United States Patent

Baumann

[15] **3,652,832**

[45] **Mar. 28, 1972**

[54] ARRANGEMENT FOR CONTROLLING PROCESSES WHICH ARE DEPENDENT UPON THE ANGULAR POSITION OF A ROTATING MEMBER

[72] Inventor: **Gunther Baumann**, Stuttgart, Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany

[22] Filed: **Feb. 26, 1970**

[21] Appl. No.: **14,513**

[30] **Foreign Application Priority Data**

Feb. 26, 1969 Germany ..... P 19 09 525.1

[52] **U.S. Cl.** ..... **235/92 MP**, 235/92 R, 235/92 CV, 235/92 EV, 235/92 PE, 235/92 T, 340/347 P

[51] **Int. Cl.** **G06m 1/274**, G06m 3/14

[58] **Field of Search** ..... 235/92 DN, 92 PE, 92 MP, 92 EV; 340/347 AD, 174.1 C, 174.1 A, 271

[56] **References Cited**

UNITED STATES PATENTS

3,024,986	3/1962	Strianese	235/92 DN
3,163,747	12/1964	Veverka	235/92 PE
3,065,461	11/1962	Aronis	340/174.1 A
3,131,383	4/1964	Brandt	340/174.1 C

Primary Examiner—Maynard R. Wilbur
Assistant Examiner—Robert F. Gnuse
Attorney—Michael S. Striker

[57] **ABSTRACT**

In a motor vehicle a rotating disk has marking which are sensed, converted to pulses and applied to a counter which has been reset. The counter furnishes a control signal when the counted number of pulses is equal to the preset number. The counter is preset by applying pulses from an oscillator during the time a monostable multivibrator is in the unstable state. This depends upon at least one operating parameter of the motor vehicle.

11 Claims, 2 Drawing Figures

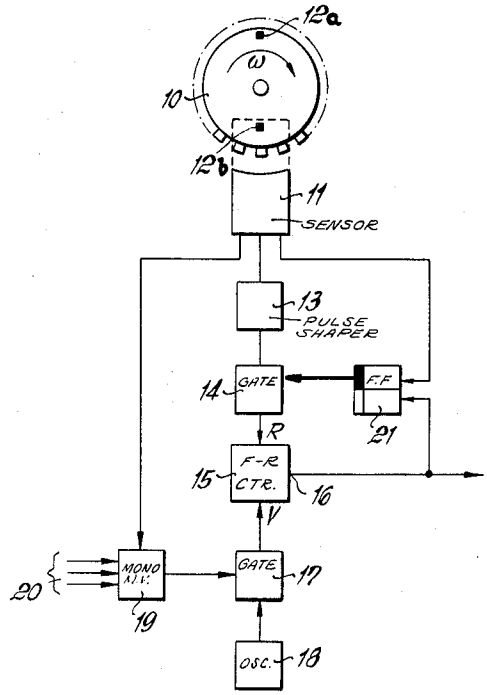
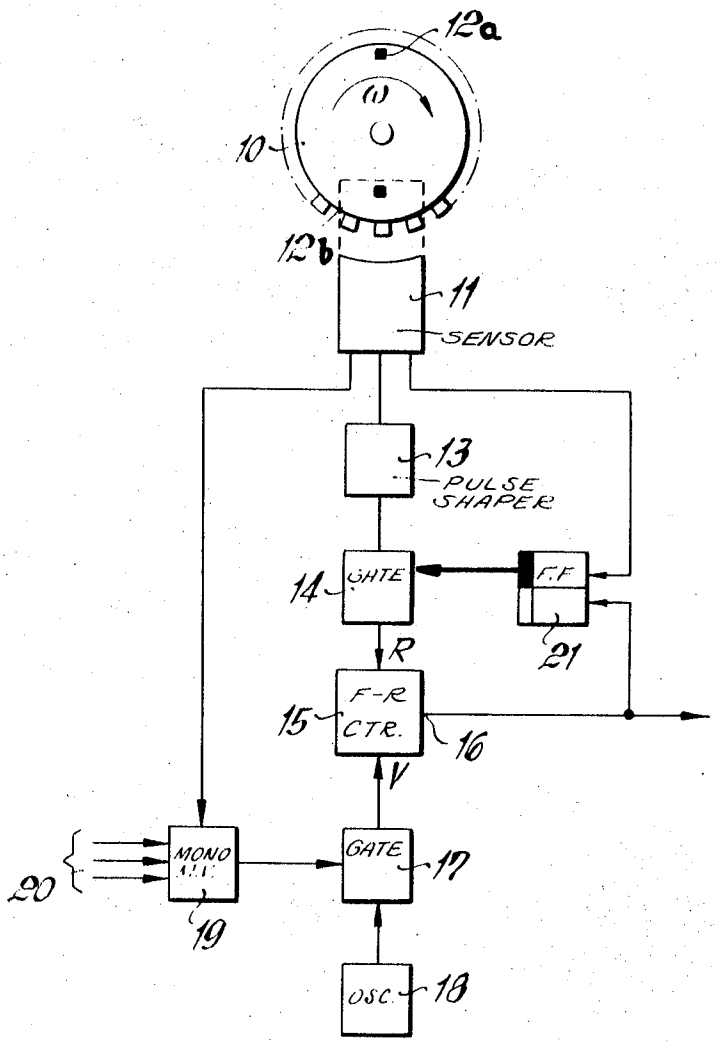
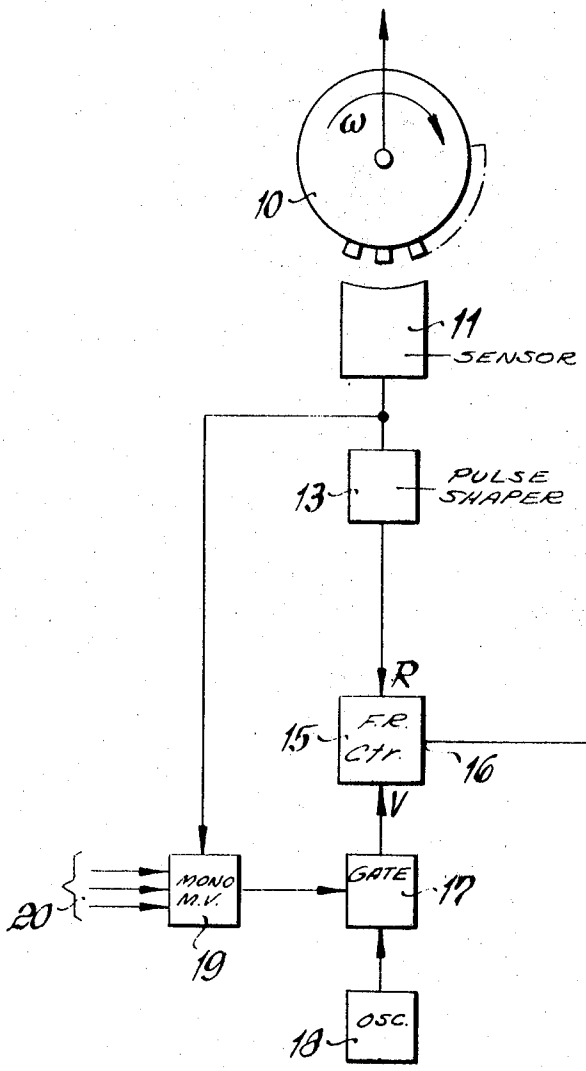


FIG. 1



INVENTOR
Günther BAUMANN
BY
Michael Hahn
his ATTORNEY

FIG. 2



INVENTOR
Günther BAUMANN
BY
Michael J. Striker
HIS ATTORNEY

ARRANGEMENT FOR CONTROLLING PROCESSES WHICH ARE DEPENDENT UPON THE ANGULAR POSITION OF A ROTATING MEMBER

BACKGROUND OF THE INVENTION

This invention relates to a system having a rotating element and at least one other element whose operation is timed in dependence upon the angular position of said rotating element relative to a reference position. In particular, it refers to a motor vehicle wherein a number of elements have an operation which is controlled in dependence upon the angular position of rotating elements.

There are many systems in which an element of such system must be controlled periodically. As an example of such systems, is a motor vehicle in which the injection of fuel or the ignition are controlled. In order to accomplish this, control signals must be generated at a time period depending upon the angular position of the crank shaft. These control signals cannot however be correlated with a particular angular position of the crank shaft, but this angular position of the crank shaft at which the control signals are generated must depend upon the particular operating conditions of the motor. Systems are known in which a monostable multivibrator is set to the unstable condition at a determined angular position of the particular rotating element in question. The time interval in which the monostable circuit means remain in the unstable position, depends upon at least one operating parameter of the engine. If now the control signal is furnished when the monostable multivibrator returns to its original position, then it is obvious that the time at which the control signal is finally furnished will depend upon a particular operating parameter of the motor. This arrangement has the disadvantage that the time in which the monostable multivibrator remains in the unstable state must vary as a first approximation inversely proportionally to the speed of the motor, in order that the angle through which the rotating element passes during the time the monostable multivibrator is in the unstable state, remains substantially constant. Since the speed of a motor may, in practice, vary in a ratio of 1 : 50, the time that the monostable multivibrator remains in the unstable state must be variable in a ratio of 50 : 1, even if variations in the time interval depending upon operating parameters of the engine are not considered. The conventional arrangement must therefore operate within very precise tolerances. It further requires substantial amounts of additional equipment in order to vary the time of the control signal generation in dependence upon other operating parameters of the motor.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a control arrangement for a system having a rotating element and at least one other element whose operation is to be timed in dependence upon the angular position of said rotating element relative to a reference position. The control arrangement comprises auxiliary pulse generating means associated with said rotating element and adapted to furnish a predetermined number of auxiliary pulses during each rotation of said rotating element. It further comprises counting means for counting said auxiliary pulses and furnishing a control signal when the number of counted auxiliary pulses is equal to a preset number. The presetting of the counting means to a preset number may be achieved by means of an oscillator which furnishes set pulses. In one embodiment of the control arrangement, in accordance with this invention, the counting means comprise a first and second counter. The first counter receives the auxiliary counting pulses, while the second counter receives the set pulses. As soon as both counters have the same number entered during each rotation, the control signal is generated.

In another embodiment of the present invention, the counting means may comprise a forward-reverse counter. The set pulses may be applied to the forward counting input, while the auxiliary pulses are applied to the reverse counting input of such a forward-reverse counter. In this case, the control signal is generated whenever the counter is in the zero condition. After the control signal has been generated, the set and auxiliary pulses may be applied at least in part simultaneously to, respectively, the forward and reverse counting inputs.

In practice, the rotating element may be mechanically connected to a disk which has markings either around its circumference or on its upper surface. These markings may be either electrical or mechanical and are sensed by sensing means. In addition to markings for generating the auxiliary pulses, the disk may have additional markings for furnishing start and release pulses whose function will be explained below. In a further extension of the present invention, the rotating disk may have markings on only a part of its circumference, and the beginning and the end of such markings, may be used to furnish the above-mentioned start and release pulses. In such an embodiment, sensing means for sensing the start pulses are not required and the beginning of the counting of the auxiliary pulses is determined by the beginning of these pulses themselves. In order to control the counting process, the reverse counting input of the counter may be connected to the auxiliary pulse generating means by means of second gating means, while the forward counting input of the counter is connected to the oscillator furnishing the set pulses by means of first gating means. The first and second gating means are rendered conductive in dependence upon the release and start pulse respectively.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows a block diagram of an embodiment of the present invention using two gating means; and

FIG. 2 is a block diagram of a simplified embodiment, using only a single gating means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the present invention will now be discussed with reference to the drawing.

In FIG. 1, a disk **10** is shown which rotates at an angular velocity ω. The disk has markings along its circumference which, when sensed by sensing means **11**, furnish the auxiliary pulses. The disk has further markings **12***a* and **12***b* for generating the start and release pulse, which will be further discussed below, respectively. It will be noted that marking **12***b* is at a different radial distance from the center of disk **10** as is the marking **12***a*. Within sensing means **11**, separate sensing means are provided for sensing each of said markings. The markings around the circumference, which furnish the auxiliary pulses after sensing by sensing means **11**, are then applied to pulse-shaping means **13** which shape them for use in subsequent circuitry. The output of the pulse-shaping means **13** is connected with the input of second gating means **14**. The output of the second gating means **14** is connected to the reverse counting input of forward-reverse counting means **15**. The forward-reverse counting means, here a counter **15**, has an output **16**, on which a control signal appears when the counter is in its zero position. The forward counting input of the counter **15** is connected to the output of the first gating means, gate **17**, whose input is connected to the output of oscillating means, namely an oscillator **18**. Monostable circuit means, namely a monostable multivibrator **19**, controls the conductivity of the first gating means. The monostable multivibrator **19** is switched to its unstable state by means of release pulses furnished by sensing means **11** in response to a marking **12***b*. The arrows labeled **20** indicate that the amount of time the monostable multivibrator **19** remains in the unstable state, is dependent upon a number of operating parameters

of the system of which the present control arrangement is a part. The second gating means, namely gate **14**, is controlled by means of bistable circuit means, here a flip-flop **21**. Flip-flop **21** in turn receives start pulses for switching it to a set position and the control signal, namely the output of counter **15** available at terminal **16**, for resetting purposes.

The arrangement shown in FIG. **1** operates as follows:

During the rotation of disk **10**, auxiliary pulses are generated continuously. Further, during each rotation, one start pulse and one release pulse is generated. It will be assumed that counter **15** is in its zero position at the beginning of operation and that the sensing means **11** generate a release pulse in response to a marking **12***b* which switches the monostable multivibrator **19** to the unstable state. In this state, gate **17** becomes conductive and allows pulses from oscillator **18** to be applied to the forward counting input of counter **15**. The pulses furnished by oscillator **18** are herein referred to as set pulses. The number of pulses which reach counter **15** from oscillator **18** depends upon the length of time the monostable multivibrator **19** is in the unstable state. The count entered into counter **15** remains in the counter until a start pulse is furnished when marking **12***a* passes the sensing means coordinated therewith. This start pulse switches the flip-flop **21** to its set condition causing gate **14** to become conductive and permit passage of auxiliary pulses from pulse shaper **13** to the forward counting input of counter **15**. The count in counter **15** is thus decreased until the zero position is reached. At this point the control signal appears at output **16**. This control signal is used for controlling a process within the system, as for example controlling the start of a fuel injection in a motor vehicle. Alternatively, it may control the ignition in an internal combustion engine. Many other possibilities exist. The preceding two examples were examples only. The control signal is further used to reset flip-flop **21**, thus closing gate **14**. The position of the start marking **12***a*, when a start pulse is generated by the sensing means, may constitute a reference position of the disk. The angle or position of the disks may then be referred to this reference position. A rotational angle of the disk may thus be considered the angle passed through by one of the markings **12** in the time period in which the counter **15** counts down to zero. The number of auxiliary pulses generated during a complete rotation of disk **10** remains constant regardless of the rotational speed of the disk. Thus, the angle, and correspondingly, the time, at which a control signal is furnished, is always correctly determined by the number of auxiliary pulses following a start pulse. As stated above, the operating parameters whose presence is indicated by arrows **20**, influence the time that the monostable multivibrator **19** is in the unstable state. Thus they also influence the time that gate **17** is conductive. Since the oscillator **18** operates at a constant frequency, the count on counter **15** will depend upon the length of time that multivibrator **19** is in the unstable state. Thus it is possible to vary the timing at which the control signal is furnished by varying the count in counter **15** at the beginning of the reverse counting. The timing of the control signal is a function only of the angle through which the disk has passed, and a changing speed of the disk does not exert any influence.

In another embodiment of the present invention, the monostable multivibrator **19** may be switched to the unstable state when gate **14** is blocked.

FIG. **2** shows an alternative embodiment of the present invention which is simplified relative to the embodiment shown in FIG. **1**. It will shown that gate **14** and the bistable circuit means **21** are omitted. Otherwise the same components are present as are present in FIG. **1**. However, the markings which result in the generation of auxiliary pulses are situated on one predetermined part of the circumference of the disk only. The remainder of the circumference has no markings. The reverse counting commences as soon as the markings for the auxiliary pulses are sensed by sensing means **11**. The monostable multivibrator **19** is switched to the unstable state whenever the generation of auxiliary pulses stops. When the monostable multivibrator is in the unstable state, counter **15** is supplied with set pulses from oscillator **18** as previously described. When processes within the system are to be controlled in a completely electronic manner, the arrangement shown in FIG. **2** is generally preferable. If, however, the markings **12***a* and **12***b* generate pulses at least partly in a mechanical manner, then the arrangement of FIG. **1** may be preferable. For example, in an internal combustion engine, the distributor may have mechanical markings. If such an ignition system is to be retained, and only the fuel injection times are to be controlled by means of an electronically controlled injection system, then the electronic-mechanical arrangement results. If, however, the ignition time of an internal combustion engine is controlled purely electronically, then the markings **12** on disk **10** may of course be omitted. In order that the best possible correspondence exists between the conditions required by the operating parameters indicated by **20**, it is desirable that the set pulses be furnished to the counter as closely to the beginning of the reverse counting procedure as possible.

The embodiments shown in FIG. **1** and **2** should not be construed as limiting the application of the present invention, since, for example, instead of a forward-reverse counter, two counters could be used and the control signals could be furnished when the count on both counters is equal.

Further, pneumatic or hydraulic solutions exist which operate in accordance with the principles set forth in this disclosure.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a system having a rotating element and at least one other element whose operation is timed in dependence upon the angular position of said rotating element relative to a reference position, a control arrangement, comprising, in combination, disk means connected to said rotating element for synchronous rotation therewith, said disk means having a plurality of first markings and first and second further markings; first sensing means for sensing said first markings and generating auxiliary pulses in response thereto; second sensing means for sensing said first and second further markings and generating, respectively, a release and start pulse in response thereto; oscillator means for generating set pulses; forward-reverse counting means having a forward counting input and a reverse counting input, said counting means furnishing a control signal for controlling said operation of said other element when the count entered therein is a predetermined count; first gating means connecting said oscillator to said forward counting input; second gating means connecting said first sensing means to said reverse counting input; and means connecting said second sensing means to said first and second gating means in such a manner that said release and start pulses control said first and second gating means respectively.

2. A system as set forth in claim **1**, wherein said system is a motor vehicle.

3. In a system having a rotating element and at least one other element whose operation is timed in dependence upon the angular position of said rotating element relative to a reference position, a control arrangement, comprising, in combination, disk means connected to said rotating element for synchronous rotation therewith, said disk means having a plurality of markings; sensing means for generating auxiliary pulses in response to said markings during a predetermined portion of the angular rotation of said disk; oscillator means for generating set pulses; forward-reverse counting means having a forward counting input and a reverse counting input

and furnishing a control signal for timing said operation of said other element when the count on said counting means is a predetermined count; first connecting means connecting said oscillator means to said forward counting input in the absence of said auxiliary pulses; and second connecting means connecting said sensing means to said reverse counting input upon the start of generation of said auxiliary pulses.

4. In a system having a rotating element and at least one other element timed in response to a control signal furnished when the angular position of said rotating element is a predetermined position relative to a reference position, a control arrangement, comprising, in combination, auxiliary pulse generating means associated with said rotating element and adapted to furnish a predetermined number of auxiliary pulses during each rotation of said rotating element; counting means for counting said auxiliary pulses and furnishing said control signal when the counted number of auxiliary pulses during a rotation is equal to a preset number; oscillator means for generating set pulses for presetting said counting means to said preset number; first monostable circuit means having a stable and an unstable state, and adapted to remain in said unstable state for a time interval depending upon at least one operating parameter of said motor vehicle; and first gating means interconnecting said oscillator means and said counting means under control of said monostable circuit means in such a manner that set pulses are transmitted from said oscillator means to said counting means only when said monostable circuit means is in said unstable state.

5. A system as set forth in claim 4, wherein said counting means comprise a first and second counter; further comprising connecting means for connecting said auxiliary pulse generating means to said first counter; and additional connecting means for connecting said oscillator means to said second counter; and wherein said control signal is furnished when the count on said first counter is equal to the count on said second counter.

6. A system as set forth in claim 4, wherein said set pulses and said auxiliary pulses are applied to said counting means at least in part simultaneously.

7. A system as set forth in claim 4, further comprising means for switching said monostable circuit means to the unstable state during each rotation of said rotating element.

8. A system as set forth in claim 7, wherein said auxiliary pulse generating means comprise a disk mounted for synchronous rotation with said rotating element, said disk having markings for generating said auxiliary pulses, said disk having a further marking for generating a release pulse; release pulse sensing means for sensing said further marking and furnishing a release pulse in response thereto; and additional connecting means for connecting said release pulse sensing means to said monostable circuit means in such a manner that a release pulse causes said monostable circuit means to be switched to said unstable state.

9. A system as set forth in claim 7, further comprising second gating means connecting said auxiliary pulse generating means to said counting means.

10. A system as set forth in claim 9, further comprising bistable circuit means for controlling said second gating means, said bistable circuit means having a set state wherein said second gating means permits transmission of said auxiliary pulses to said counting means and a reset state wherein said second gating means blocks transmission of said auxiliary pulses to said counting means; wherein said bistable circuit means is switched to said reset state by said control signal; further comprising means for furnishing a start signal for switching said bistable circuit means to the set state at a predetermined start time during each rotation of said rotating element.

11. A system as set forth in claim 10, wherein said monostable circuit means is switched to the unstable state when said bistable circuit means is in said reset state.

* * * * *