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(54) **Centrifugal advance mechanism for a spark ignition system ignition distributor.**

(57) A centrifugal advance mechanism wherein the degree of advance of the output shaft of the mechanism relative to the input shaft of the mechanism increases, as a result of smoothly increasing speed, in a stepwise manner, the mechanism including a first plate (13) rotatable with the input shaft (11), and a second plate (18) rotatable relative to both the input shaft (11) and the output shaft (12). A cam member (21) is coupled to the output shaft (12) to rotate therewith, and is engaged by centrifugal weights pivoted on the first shaft (11). A first tension spring (26) acts between the input shaft and the output shaft to urge the output shaft to a rest position, and a second tension spring (27) acts between the output shaft (12) and the second plate (18) to urge the second plate (18) to a rest position relative to the output shaft (12). The second plate (18) and the first plate (13) include co-acting abutment means (29, 15) to limit movement of the second plate (18) with the output shaft (12) relative to the input shaft (11). Before co-operation of the abutment means (15, 29) the shaft (12) is moved relative to the shaft (11) against the action of the spring (26), whereas after co-operation of the abutment means (15, 29) movement of the shaft (12) relative to the shaft (11) takes place against the combined action of the springs (26, 27.)

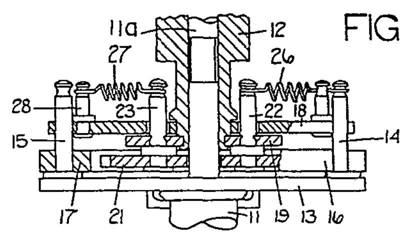
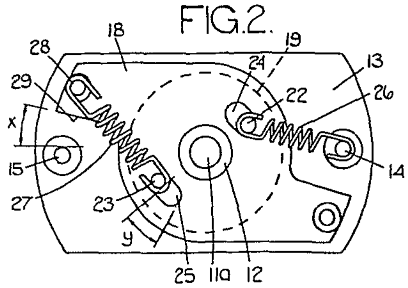


FIG.1.

FIG.2.



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Croydon Printing Company Ltd.

This invention relates to a centrifugal advance mechanism for use in the ignition distributor of an internal combustion engine spark ignition system.

The operating conditions of certain internal combustion engines are optimised when the ignition timing is advanced in a stepped manner with increasing engine speed rather than a continuous manner as is the case with many engines. Thus such certain engines require, as the engine speed increases, a period of engine speed increase where the ignition timing remains constant after a previous timing advance and prior to a subsequent advance. A mechanism for achieving such a timing advance sequence is disclosed in British Patent Specification No. 798059. The construction and operation of this prior construction will be evident from a reading of Specification No. 798059 and it will be recognised that a torsion spring which is prestressed and which influences the advance mechanism above a certain engine speed is required. Assembly of the components in particular a prestressed torsion spring, of such a construction during its manufacture is considered to be a problem, as is controlling the prestressing of the torsion spring in a manner to ensure consistently accurate timing control over a number of ostensibly identical mechanisms, and it is an object of the present invention to provide a centrifugal advance mechanism capable of producing a stepped timing characteristic wherein these problems are minimized.

A centrifugal advance mechanism according to the invention includes an input shaft, an output shaft which is to rotate with the input shaft and whose angular relationship with the input shaft is to be varied in accordance with the rotational speed of the input shaft, the input and output shafts having a common axis of rotation, a first plate fixed in relation to the input shaft so as to rotate therewith, a weight mounted on said first plate for pivotal movement relative thereto about an axis parallel to said rotational axis, a cam member fixed in relation to said output shaft so as to rotate therewith, said cam member being engaged by said weight and being movable thereby as a result of pivotal movement of the weight and thus effecting angular movement of the output shaft relative to the input shaft about said rotational axis, a second plate capable of angular movement about said rotational axis relative to said input and output shafts, a first tension spring acting between the first plate and the output shaft and urging the output shaft angularly to a rest position relative to the input shaft, a second tension spring acting between the output shaft and the second plate and urging the second plate with predetermined force to a rest position defining one limit of the permitted angular movement of the second plate relative to the output shaft, and, abutment means restricting angular movement of the second plate relative to the first plate, the arrangement being such that as the rotational speed of the input shaft increases from zero, said weight pivots under the action of centrifugal force relative to said first plate thus moving said cam member and the output shaft angularly relative to the input shaft while rotating with the input shaft, against the action of said first spring, said second spring constraining said second plate to remain in its rest position relative to said output shaft, and the angular displacement of the output shaft with respect to the input shaft increasing as the speed of rotation increases until said abutment means prevents further movement of the second plate with said output shaft relative to the input shaft whereupon the angular displacement of the output shaft relative to the input shaft remains constant until the speed of rotation has increased sufficiently to overcome said predetermined force generated by said second spring, whereupon said output shaft and said cam means is moved by said weight against the combined action of the first and second springs to further increase the angular displacement of the output shaft with respect to the input shaft with further increasing speed of rotation of the input shaft.

Preferably a first anchor post extends from said first plate parallel to said axis of rotation, a second anchor post extends parallel to said first anchor post from the cam member, and said first spring is coupled at one end to the first anchor post and at its other end to the second anchor post.

Conveniently a third anchor post extends from said cam member parallel to said axis of rotation, and a fourth anchor post extends from said second plate parallel to said third anchor post, said second spring being coupled at one end to the third anchor post and at its other end to the fourth anchor post.

Preferably a second weight is pivotally mounted on said first plate for movement about an axis parallel to the pivotal axis of the first mentioned weight.

Preferably one of said first and second weights is pivotally mounted on said first anchor post.

Desirably a third plate is rigidly secured to said output shaft, and said cam member is rigidly secured to said third plate by means of said second and third anchor posts.

Conveniently said first and second plates and said cam member extend parallel to one another, said cam member lies between said first and second plates, and said second and third anchor posts extend through arcuate slots in said second plate.

One example of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a diagrammatic said elevational view, partly in section, of a centrifugal mechanism,

Figure 2 is a plan view of the mechanism shown in Figure 1 with parts thereof omitted for clarity, and

Figure 3 is a graph illustrating the operation of the mechanism shown in Figures 1 and 2.

Referring to the drawings, there is shown a centrifugal advance mechanism for use in an ignition distributor of an internal combustion engine.

The operating characteristics of the internal combustion engine require that the ignition timing be controlled in accordance with the graph shown in Figure 3 where engine speed is plotted along the horizontal axis and degrees of ignition advance is plotted on the vertical axis. The input shaft 11 of the mechanism is driven from the crank shaft of the engine, and the output shaft 12 of the mechanism operates the contact breaker assembly, or its equivalent, of the spark ignition system of the vehicle. The output shaft 12 additionally carries the sparking pulse distribution mechanism, conventionally a rotor arm. As can be understood with reference to Figure 3 the requirements are that in the rest condition of the engine there is zero degrees of advance. It is to be understood however that zero degrees of advance is zero degrees of advance of the output shaft 12 in relation to the input shaft 11, and does not necessarily represent the static ignition timing requirement of the engine. For example the static ignition timing of the engine may be 8 degrees before top dead centre, but for the purposes of this Specification references made only to the angular relationship of the output shaft 12 and the input shaft 11, and with the engine stationary the angular relationship of the shaft 12 to the shaft 11 is zero degrees of advance. It is required that until the engine speed reaches A revolutions per minutes there shall be no advance of the shaft 12 relative to the shaft 11. Between engine speeds A and B it is required that there shall be a gradual advance of the shaft 12 in relation to the shaft 11 until at speed B x degrees of advance has occurred. Thereafter, between speed B and speed C it is required that there should be no further advance, until speed C has been exceeded. Between speeds C and speed D there is required again to be a gradual increase in advance until at speed D the degree of advance is x degrees plus y degrees. After speed D it is required that there should be no further advance.

Referring now more specifically to Figures 1 and 2 the centrifugal mechanism input shaft 11 is formed with an axial extension 11a upon which is rotatably mounted a hollow output shaft 12. A first plate 13 is rigidly secured to the shaft 11 and extends transverse thereto, the shaft 11 extending from one face of the plate 13 and the extension 11a extending from the opposite face of the plate 13. At a pair of diametrically opposite points of equal radius the plate 13 carries first and second pivot posts 14, 15 extending parallel to the axis of rotation of the shafts 11, 12. Pivotally mounted on the posts 14, 15 are respective control weights 16, 17 the control weights 16, 17 being movable pivotally relative to the posts 14, 15 under centripetal force as the shaft 11 rotates.

Mounted at the lower end of the shaft 12 for angular movement relative to the shaft 12 about the axis of rotation of the shaft 12 is a second plate 18 lying parallel to, but spaced from the plate 13. A third plate 19 extending parallel to the plate 18 lies between the plate 18 and the control weights 16, and is rigidly secured to the output shaft 12. Between the third plate 19 and the first plate 13, and cooperating with the control weights 16, 17 is a plate-like cam member 21 which is rigidly secured to the plate 19 by means of posts 22, 23 extending parallel to the axis of rotation of the shafts 11, 12 in a direction away from the plate 13. The posts 22, 23 extend through arcuate slots 24, 25 in the plate 18 and terminate at a height above the plate

18 substantially equal to the height of termination of the posts 14, 15.

A first helically wound tension spring 26 is anchored at one end to the post 14, and at its other end to the post 22, and a second similar helically wound tension spring is anchored at one end to the post 23 and at its other end to an anchor post 28 upstanding from the plate 18. It will be recognised that since the plate 18 is angularly movable with respect to the shaft 12 it is also angularly movable with respect to the plate 19 and cam member 21. Thus the spring 27 urges the plate 18 to a rest position in relation to the output shaft 12, the rest position being defined by abutment between the posts 22, 23 and one end of each of the respective arcuate slots 24, 25. The spring 26 acting between the output shaft 12 and the input shaft 11 urges the shaft 12 to a rest position relative to the shaft 11 defined by abutment of the cam member 21 with the weights 16, 17, and abutment of the weights 16, 17 with stops provided either on the cam member 21 or on the extension 11<u>a</u> of the shaft 11 (the zero advance position of the mechanism).

When the parts of the mechanism are in their rest positions the spring 26 is arranged to be prestressed, and so even in the rest position applies a force to the posts 14, 22 drawing them towards one another. Similarly, in the rest position of the plate 18 relative to the output shaft 12 the spring 27 is stressed, it being appreciated that the springs 26 and 27 are assembled to the posts 14, 22 and 23, 28 in a pre-stressed condition.

The operation of the mechanism is as follows:-

With the parts in their rest position, and the shaft 11 commencing to rotate, then the shaft 12 rotates with the shaft 11, by virtue of the coupling defined by the weights 16, 17 and the cam member 21. Owing to the pre-stress in the spring 26 no movement of the shaft 12 relative to the shaft 11 occurs until a predetermined speed of rotation has been reached, at which speed the outward force exerted on the weights 16, 17 as a result of the rotation, overcomes the pre-stressing of the spring 26 (speed A). The shaft 12 and plate 19 of course move with the cam member 21 and so the shaft 12 is advanced angularly about the axis of rotation of the shaft relative to the shaft 11. At this stage the plate 18 moves with the shaft 12 since the spring 27 holds the ends of the slots 24, 25 against the posts 22, 23. As the speed of rotation of the shaft 11 increases the advance of the shaft 12 relative to the shaft 11 increases until a face 29 of the plate 18 abuts the post 15 of the plate 13 (speed B). Thereafter, as the speed of rotation of the shaft 11 increases further the plate 18 cannot move angularly with respect to the plate 13, and thus the spring 27 aids the spring 26 in resisting angular movement of the shaft 12 relative to the shaft 11. However, the force exerted by the weights 16, 17 continues to increase as the speed increases, and thus the force opposing the combined action of the springs 26, 27 increases. It will be recalled that the spring 27 is fitted to the posts 23, 28 with a predetermined pre-stress, and thus as the speed increases no additional advance movement of the shaft 12 relative to the shaft 11 occurs until the speed of rotation of the shaft 11 has increased to a speed such that the force exerted by the wieghts 16, 17 overcomes the pre-stressing of the spring 27 (speed C). Thereafter, as the speed increases the cam member 21 is moved further by the weights 16, 17 carrying the plate 19 and the shaft 12 with it. The plate 18 no longer moves, because of its abutment with the posts 15, and thus the posts 22, 23 move along the length of their arcutate slots 24, 25. The degree of advance of the shaft 12 thus increases with further increasing speed until the posts 22, 23 abut the far ends of their respective slots 24, 25 (speed D) at which point no further movement of the member 21, and therefore the shaft 12, relative to the plate 13 and therefore the shaft 11 can occur. Thus any further increase in speed does not generate a further increase in advance of the shaft 12 relative to the shaft 11.

It will be recognised that as the speed of rotation of the shaft 11 gradually decreases then the advance of the shaft 12 in relation to the shaft 11 also decreases, the relationship between the advance of the shaft 12 and the speed of rotation of the shaft 11 always being in accordance with the characteristics illustrated by the graph of Figure 3.

It is to be understood that the dimensions of the components shown in Figures 1 and 2, in particular the spacing between the surface 29 and the post 15, and the lengths of the slots 24, 25 is not necessarily strictly in accordance with the dimensions on the graph in Figure 3, the dimensions in Figures 1 and 2 and the graph in Figure 3 being shown purely for purposes of explanation.

CLAIMS:

1. A centrifugal advance mechanism including an input shaft, an output shaft which is to rotate with the input shaft and whose angular relationship with the input shaft is to be varied in accordance with the rotational speed of the input shaft, the input and output shafts having a common axis of rotation, a first plate fixed in relation to the input shaft so as to rotate therewith, a weight mounted on the first plate for pivotal movement relative thereto about an axis parallel to said rotational axis, a cam member fixed in relation to said output shaft so as to rotate therewith, said cam member being engaged by said weight and being movable thereby as a result of pivotal movement of the weight and thus effecting angular movement of the output shaft relative to the input shaft about said rotational axis, and, a first tension spring acting between said first plate and said output shaft and urging said output shaft angularly to a rest position relative to said input shaft, characterized in t hat a second plate 18 is capable of angular movement about said rotational axis relative to said input shaft 11 and said output shaft 12, and there is provided a second tension spring 27 acting between the output shaft 12 and the second plate 18 and urging the second plate 18 with predetermined force to a rest position defining one limit of the permitted angular movement of the second plate 18 relative to the output shaft 12, and, abutment means 15, 29 restricting angular movement of the second plate 18 relative to the first plate 13, whereby as the rotational speed of the input shaft 11 increases from zero, said weight 16, 17 pivots under the action of centrifugal force relative to said first plate 13 thus moving said cam member 21 and the output shaft 12 angularly relative to the input shaft 11 while rotating with the input shaft 11, against the action

of said first tension spring 26, said second tension spring 27 constraining said second plate 18 to remain in its rest position relative to said output shaft 12, and the angular displacement of the output shaft 12 with respect to the input shaft 11 increasing as the speed of rotation increases until said abutment means 15, 29 prevents further movement of the second plate 18 with the output shaft 12 relative to the input shaft 11 whereupon the angular displacement of the output shaft 12 relative to the input shaft 11 remains constant until the speed of rotation has increased sufficiently to overcome said predetermined force generated by said second spring 27, whereupon said output shaft 12 and said cam means 21 is moved by said weight 16, 17 against the combined action of the first and second tension springs 26, 27 further to increase the angular displacement of the output shaft 12 with respect to the input shaft 11 with further increasing speed of rotation of the input shaft 11.

2. A mechanism as claimed in claim 1 characterised in that a first anchor post 14 extends from said first plate 13 parallel to said axis of rotation, a second anchor post 22 extends parallel to said first anchor post 14 from the cam member 21, and said first spring 26 is coupled at one end to the first anchor post 14 and at its other end to the second anchor post 22.

3. A mechanism as claimed in claim 2 characterised in that a third anchor post 23 extends from said cam member 21 parallel to said axis of rotation, and a fourth anchor post 28 extends from said second plate 18 parallel to said third anchor post 23, said second spring 27 being coupled at one end to the third anchor post 23 and at its other end to the fourth anchor post 28.

4. A mechanism as claimed in any one of the preceding claims characterised in that a second weight 17 is pivotally mounted on said first plate 13 for movement about an axis parallel to the pivotal axis of the first mentioned weight 16.

5. A mechanism as claimed in claim 4 wherein one of said first and second weights 16, 17 is pivotally mounted on said first anchor post 14.

6. A mechanism as claimed in claim 3, or in claim 4 or claim 5 where dependent upon claim 3, characterised in that a third plate 19 is rigidly secured to said output shaft 12, and said cam member 21 is rigidly secured to said third plate 19 by means of said second and third anchor posts 22, 23.

7. A mechanism as claimed in claim 3, or in any one of claims 4 to 6 where dependent upon claim 3, characterised in that said first and second plates 13, 18 and said cam member 21 extend parallel to one another, said cam member 21 lies between the first and second plates 13, 18, and said second and third anchor posts 22, 23 extend through arcuate slots 24, 25 in said second plate 18.

FIG.1.

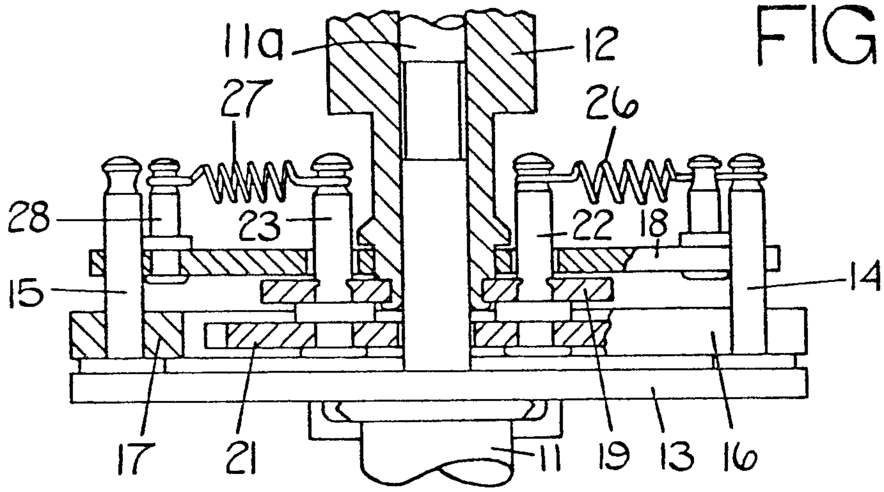


FIG.2.

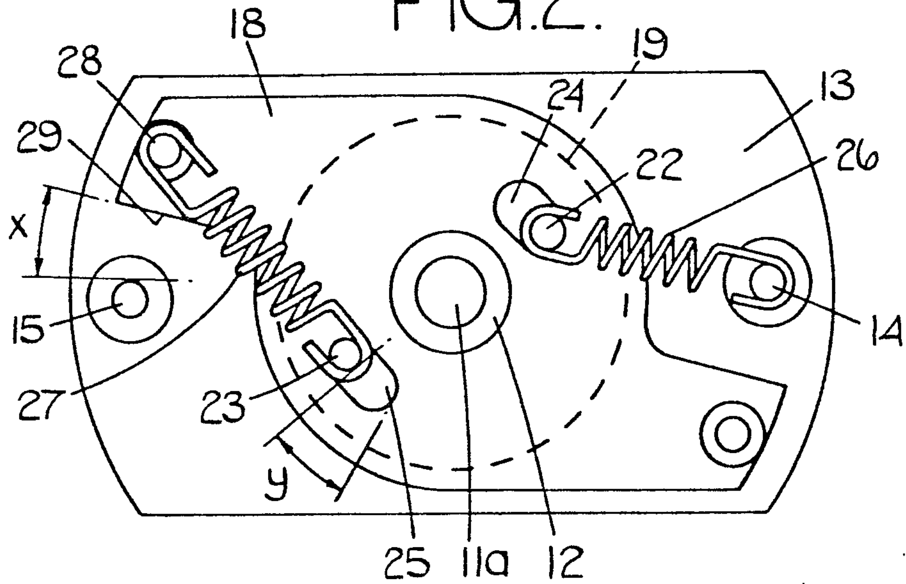
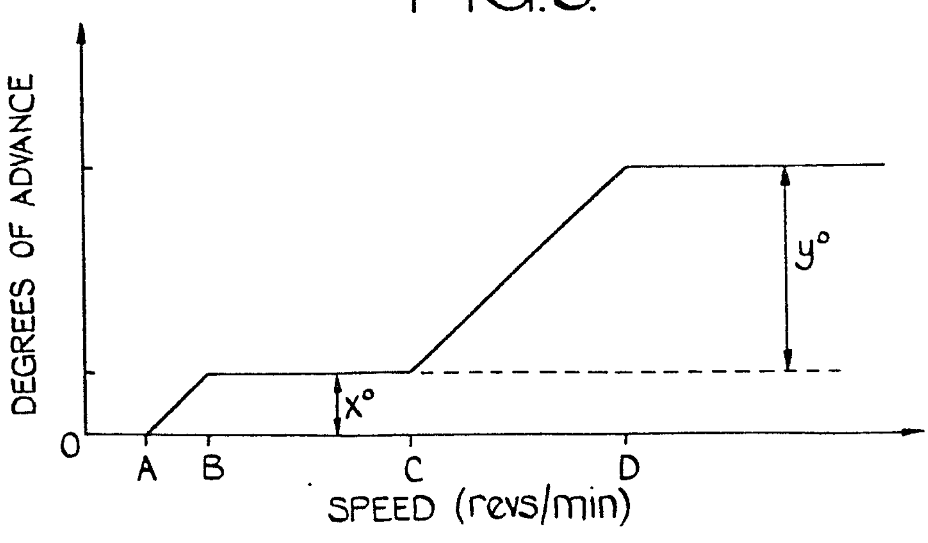


FIG.3.



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EUROPEAN SEARCH REPORT

Application number

EP 80 30 3090.7

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	FR - A1 - 2 368 616 (DUCELLIER ET CIE) * complete document * --	1-4, 7
	DE - A1 - 2 802 097 (HITACHI) * complete document * ----	1,4

CLASSIFICATION OF THE APPLICATION (Int Cl 3)

F 02 P 5/04

TECHNICAL FIELDS SEARCHED (Int Cl 3)

F 02 P 5/04

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
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T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	18-12-1980	BORRELLY