PATENT SPECIFICATION

Application Date: April 30, 1935. No. 25992/36. **457,849**

(Divided out of No. 457,761).

Complete Specification Left: April 6, 1936.

Complete Specification Accepted: Nov. 30, 1936.

PROVISIONAL SPECIFICATION

An Improved Gear-ratio Indicator and/or Control Device

I, GEORGE CONSTANTINESCO, British subject, of Oxen House, Torver, Coniston, Lancashire, do hereby declare the nature of this invention to be as follows:—

The object of this invention is to provide an apparatus for indicating and controlling the gear ratio between two (or more) rotating shafts which may be engaged or disengaged at will if desired automatically.

The invention is particularly applicable to gear boxes of any kind where various gear ratios may be engaged between a driving member and a driven member.

The invention is also applicable to cases where the transmission between two shafts is a friction drive and when it is required to know the amount of slip occurring or to control or prevent such slip.

According to my present invention, a gear ratio indicator and/or control device comprises two members, one of which is a driving member, referred to hereafter as the primary member, and the other a driven member, hereinafter referred to as the secondary member, the two members being continuously or intermittently driven, and a third member (hereinafter referred to as the indicator, such expression being intended to include a control member) which is frictionally driven by the primary and secondary members and serves to indicate and/or control the gear ratio between the primary and secondary members or driving elements thereof.

In one form of the invention there are provided two rotating members, one the primary driven by say the driving shaft of the gear box either at the same speed or at a predetermined fixed proportion of such speed, and a secondary member similarly driven by the driven shaft of the gear box.

The primary and secondary members which may more conveniently be termed the rotors, comprise two cylinders with parallel axes revolving round their respective axis in the same direction. The rotors are set a certain distance apart and between them is interposed a third cylinder hereinafter termed the indicator, preferably hollow so as to have a certain elasticity. This indicator is normally parallel with the rotors and stands normally jammed between the rotors so that in that position all the three axes of the rotors and indicator are in the same plane.

The indicator is therefore free to rotate and to move transversely a certain amount on each side of the plane containing the rotor axes. This amount depends on the elasticity of the indicator and is limited by two stops on either side. These stops may be for instance two carbon brushes or some form of electric contact supported by suitable springs. In the normal position the indicator stands clear of the stops and continues to remain in this position when the rotors are rotating at a predetermined ratio of speed which depends on the diameters of the rotors and the manner in which they are driven. Suppose that the rotors are equal in diameter, then as long as they rotate at the same angular speed the indicator will be driven by the rotors by frictional contact but will not move transversely. But as soon as one of the rotors slows down or accelerates relatively to the other, the indicator will move towards the one or the other of the stops and eventually press against the stop as long as the synchronism between the rotors is broken.

If the rotors and indicator are metallic for example and in electrical contact with one pole of a battery and the carbon brushes with the other pole, an electric circuit will be closed when the rotors do not rotate at the same speed. This electric circuit may include an electric lamp to give a warning or actuate an electromagnet or servo motor which in turn may act in such a way on the driving member of the gear box, as either to prevent the engagement of the gears or to restore the synchronism by acting for example on the prime mover which will accelerate or decelerate until the synchronism is restored. As soon as this is obtained the indicator will resume a position away from the stops.

If the gear box to be controlled has more than one gear ratio, the apparatus is provided with as many sets of rotors and

[*Price* 1/-]

indicators as there are gear ratios, each set being driven at the correct speeds which will give synchronism to each particular gear ratio. For instance all the primary rotors in each set can be driven by one axial shaft while all the secondary rotors will be driven from an intermediary shaft driven by the final driven member of the gear box through suitable gearings so that each set will synchronise respectively with the first, second, third and so forth gear ratios of the gear box.

In another form instead of cylinders for the primary and secondary members I may employ two equal cones with parallel axes and arrange one or more indicator cylinders with their axes parallel to the generatrices contained in the axial plane of the cones. Each indicator will correspond then to a particular gear ratio between the angular speeds of the cones.

Instead of the indicators closing a circuit when the synchronism is broken, I may arrange to close a circuit only when the synchronism is in force. An apparatus with several indicators for various gear ratios will then indicate which particular gear ratio happens to be between the primary and secondary in the gear box either when the gears are engaged or disengaged.

Dated the 23rd day of September, 1936.

CARPMAELS & RANSFORD,
Agents for Applicant,
24, Southampton Buildings,
London, W.C.2.

COMPLETE SPECIFICATION

An Improved Device Responsive to Changes of Speed Relationship of Two Rotary Members

I, GEORGE CONSTANTINESCO, British subject, of Oxen House, Torver, Coniston, Lancashire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to devices responsive to changes of speed relationship of two rotary members and its object is to provide an apparatus for indicating and/or controlling the gear ratio between two (or more) rotating shafts which may be engaged and disengaged at will, if desired automatically.

The invention is particularly applicable to machine tools of any kind where various gear ratios may be engaged between a driving member and a driven member.

The invention is also applicable to cases where the transmission between two shafts is a friction drive and when it is required to know the amount of slip occurring and to control or prevent such slip.

According to the present invention a device responsive to changes of speed relationship of two rotary members comprises a third rotary member driven by direct engagement between its inner or outer periphery and the peripheries of the two rotary members, one of which is a driving member referred to hereafter as the primary member and the other a driven member hereinafter referred to as the secondary member, whilst its axis is capable of translational movement, the arrangement being such that the third member is urged to shift its position to accommodate itself to the differential driving action upon it. This is effected by forming the third member, hereinafter referred to as the indicator (which expression is intended to include a control member) as elastically deformable so that it will accommodate itself in different positions to differential peripheral speeds at the points of driving engagement.

Preferably also the mounting of the indicator in relation of the primary and secondary members is such that its axis is to one side of a plane containing the axes of the primary and secondary members when the angular speeds thereof have a certain relationship but the axis moves towards that plane when that relationship alters in one direction.

The indicator may be in the form of one or more metallic rings or discs and is adapted to move into and out of contact with electric contacts which are preferably spring supported.

In devices responsive to changes of speed relationship of two rotary members, it is known to provide a third member peripherally engaging the two members and capable of translational movement in response to differences in speed between the two first members.

Various forms of the invention are diagrammatically illustrated in the accompanying drawing in which: in Figures 1 to 4 the various members of the control device are in the form of rings whilst in Figures 5 and 6 the primary and secondary members are in the form of coned pulleys. Figure 7 shows a multiple arrangement of that shown in Figures 5 and 6.

In the form shown in Figure 1, the device comprises two rotating members, one the primary 1 driven by the driving shaft of the gear box either at the same speed or at a predetermined fixed proportion of such speed, and a secondary mem-

ber 2 similarly driven by the driven shaft of the gear box.

The primary and secondary members which may more conveniently be termed the rotors, comprise two discs or rings with parallel axes revolving round their respective axis in the same direction. The rotors are set a certain distance apart and between them is interposed a third elastically deformable disc or ring 3 hereinafter termed the indicator, preferably hollow so as to have a certain elasticity.

The indicator 3 is free to rotate and to move transversely a certain amount on each side of the plane containing the rotor axes. This amount depends on the elasticity of the indicator and is limited by two stops 4 on either side. These stops may be for instance two carbon brushes or some form of electric contact supported by suitable springs 5 (as shown in Figure 2). For the sake of convenience, the apparatus now being described is so done with a view to what occurs when synchronism is broken but a useful application of the invention is to provide apparatus which gives an indication when passing from different angular speeds of the rotation of the rotors to synchronism. In the position shown in Figure 1 the indicator 3 stands clear of these stops 4 and continues to remain in this position when the rotors 1, 2 are rotating at a predetermined ratio of speed which depends on the diameters of the rotors and the manner in which they are driven. Suppose that the rotors are equal in diameter, then as long as they rotate at the same angular speed the indicator will be driven by the rotors by frictional contact but will not move transversely. But as soon as one of the rotors slows down or accelerates relatively to the other, the indicator will move towards the one or the other of the stops and eventually press against the stop as long as the synchronism between the rotors is broken. Conversely, when the indicator is pressing against one of the stops and the angular speeds of the rotation of the rotors is approaching synchronism, the indicator will move away from the stop so that by the time synchronism is reached, the indicator will be in its normal position.

If the rotors and indicator are metallic for example and in electrical contact with one pole of a battery 6 and the carbon brushes with the other pole, an electric circuit will be closed when the rotors do not rotate at the same speed assuming the rotors to be of equal diameter, or a fixed gear ratio when their diameters are different. This electric circuit may include an electric lamp to give a warning or actuate an electromagnet or servo motor which in turn may act in such a way on the driving member e.g. of a gear box, in a manner similar to that foreseen in my co-pending application No. 12918/35 (Serial No. 457,761), as either to prevent the engagement of the gears or to restore the synchronism by acting for example on the prime mover which will accelerate or decelerate until the synchronism is restored. As soon as this is obtained the indicator will resume a position away from the stops.

In the arrangement shown in Figure 4 an alternative type of synchroniser is shown in which the indicator 3 is, in the form of a ring, external to the primary and secondary 1, 2. In this arrangement if the primary and secondary are rotating at the same speed the indicator will remain stationary but on synchronisation of the speeds of the primary and secondary being upset, the indicator will be caused to move to one side or the other to contact with one or other of the stops 4.

In the modification shown in Figures 5 and 6, the primary and secondary are in the form of coned pulleys 7, 8 the indicator comprising two rings 9 which normally are jammed between the pulleys 7, 8, the contacting surfaces of which are insulated from the shafts 7^1, 8^1 of said pulleys. In this arrangement, the indicator rings 9 are each in permanent contact with a spring mounted contact 10, so that lack of synchronism between the primary and secondary is indicated by one or other of the rings 9 breaking contact. When the primary and secondary members are rotating in synchronism owing to the variation of peripheral speeds due to the wedge-shape of the coned pulleys, the two rings 9, which are in contact with each other, are each urged to move to contact with the contacts 10, to complete the circuit, but on synchronism being broken, one or other of the rings 9 will move away from its contact and break the circuit. An apparatus with several indicators for various gear ratios (see Figure 7 described below) will then indicate which particular gear ratio happens to be between the primary and secondary in the gear box either when the gears are engaged or disengaged.

If the gear box to be controlled has more than one gear ratio, the apparatus is provided with as many sets of rotors and indicators as there are gear ratios (see Figure 7) each set being driven at the correct speeds which will give synchronism to each particular gear ratio. For instance all the primary rotors 7 in each set can be driven by one axial shaft 7^1 while all the secondary rotors 8 will be driven from the final driven member 8^1 of the gear box (not shown) through suitable

gearings (not shown) so that each set will synchronise respectively with the first, second, third and so forth gear ratios of the gear box. Each indicator will correspond then to a particular gear ratio between the angular speeds of the cones.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A device responsive to changes of speed relationship of two rotary members and comprising a third rotary member driven by direct engagement between its inner or outer periphery and the peripheries of the two rotary members whilst its axis is capable of translational movement and being elastically deformable so that it will accommodate itself in different positions to differential peripheral speeds at the points of driving engagement respectively.

2. A device as claimed in claim 1 in which the mounting of the driven rotary member in relation of the two driving rotary members is such that its axis is to one side of a plane containing the axes of the two rotary members when the angular speeds of the two rotary members have a certain relationship but that the axis moves towards that plane when that relationship alters in one direction.

3. A device as claimed in claim 2 in which there are two driven rotary members whose axes, when the speeds of the driving rotary members bear the certain relationship, are on opposite sides of the plane containing the axes of the two driving rotary members.

4. A device as claimed in any of the preceding claims in which there are a plurality of pairs of rotary members with the same angular speed relationships but different peripheral speed relationships in the drive upon the corresponding driven members.

5. A device as claimed in any of the preceding claims in which a driven rotary member is a ring encircling a pair of driving rotary members.

6. A device as claimed in any of claims 1 to 4 in which a driven rotary member is jammed between a pair of driving rotary members.

7. A device as claimed in any of the preceding claims in which movement of a driven rotary member is caused to make or break electrical contacts in an electrical circuit serving to operate an indicator of or means for controlling a change of the speed relationship of the driving rotary members.

Dated the 23rd day of September, 1936.

CARPMAELS & RANSFORD,
Agents for Applicant,
24, Southampton Buildings,
London, W.C.2.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1936.

Fig. 1.

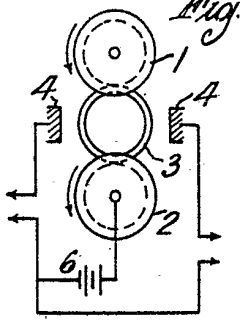


Fig. 2.

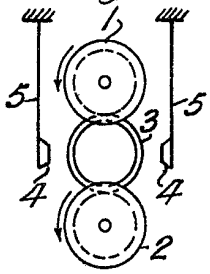


Fig. 3.

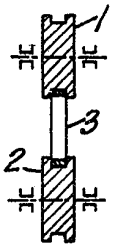


Fig. 4.

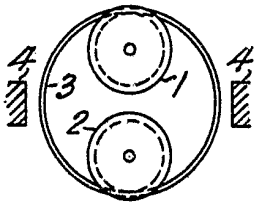


Fig. 5.

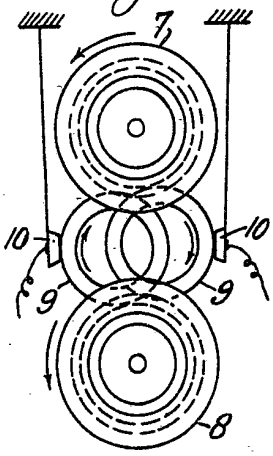


Fig. 6.

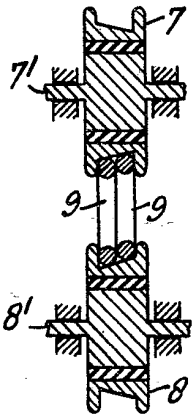
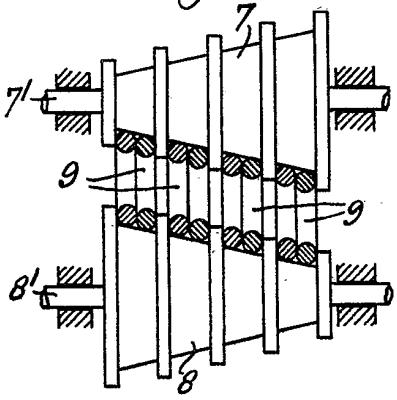


Fig. 7.



Malby & Sons, Photo-Lith.