PATENT SPECIFICATION

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(Divided out of No. 457,761).

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PROVISIONAL SPECIFICATION

Improvements in or relating to Gear Changing Mechanism

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 a 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 parallelaxes 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 those 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 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 its normal position away from the stops.

If the gear box to be controlled has

[*Price* 1/-]

more than one gear ratio, the apparatus is provided with as many sets of rotors and 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 gearing 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.

In another form of the invention I use as rotors two flat discs rotating in the same plane round two fixed axes and as an indicator a system formed of a differential whose intermediary member is fixed on and can rotate with a solid shaft perpendicular to and in the same plane with the rotor shafts. The other two members of the differential are rotated through hollow shafts by two equal friction discs each in contact at right angles with each rotor disc.

The solid shaft of the indicator is guided at one end in a bearing which allows it free axial movement, the other end of the shaft being threaded and screwed into a fixed nut.

It will be seen that if the rotor discs rotate in opposite directions the third member of the differential will be stationary only when the friction discs have exactly the same speed. In such conditions the indicator system remains stationary along its shaft. But as soon as the relative angular velocities of the rotors is altered the indicator will have its shaft rotated by the intermediary member of the differential with the result that the indicator shaft will be screwed into or out of the fixed nut and thus the whole indicator system will move along its axis and thus alter automatically the diameters of the pitch circles of contact of the friction discs with the rotor discs. If the screw continues to turn in the same direction this action will continue until the indicator takes such a position that its friction discs rotate again at the same speed thus rendering the indicator again stationary.

The new position of the indicator will therefore be an indication of the new gear ratio between the rotors and the axial movement of the indicator shaft will indicate or control if necessary as said above the gear ratio between the primary and secondary members of any mechanisms like gear boxes or the like. Instead of the rotors being in one plane I may arrange them in two parallel planes coaxially and place the indicator system between them with its shaft slightly tilted so that each rotor drives only one of the friction discs.

In this form of the invention only one indicator and a pair of rotors are necessary to indicate any number of gear ratios. For instance if the rotors are rotated respectively from the engine and the cardan shaft of a motor vehicle, the indicator will assume automatically as many fixed positions as there are gear changes in the gear box, by providing suitable electric, pneumatic or hydraulic relay devices, the indicator can actually control or even effect the gear changes in the gear box from the neutral position of the gears without any necessity for declutching. This is a consequence of the fact that there corresponds a certain position of the indicator for each pair of gears in the gear box to be engaged when these are rotating at the same speed. If then in such position the indicator closes for example an electric circuit, the current can operate the gear change directly or through suitable relays and servomotors.

In a still further form of the invention the primary and secondary rotors are intermittently driven by providing the rotors with one way clutches which will drive them in one direction only, when oscillatory motion is imparted to the said one way clutches or freewheels. Preferably the stroke of the oscillations is so arranged as to remain constant, either by providing limiting stops, or by driving them through rigid connections. In such cases the two shafts of any machine of which the relative angular speed is to be controlled will be provided with eccentrics, cams, notches or the like for producing oscillatory motion. This will be carried by links, wires or chains to the

controlling instrument where the oscillatory motion will act on the oscillating members which drive the rotors. Alternatively this may be effected by means of electro-magnets energised intermittently by suitable interruptors mounted on the respective rotating shafts. For all the types in which the instrument is arranged for one or more constant gear ratios the oscillations of constant amplitude will be transmitted direct to the freewheel oscillators.

For all types in which the instrument indicates with only two rotors a variable number of speeds, the oscillations of constant amplitude will be transmitted to the intermediary members which drive the rotors, for example to the friction discs or cones which impart variable angular rotation to the rotors.

In a modification intermittent motion may be imparted by oscillatory arms articulated at a fixed point, the pivotal point of the oscillating members driving the freewheels of the rotors being so arranged that it can be adjusted along the length of the oscillatory arms.

By such an arrangement the two arms having oscillations of constant angular amplitude about their fixed pivotal points will impart to the rotors intermittent movements of rotation of variable amplitude.

The instrument in this form being positively driven (i.e. without the intervention of friction surfaces) is capable of transmitting considerable force to the indicator which can therefore, if desired, control directly, without relays, for example steam, pneumatic or hydraulic valves, electric rheostats, throttles of engines and the like control apparatus.

In another form of the invention, the instrument is adapted to work in conjunction with a governor driven by the prime mover for example the engine of a motor vehicle, rail car, locomotive, winch or like machine in which there are frequent variations in load and in which a gear box is required. The governor is arranged to control a clutch between the engine and the primary of the gear box so that when the speed of the engine falls below a certain limit, the clutch is disengaged. The governor preferably acts also when the speed of the engine exceeds a certain limit by closing the throttle and also disengages the clutch. The gear box is provided with a mechanical fluid or electromagnetic gear change mechanism controlled by the gear ratio control mechanisms described and is preferably so arranged also that when the clutch is disengaged, the gear box is thrown into the neutral position and remains so.

If the gear box is hand controlled, I may for safety provide catches which normally prevent movement of the gear lever, such catches being released at the right moment by the gear ratio control instrument which will release only the particular catch which corresponds to the gears which are in synchronism at that moment. At the same time the indicator will show which gear is to be engaged. The driver then has merely to push the lever of the gear box to that gear change. The gear lever may be made of elastic material or be elastically articulated so that it may be pushed into positioning for changing gear, and held there, until the appropriate catch has been released by the control instrument when the gear change will be effected by the elastically stored energy from the lever.

When the gear box is operated by a servomotor, for example pneumatically, the gear change valve will be operated directly or through relays from the control instrument.

In the case in which the invention is applied to an automobile, the operation is as follows:—

The gear box being in neutral and the clutch disengaged, either because the engine is not running or running at a speed too below the limit at which the governor declutches, the lowest gear is moved into engagement by the driver. The engine is accelerated by opening the throttle gradually and when the speed of the engine reaches the lower limit at which the governor actuates the clutch, the clutch engages and the automobile commences to move. As soon as the automobile and engine have accelerated up to the upper limit, the clutch is disengaged through the governor and the throttle closed against the force which tends to keep it open. The engine slows down until the gear ratio control indicates that the second gear ratio is in synchronism and the gear change is effected automatically. This will be repeated from gear to gear until the top gear is reached.

When the automobile, which is now on top gear, comes to a gradient which is sufficiently steep to slow down the engine until the under limit is reached, the clutch is disengaged through the governor, the engine accelerates (because the throttle is open), and the indicator effects or allows a gear change at the right time to the next lower gear, and so on until the lowest gear is in operation.

The invention is applicable to all cases where two shafts have to be synchronised and to such applications as to prevent the slip of belt or rope transmissions, friction drives and the like.

Dated the 23rd day of October, 1936.

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COMPLETE SPECIFICATION

Improvements in or relating to Gear Changing Mechanism

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 gear changing mechanism such as may be used, for example in gear boxes for use in automobiles, locomotives and like power driven vehicles.

A gear change control according to the present invention comprises means for preventing the change from being completed until the teeth of the gears or clutches in the gear box are synchronised or moving at substantially the same speeds.

The invention is diagrammatically illustrated in the accompanying drawing in which:

Figure 1 shows the invention applied to effect shockless speed changes in a gear box such as is used in an automobile.

Figure 2 is a detailed view of the catch mechanism and its contacts.

Referring to the drawing, the gear lever 100 which is preferably made of elastic material so as to be capable of flexing, carries at its lower and rigid end 74 a member 75 on which are arranged as many contact pieces 76 as there are gear ratios in the gear box. Each contact piece 76 is connected to a synchroniser terminal in the synchroniser 77 which is as claimed in the specification No. 12918/35 (Serial No. 457,761) or in the specification No. 25992/36 (Serial No. 457,849). Each contact 76 is connected to one of the terminals 47 (Fig. 3) of the former specification. Normally positioned in obstructive engagement with the contact carrying member 75 is a catch 78 which is spring returned (as shown at 78^1) and which is in the form of an armature which can be attracted out of its obstructing position by an electro-magnet 79. The catch is also part of an electric circuit including a second electro-magnet 80 which is adapted to be energised from a battery 81. The catch normally, that is to say when the electro-magnet 79 is de-energised and the armature is freed, is in such a position that it prevents the gear lever from being moved from one gear position to another gear position, that is from one slot to another in a gate 84 if such as provided.

In operation, when the driver desires to effect a gear change he moves the knob 74^1 of the lever 100 towards the gear position corresponding to the ratio which he desires to engage. This movement makes contact between the catch 78 and the selected contact piece 76 carried by the member 75 on the rigid part 74 of the gear lever but does not complete either any circuit or the gear change. When the synchroniser 77 has operated as is described with reference to Figures 2 and 3 of the specification No. 12918/35 (Serial No. 457,761) and when the movable terminal 46 has reached the terminal 47 that is in the same circuit as the selected contact piece 76 and the catch 78, the electric circuit is completed and current passes from one side of the battery 81 through the terminals 46, 47 of the synchroniser 77 to the operative contact piece 76, and through the catch 78 and electro-magnet 80 back to the battery 81. The energisation of the electro-magnet 80 lifts its armature 80^1 and hence an arm 82 carried thereby to close a contact 83 in the circuit of the electro-magnet 79, thereby allowing heavy current to energise said electro-magnet 79, to withdraw the catch 78 from its obstructive position so that the rigid part 74 of the gear lever 100 may follow the knob 74^1 so as to complete its stroke to the selected position in the gate 84. The arm 82 is returned to its normal position by a spring 83^1. It will thus be seen that it will be impossible for the gear lever to be moved completely to its position in the gate corresponding to the ratios selected until the gear or clutch teeth corresponding to the gear ratio to be engaged are rotating at equal speeds.

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 gear change control for use with gear boxes and comprising a gear change lever which, when urged towards any particular gear ratio engagement position, is held by a catch against completing the stroke, until released, at the instant of

establishment of synchronism of the gear or clutch teeth to be engaged, by a releasing impulse or force transmitted to the catch from a synchroniser apparatus forming the subject matter of specification No. 12918/35 (Serial No. 457,761).

2. A gear change control for use with gear boxes and comprising a gear change lever which, when urged towards any particular gear ratio engagement position, is held by a catch against completing the stroke, until released, at the instant of establishment of synchronism of the gear or clutch teeth to be engaged, by a releasing impulse or force transmitted to the catch from a synchroniser apparatus forming the subject matter of specification No. 25992/36 (Serial No. 457,849).

3. A gear change control according to claim 1 or 2 in which the gear lever is made of springy material so that the knob part of the lever can complete its stroke idly to its final position, such as a notch in a gate, leaving the main or rigid part of the lever to follow after synchronism has been effected.

4. Apparatus as claimed in any preceding claim in which the catch comprises part of an electro-magnet which when de-energised allows the catch to remain in such a position as obstructively to prevent completion of stroke of the gear lever, whilst permitting pre-selection by effort maintained upon the knob of the lever until the synchroniser allows completion of the stroke.

5. Apparatus as claimed in any preceding claim in which the gear lever carries a member normally engaged and held by the catch and provided with a plurality of contacts equal in number to the number of gear ratios in the gear box, the arrangement being such that selector movement of the knob of the lever causes one of these contacts partly to make a circuit corresponding to the ratio selected, this circuit not being completed until the synchroniser does so on the gear or clutch teeth of that ratio being in synchronism, whereupon the catch is withdrawn and the lever moves on to complete the change.

6. Gear changing mechanism according to any preceding claim substantially as hereinbefore described with reference to the accompanying drawing.

Dated this 23rd day of October, 1936.

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Fig. 1

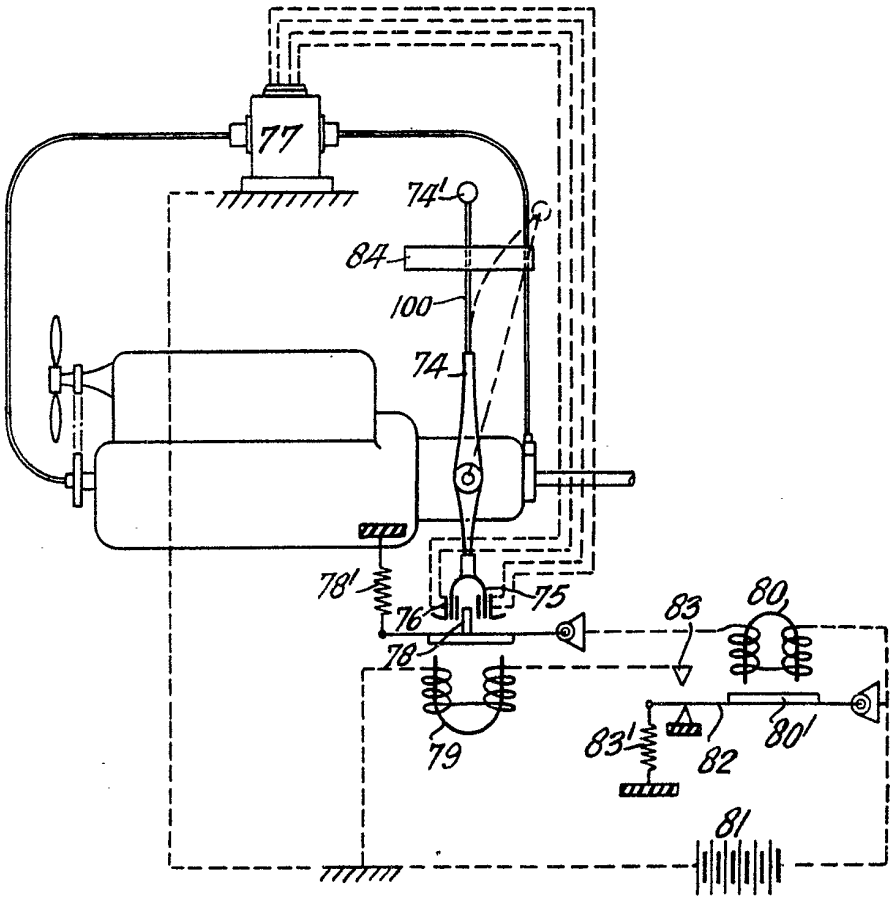
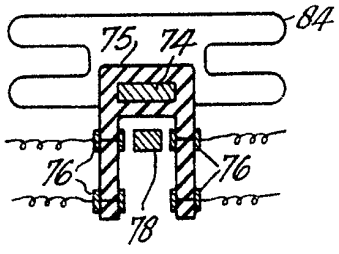


Fig. 2.



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