The edge 27 of the axially extending flange is positioned in relation to the switch 30 so that when the overrunning condition of the flywheel 11 causes the cam mechanisms to move the axially movable member axially outwardly relative to the housing 2 the edge 27 of the axially extending flange 25 moves in a switch-actuating direction to a position between the switch 30 and the second magnet 33. This effectively destroys the counteracting effect of the second magnet and causes the switch contacts to be closed by the field from the first magnet 32 and thus to actuate the system for effecting release of the brakes.

It will be noted that in the system described above there is no mechanical contact between any rotating member and a stationary member. However, it would be possible, although less desirable, for the axially movable member to engage a roller connected to an arm for actuating an electrical switch mechanically.

In a second embodiment shown in FIGS. 6 and 7, an annular housing 36 is of similar form to that described above, but the flywheel 37 is supported on three freely rotatable roller members 38 in the form of flanged pulleys mounted on spindles 39 in a similar manner to the gear wheels 9 of the previous embodiment. An axially movable member 40 is mounted on the spindles and is in the form of an annular flange similar to the axially movable member 24 described in the previous embodiment and includes a switching member in the form of an axially extending flange similar to the flange 25 of the previous embodiment.

In this embodiment axial movement of the axially movable member 40 is effected by means of frictional engagement of a friction member 41 with one side of the flywheel 37. The friction member 41 forms part of a thrust mechanism which itself forms part of sensing means associated with the flywheel and arranged to respond to an overrunning condition thereof. The friction member 41 is in the form of an annular synchronizing flange mounted for circumferential movement within the housing 36 and having associated therewith at equally angularly spaced positions in a common pitch circle coaxial with the flange, three friction elements. Each friction element extends through a corresponding aperture in the flange and comprises a flat brake shoe or pad 42 having a backing plate 43 pivotally connected to one end of a rigid link member 44 which is pivotally secured at its other end to a bracket 45 attached to the axially movable member 40. The backing plate 43 is wedge-shaped and has an inclined rear surface 46 for engagement with a corresponding axially fixed inclined surface formed on a wedge member in the form of a bracket 47 attached to the housing 36. A return spring 48 is provided to draw the axially movable member 40 towards the flywheel 37, and the arrangement of the inclined surfaces on the backing plate 43 of the brake shoes 42 and the fixed inclined surfaces formed on the brackets 47 is such that a wedging action is caused, during acceleration of the gear box output shaft, which causes the flywheel rapidly to be brought to the same speed as the housing. When the housing is decelerated however, this wedging action does not occur and the frictional engagement of the shoes with the side of the flywheel causes the shoes 42 to be dragged in the direction of rotation of the overrunning flywheel and thus to thrust the axially movable member 40 away from the friction member, a stop 49 in the form of a limb formed integrally with the link 44 and engageable with the axially movable member being provided to limit the angular movement of the link.

In order to effect sufficient movement of the axially movable member to actuate the associated switch when a skid is detected, it may be necessary to form the pad 42 of a friction material having a higher coefficient of friction than normal brake friction materials, or else to form inclined slots or the like in the rubbing surfaces of the pads to achieve a similar result. The high coefficient of friction results in a correspondingly large drag force on the pad when the flywheel overruns the housing, which is sufficient to move the link member 44 through a relatively large angle.

The operation of the device which forms the second embodiment of the invention is similar to that described above in relation to the first embodiment of the invention in that axial movement of the axially movable member 40 in a switch-actuating direction is caused to operate a signalling device in the form of an electrical switch which forms part of a system for effecting release of the brakes whenever the rate of deceleration of the housing is sufficient to cause the required axial movement.

If the device is mounted on the vehicle so that it faces in a direction such that linear deceleration of the vehicle causes the axially movable member 40 to tend to move towards the flywheel 37, this tendency opposes the movement of the axially movable member to release the brakes. The effect of this is to delay the operation of the brake releasing system until a higher rate of angular deceleration occurs. Also, the resulting drag on the flywheel is increased and the length of the period in which the flywheel remains in an overrunning condition is reduced. These effects enable the brakes to be operated for a longer period when the vehicle is running on a surface having relatively good frictional characteristics than when the vehicle is running on a slippery surface.

In a third embodiment shown in FIG. 8 and otherwise similar to the first embodiment, the roller members are in the form of gear wheels 66 which engage teeth formed in the radially outer periphery of the flywheel 67. A cam mechanism (not shown) associated with the flywheel and constructed and arranged in substantially the same manner as the cam mechanism of the first embodiment is provided to actuate an axially movable member corresponding to the member 25 of

the first embodiment, and which is in the form of an annular steel plate **68** coaxial with the housing **69** and having an annular steel flange **70**.

The housing **69** comprises an annular wall member **71** located between the flange **70** and a signalling device **72** corresponding to the signalling device **28**. The wall member **71** is of a nonmagnetic material having negligible effect on the magnetic fields of the first and second magnets **73,74** respectively of the sensing device **72**. The wall member serves to prevent or reduce the ingress of dirt and moisture into the housing **69**.

The magnets **73,74** are arranged with their magnetic fields in opposition so that the contacts of the reed switch **75** normally remain open. When the flywheel is in the overrunning condition and the cam mechanism moves the flange **70** axially towards the sensing device, the steel flange captures part of the magnetic field of the first magnet **73** and allows the second magnet **74** to cause the contacts to close.

In any of the embodiments described above the arrangement of a magnetic reed switch for actuation by the axially movable member may take several forms (not shown) which are alternative to that shown in FIGS. **1, 4** and **5**. For example, the axially movable member may incorporate an annular magnet coaxial with the housing for operating the switch, and this may be polarized either in the radial or in the axial direction, the switch being orientated and located correspondingly. No fixed magnets corresponding to the magnets **32,33** are then required and the orientation and location of the reed switch is such that its contacts normally remain open. When the flywheel is in the overrunning condition, axial movement of the annular magnet causes the magnetic field in which the switch lies to be such that the contacts become oppositely magnetically polarized, and the contacts close.

In a further alternative arrangement (not shown) of the magnetic reed switch, which is otherwise similar to that described above in connection with the first embodiment, the first magnet **32** (see FIGS. **1, 4** and **5**) is omitted and the axially extending flange **25** is arranged normally to lie between the second magnet **33** and the switch **30** so that it captures a substantial portion of the magnet's magnetic field and prevents the magnet from causing the switch contacts to close. When the flywheel is in the overrunning condition, the flange **25** is moved axially, allowing the magnet to cause the switch contacts to close.

In the embodiments described above, alternative switching mechanisms which also do not require mechanical contact between the rotating and the stationary member may be employed. These may take the form of pneumatic sensing devices which incorporate stabilized air jets which impinge on or may be interrupted or deflected by the switching member, or means associated therewith, and which operate by well-known principles. For example, means may be provided to sense the change in back pressure in the air jet supply line and actuate a relay valve, other valve, or an electrical switch when the switching member moves across the jet; or the jet may be arranged normally to be interrupted by the switching member, but on axial movement of the switching member to be released so that the air jet acts directly upon a member associated with an electrical switch or a relay valve or other valve. Alternatively, axial movement of the switching member may be arranged to cause an annular deflector associated with the flange **25** to deflect the air jet or jets from one direction to another and thereby open or close an associated switch or valve.

In a further alternative arrangement (not shown) the axial position of the edge of the switching member may be sensed by a radiation source such as a light beam and an associated radiation sensing means such as a photoelectric cell connected in an appropriate electrical circuit for actuating a system for releasing the brakes, the flange being arranged to interrupt reflect or refract the radiation emitted by the source, when the switching member is moved in the switch-actuating direction.

In the embodiments described above the overrunning action of the flywheel is detected by means of axial movement of an axially movable member. In a further embodiment shown in FIGS. **9** to **12**, a flywheel **50** supported in a similar manner to that in the first embodiment described above is arranged so that on overrunning it will cause first cam members **51** to rotate, but instead of providing second cam members to be moved axially by such rotation, a drive member in the form of a pinion **52**, is secured to each of the first cam members **51** and meshes with teeth formed on the inner periphery **53** of a first annular disc **54** mounted coaxially with the housing for rotation therewith and extending radially in a position adjacent a gap formed in the end wall of the housing **55**. A first series of magnets **56** are secured to the outer periphery of the annular disc **54**, the magnets being circumferentially aligned along a common pitch circle, evenly spaced around the circumference and arranged so that all their fields run in the same circumferential direction. The gap in the end wall of the housing **55** is sealed by a thin wall **57** of nonmagnetic material and a second annular disc **58** formed integrally with the housing is provided on the outer side of the gap to support a second series of magnets **59** arranged on the same pitch circle and in a similar manner to those of the first series **56**. A reed switch **60** is mounted on a stationary member **61** and is positioned so that as the two series of magnets **56,59** rotate with the housing **55**, the magnetic fields of their series of magnets pass through the switch. The switch is provided with two pairs **62,63** of contacts which are connected electrically in parallel with one another and are circumferentially spaced relative to one another, with respect to the annular housing. The reed switch **60** is connected in an electrical brake release circuit (see FIG. **10**) in series with a battery **64** and brake release means **65**.

The first and second series of magnets **56,59** are arranged relative to one another so that when the flywheel **50** is rotating at the same speed as the housing **55** their magnetic fields do not operate the switch. Thus when the flywheel is not overrunning, the cam members **51** are arranged to hold the annular disc in a position such that the first series of magnets **56** are axially aligned with the second series **59**, and in this position, as the housing rotates, the fields of the two series of magnets are directed axially and do not cause the contacts to be closed.

When overrunning of the flywheel **50** takes place each cam member **51** acts to cause a rotation of the annular disc **54**, carrying the first series of magnets **56**, relative to the second series of magnets **59**, and this causes circumferentially extending magnetic fields to be set up which cause each of the two pairs of contacts to be opened and closed successively as the housing rotates. The spacing between the two pairs of contacts is such that when either of the pairs is open the other pair is closed and since the two pairs of contacts are connected in parallel the resulting effect is that one or the other or both of the pairs of contacts provides a path for current throughout the cycle of rotation of the housing to actuate the associated brake-releasing system.

In a further embodiment of the invention otherwise similar to the second embodiment, and shown in FIGS. **13–16**, an annular flywheel **76** is mounted for rotation within a housing **77** on pulley wheels **78** which are rotatably mounted through low friction bushes **88** on axially extending spindles **79** secured to the housing in the same manner as the spindles **6**.

A first annular flange **80** is mounted on the spindles **79** for rotation with the housing **77**, and is supported on the spindles through bearings **81** and associated low friction bushes **99** for limited angular movement relative to the housing as will be described. The first annular flange is adapted to receive at a plurality of circumferentially spaced positions, pads in the form of buttons **82** of friction material for engagement with the respective side face of the flywheel **76**. The first annular flange **80** and the buttons **82** of friction material together constitute a friction member forming part of a thrust mechanism, which itself forms part of sensing means associated with the flywheel and arranged to respond to an overrunning condition thereof. Each button of friction material is formed with a projection **83** engageable with a wedge member **84** having an inclined surface. A wedging member is provided for each but-

ton at a corresponding point on the inside surface of the housing 77. Each button 82 is spring-loaded into frictional engagement with the flywheel 76 by a coiled spring 97 acting between the flange 80 and the button.

The spacing of the flywheel and the wedge member 84 is such that rotation of the housing relative to the flywheel causes the projections 83 of the button 82 to slide along the inclined surfaces of the wedge members 84, forcing the buttons into engagement with the flywheel so that the buttons are wedged between the flywheel and the inclined surfaces of the wedge members 84. Thus on acceleration of the housing the flywheel rapidly reaches the same rate of rotation as the housing.

An axially movable member in the form of a second annular flange 85 is also mounted on the spindles 79 within the housing 77. The second annular flange 85 is mounted on the spindles through sleeves 86 axially slidably located on the respective spindles. Each sleeve 86 is biassed away from the flywheel in an axial direction by a coiled compression spring 87, which is wound around the sleeve 86 at one end and engages at its other end a shoulder 98 formed on the spindle 79.

One wall of the housing 77 is formed by an annular wall member 89 of nonmagnetic material which is located between the second annular flange 85 and a signalling device 90. The signalling device 90 is constructed and arranged in a manner similar to the signalling devices already described, and includes a magnet 91 and a reed switch 92 arranged so that axial movement, away from the signalling device, of the second annular flange 85 causes the contacts of the reed switch, which are normally open, to close.

Between successive circumferentially spaced wedge members 84 on the housing there are provided link members 93 pivotally connected at their ends to the first and second annular flanges 80 and 85 respectively.

Each link member comprises a rodlike portion 94 having at each end a part-spherical head 95 seating in a corresponding part-spherical seat 96 formed in the respective annular flange 80 or 85.

When the flywheel 76 overruns the housing 77 the first annular flange 80 is dragged by the flywheel in a circumferential direction through a short distance. The second annular flange 85 is nonrotatable relative to the housing and therefore the two annular flanges are angularly displaced a little from each other.

Such displacement causes the link members 93 to pivot about their ends, thus drawing the second annular flange 85 towards the friction member in an axial direction to operate the reed switch 92 as described.

In embodiments of the invention employing magnets to operate a reed switch or the like, the magnets may be in the form of permanent magnets or electromagnets. When electromagnets are employed they may be arranged to be energized by, for example, a pressure operated switch associated with a driver's brake pedal, only when the brakes of the associated vehicle are applied, in order to avoid providing a permanent electrical load on the electrical system thereof.

I claim:

1. A skid-sensing device for vehicle antiskid braking system comprising a hollow annular rotatable housing having a direct driveable attachment for mounting thereof to a rotatable drive transmission member of a vehicle, a plurality of spaced-apart roller members individually mounted for rotatable movement on said housing, an annular flywheel disposed within said housing and mounted for rotational movement on said roller members, said flywheel and housing being arranged for attachment as a unit to said transmission, means providing a driveable connection between the respective roller members and said flywheel to drive said flywheel synchronously with said housing during normal vehicle motion and to provide for continuous overrun of said flywheel relatively to said housing in response to deceleration of said transmission member in excess of a predetermined value, and sensing means disposed within said housing and responsive to the overrunning of said housing by said flywheel to effect antiskid operation.

2. A skid-sensing device according to claim 1 wherein the roller members are rotatably mounted on spindles, the spindles being mounted with their axes parallel to the axis of the housing at angularly spaced-apart positions in a common pitch circle around the axis of the housing.

3. A skid-sensing device according to claim 1 wherein the roller members engage the inner periphery of the flywheel.

4. A skid-sensing device according to claim 1 wherein the roller members engage the outer periphery of the flywheel.

5. A skid-sensing device according to claim 1 having three roller members.

6. A skid-sensing device according to claim 1 wherein the rollers members are gear wheels.

7. A skid-sensing device according to claim 1 wherein the roller members are pulleys.

8. A skid-sensing device according to claim 1 wherein the sensing means associated with the flywheel comprises a cam mechanism arranged to actuate a signalling device.

9. A skid-sensing device according to claim 8 wherein the roller members are rotatably mounted on spindles which are mounted with their axes parallel to the axis of the housing at angularly spaced-apart positions in a common pitch circle around the axis of the housing, a plurality of cam mechanisms being provided, each cam mechanism being associated with a respective roller member and comprising first and second cylindrical cam members mounted for limited rotation relative to each other on the spindle on which their respective roller member is mounted, the confronting faces of the cam members being formed into cam surfaces, and a return spring biassing the cam members towards each other.

10. A skid-sensing device according to claim 9 wherein the roller member associated with each cam mechanism is rotatably mounted on the first cam member.

11. A skid-sensing device according to claim 10 comprising a coiled clutch spring wound round abutting cylindrical portions of the roller member and the first cam member to provide a drive connection between the roller member and the first cam member.

12. A skid-sensing device according to claim 9 comprising a coiled torsion spring coupled to the cam members to provide torsion to resist relative rotation of the cam members.

13. A skid-sensing device according to claim 9 comprising a peg to limit the angular movement of the first cam member relative to its associated spindle, the peg extending through clearance holes formed in the spindle and located at its ends in bores formed in the cam member, and wherein the second cam member is nonrotatable relative to the spindle.

14. A skid-sensing device according to claim 13 wherein the spindles are hollow and each contain a coiled torsion spring coupled to the cam members to provide tension to draw the cam members towards one another and torsion to resist relative rotation of the cam members, the torsion spring being associated at one end with the peg and at the other end with a support which is adjustable to vary the torsional forces exerted by the spring on the cam members.

15. A skid-sensing device according to claim 8 comprising a movable switching member, and an associated switch, the cam mechanism being arranged to move the switching member in a switch-actuating direction when the flywheel is in the overrunning condition.

16. A skid-sensing device according to claim 1 wherein the sensing means associated with the flywheel comprises a thrust mechanism including a friction member engageable with the flywheel.

17. A skid-sensing device according to claim 16 comprising a wedge member associated with the housing and rotatable therewith, the wedge member having an inclined surface, the device being arranged so that the friction member is wedged between the said inclined surface and the flywheel during angular acceleration of the housing.

18. A skid-sensing device according to claim 16 comprising an axially movable member and a link member, the link member being pivotally connected at one end to the friction member and at its other end to the axially movable member,

whereby angular movement of the friction member with respect to the axially movable member in the normal direction of rotation of the flywheel causes axial movement of the axially movable member.

19. A skid-sensing device according to claim 18 wherein the axially movable member is in the form of an annular flange, said friction member being in the form of an annular flange, and mounted for circumferential movement within said housing, and a link member operatively connected between said axially movable member and friction member to draw such members together when the flywheel is in an overrunning condition during rotation of the flywheel in the direction corresponding to normal forward motion of the vehicle, and return spring means for biassing said axially movable member away from said friction member.

20. A skid-sensing device according to claim 19 wherein the friction member comprises pads of friction material spring-loaded into frictional engagement with the flywheel.

21. A skid-sensing device according to claim 19 wherein the link member is connected to the friction member and to the axially movable member by part-spherical head portions formed at each end of the link member and seating in corresponding part-spherical seats formed in the friction member and the axially movable member.

22. A skid-sensing device according to claim 18 wherein the axially movable member is in the form of an annular flange, the friction member also being in the form of an annular flange and being mounted for circumferential movement within the housing, the friction member being arranged to cause the link member to thrust the axially movable member away from the friction member when the flywheel is in the overrunning condition during rotation of the flywheel in the direction corresponding to normal forward motion of the vehicle, a return spring being provided to bias the axially movable member towards the friction member.

23. A skid-sensing device according to claim 22 comprising a stop to limit angular movement of the link member relative to the thrust member in the direction of rotation of the flywheel.

24. A skid-sensing device according to claim 18 wherein the axially movable member comprises a switching member and an associated switch, the thrust mechanism being arranged to move the switching member in a switch-actuating direction when the flywheel is in the overrunning condition.

25. A skid-sensing device according to claim 15 wherein the switch associated with the movable switching member comprises a reed switch including a pair of contacts which are responsive to the field strength of, and to the direction of, a magnetic field in which the switch is placed.

26. A skid-sensing device according to claim 24 wherein the switch associated with the movable switching member comprises a reed switch including a pair of contacts which are responsive to the field strength of, and to the direction of, a magnetic field in which the switch is placed.

27. A skid-sensing device according to claim 25 wherein the contacts of the reed switch are normally open and are arranged to be closed when the flywheel is in the overrunning condition by the magnetic field in which the switch lies after movement of the switching member in the switch-actuating direction.

28. A skid-sensing device according to claim 26 wherein the switching member is movable in an axial direction with respect to the housing, and comprises an annular magnet which is coaxial with the housing, rotatable therewith and polarized in a radial direction.

29. A skid-sensing device according to claim 26 wherein the switching member is movable in an axial direction with respect to the housing and comprises an annular magnet which is coaxial with the housing, rotatable therewith, and polarized in an axial direction.

30. A skid-sensing device according to claim 26 wherein the switch associated with the movable switching member comprises a magnet mounted in the region of the reed switch and aligned so that its uninterrupted magnetic field causes the switch contacts to close, the switch member comprising a ferromagnetic material and being normally positioned to capture a portion of the magnetic field of the magnet and allow the switch contacts to remain open, the switching member moving when the flywheel is in the overrunning condition, to a position such that the field strength of the magnet at the reed switch is sufficient to close the contacts thereof.

31. A skid-sensing device according to claim 26 wherein the switch associated with the movable switching member comprises two magnets mounted in the region of the reed switch so that their magnetic fields are in opposition, the magnets being arranged so that their uninterrupted combined field strength acting on the reed switch contacts is insufficient to cause the contacts to close, the switching member comprising a ferromagnetic material and being positioned so that when it is moved in the switch-actuating direction it captures a portion of the magnetic field of one of the magnets thereby allowing the magnetic field of the other magnet to cause the switch contacts to close.

32. A skid-sensing device according to claim 17 wherein the switch associated with the movable switching member is arranged to be actuated by direct mechanical contact with the switching member.

33. A skid-sensing device according to claim 26 wherein the switch associated with the movable switching member is arranged to be actuated by direct mechanical contact with the switching member.

34. A skid-sensing device according to claim 17 wherein the switch associated with the movable switching member comprises a jet arranged to allow a steady flow of fluid therethrough, and pressure-sensing means mounted in association with the jet and arranged to respond to interruption of deflection of the jet, the switching member being arranged to interrupt or deflect the flow of fluid from the jet when moved in the said switch-actuating direction.

35. A skid-sensing device according to claim 26 wherein the switch associated with the movable switching member comprises a jet arranged to allow a steady flow of fluid therethrough, and pressure-sensing means mounted in association with the jet and arranged to respond to interruption of deflection of the jet, the switching member being arranged to interrupt or deflect the flow of fluid from the jet when moved in the said switch-actuating direction.

36. A skid-sensing device according to claim 17 wherein the switch associated with the movable switching member comprises a radiation source and radiation-sensing means mounted in association with the radiation source and arranged to respond to interruption reflection or refraction of the radiation emitted by the source, the switching member being arranged to interrupt, reflect or refract the radiation emitted by the source when moved in the said switch-actuating direction.

37. A skid-sensing device according to claim 36 wherein the switch associated with the movable switching member comprises a radiation source and radiation-sensing means mounted in association with the radiation source and arranged to respond to interruption reflection or refraction of the radiation emitted by the source. The switching member being arranged to interrupt, reflect or refract the radiation emitted by the source when moved in the said switch-actuating direction.

38. A skid-sensing device according to claim 1 wherein the means associated with the flywheel and arranged to respond to an overrunning condition thereof comprises a first annular disc mounted coaxially with the housing for rotation therewith and arranged to be angularly movable relative to the housing when the flywheel is in the said overrunning condition, a first series of magnets secured to the first annular disc, a second annular disc, the second annular disc being secured to the housing coaxially therewith for rotation with the housing, a second series of magnets, the second series of magnets being secured to the second annular disc, and a reed switch mounted so that the magnetic fields of the two series of magnets pass through the switch, the magnets and the switch being arranged

so that during rotation of the housing, angular movement of the first annular disc relative to the second annular disc causes the contacts of the switch to open or to close.

39. A skid-sensing device according to claim **38** wherein the roller members are rotatably mounted on spindles which are mounted at spaced-apart positions in the housing, a plurality of cam members being provided, each cam member being mounted on the spindle of a respective roller member, a drive connection being provided to transmit torque to each cam member from its respective roller member when the flywheel is in the overrunning condition, and a drive member being provided for each cam member to transmit drive to the first annular disc to effect angular movement thereof relative to the housing.

40. A skid-sensing device comprising a housing, means for mounting said housing on a rotatable member which rotates synchronously with a vehicle wheel, an annular flywheel disposed within said housing, a plurality of spaced-apart roller members carried by said housing and each having means for rotatable mounting thereof, means forming a drivable mounting connection between a respective one of said roller members and said annular flywheel to provide continuous rotation of said flywheel and overrunning of said flywheel relatively to said roller members providing said drivable mounting connection, axially movable means angularly movable responsively to overriding of said roller members by said flywheel from a first position to a second position, and sensing means responsive to the axial movement of said angularly movable means during differential speed between said flywheel and said housing to effect antiskid operation until the flywheel and casing have attained synchronous speed.

41. A skid-sensing device in accordance with claim **40** wherein said housing is in the form of a hollow annular body, adapted to be attached as a unit together with said flywheel to a rotatable drive shaft of a vehicle for rotation therewith.

42. A skid-sensing device according to claim **16** wherein the axially movable member is in the form of an annular flange, said friction member being in the form of an annular flange, and mounted for circumferential movement within said housing, and a link member operatively connected between said axially movable member and friction member to draw such members together when the flywheel is in an overrunning condition during rotation of the flywheel in the direction corresponding to normal forward motion of the vehicle, and return spring means for biasing said axially movable member away from said friction member.

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