

The subject of the present invention is a device which, inserted into a chain of functionally aligned elements, ensures the deviation from alignment of this chain as well as, on command, its realignment.

5           A device of this type can be used, especially, to ensure safety in an initiation system of an explosive charge.

10           In fact, an explosive charge is generally equipped with an initiation system which permits controlled detonation of the explosive at the desired moment and under the desired conditions. Initiation systems customarily consist of small explosive charges arranged in cascade or as a chain: an electrical or mechanical device permits initiation of a detonator which transmits  
15 its detonation to a series of pyrotechnical elements of increasing powers, such as relays and pulses, before initiating the explosive charge.

20           The initiation system is said to be "armed" when it is ready to cause the detonation of the explosive charge, that is to say when all its elements are in the required positions or are released in order to assume them, so that the system can function in the envisaged manner.

25           In order to prevent accidental initiation during operations of handling, transportation or firing, the pyrotechnical chain is interrupted, for example by deviation from alignment of one of its elements, such that, if the detonator detonates, the premature explosion of the explosive charge is prevented.

30           The known means for causing the arming of an initiation system generally use a stored, electrical or mechanical, energy which risks deteriorating or being released in the event of extended storage, above all in severe vibrational or climatic environments.

35           Among the known solutions, mention may be made of that described in document US-A-2,742,859, which relates to a fuse for a bomb. This fuse is actuated mechanically on impact and comprises diverse mechanical elements

intended to keep the detonator in a safety position, which is out of alignment, until the bomb is jettisoned; after jettisoning, arming is effected by means of a propeller fixed to the bomb.

5           Still among the known solutions, mention may be made of that of document US-A-2,409,205, which also describes a fuse for a bomb whose purpose is similar to the preceding one.

10           The subject of the present invention is an aligning device which, when it is applied to an initiation system for an explosive charge, makes it possible to prevent the preceding drawbacks.

More precisely, the subject of the invention is an aligning device as defined in Claim 1.

15           Further subjects, particular features and results of the invention will emerge from the following description which is given by way of non-limiting example and illustrated by the appended drawings, which represent:

20           - Figure 1, an embodiment of the aligning device according to the invention;

- Figure 2, the illustration of a variant embodiment of the preceding figure;

25           - Figures 3a, 3b and 3c, an embodiment of a locking and safety device capable of being used in the device according to the invention.

In these various figures, the same reference numerals relate to the same elements.

30           Figure 1 thus represents an embodiment of the aligning device according to the invention. In this figure, a shaft 1 has been represented, known as the entry shaft, extending via a threaded part 10 forming a worm, the shaft 1 being capable of rotating about a longitudinal axis 12. The shaft 1 is carried, for example, by a frame 13 via a piece 11 forming a stop.

35           The device also comprises a toothed pinion 2 which is internally threaded to receive the worm 10.

The device further comprises a barrel 3, substantially in the shape of a disc, capable of rotating about

an axis 40 which is substantially parallel to the axis 12 and passes through the centre of the disc. The barrel 3 comprises a bore 31 which is not coaxial with its axis of rotation 40, in which the pinion 2 is inserted.

5           The device comprises, moreover, means 4 capable of interacting with the pinion 2, such as a disc which is toothed at least over a part of its periphery, forming a sector, as represented in the figure. The sector 4 has the same axis (40) as the barrel 3 and is integral with  
10 the latter.

          The device further comprises a detonator 50, carried by a frame which is not represented, and a relay 54 carried by a frame 14 located on the same axis 53 as the detonator 50. The elements 50 and 54 are arranged  
15 such that they are separated by the barrel 3. The latter further carries a relay 51, intended to be aligned, on command, by the device according to the invention, with the elements 50 and 54 on the axis 53.

          The device functions as follows:

20           In the figure, the different components have been represented in their initial position, not in alignment. In this position, the barrel 3 serves as a mask between the detonator 50 and the relay 54.

          When a rotational movement is conferred on the  
25 entry shaft 1, which movement constitutes the realigning command, the worm 10 causes, by rotating, the translational movement (arrow 20) of the pinion 2. In fact, the sector 4, interacting with the teeth of the pinion 2, blocks the latter in rotation while the pinion is engaged  
30 in the bore 31 of the barrel 3. The translational movement of the pinion 2 continues until the latter is clear of the barrel 3 and abuts on the piece 11. At this moment, the pinion is no longer driven except in rotation, driving the sector 4 in rotation and,  
35 consequently, the barrel 3 in rotation. The total angle of rotation of the barrel is, of course, a function of the part of the sector 4 which is toothed, as well as of the initial position of the latter on the pinion 2. In

the final phase, the pinion 2 escapes from the toothed sector 4 and enables the entry shaft 1 to continue rotating; this enables the shaft 1 to perform other optional functions without adversely affecting the alignment of the priming system.

The effect of the rotational movement is represented by dotted arrows on the barrel 3: the relay 51 is then aligned (dotted line 52) on the axis 53 with the elements 50 and 54, thus realigning the pyrotechnical chain 50, 51 and 54 on the axis 53, the chain then being ready to function.

In the configuration of Figure 1, when the power of the detonator 50 is sufficient, the relay 51 may be replaced by a simple orifice, allowing the detonation to pass through.

It should be noted that the time of rotational movement of the pinion is virtually negligible when compared with its time of translational movement, the latter thus representing substantially the time for aligning the chain.

Figure 1 also represents different locking and safety devices capable of being used individually or in combination in the device according to the invention.

It is thus that the rotation of the barrel 3 enables a spring 74, stored in the free state, to store the energy which, partially restored, serves for blocking the barrel in the aligned position by virtue of a suitable notch 33 for receiving a finger forming a bolt 73, permitting blocking of the barrel 3 in a position corresponding to the desired alignment.

Also represented is a finger 71, carried by the frame 14, inserted in a notch 32 of the barrel 3. This finger constitutes a locking device capable of being unlocked through the action of an acceleration.

Another locking device has further been represented in the form of a finger 72 bearing on the worm 10 at the level of the pinion 2, intended to prevent any translational movement of the latter. This finger is

used, for example, to ensure the safety of the device during its storage and it is removed during its use.

In a variant embodiment also represented in Figure 1, this structure may be used to realign a second  
5 pyrotechnical chain: the barrel 3 then comprises a percussion detonator 61, arranged so as to be brought into alignment with the axis 12 upon rotation of the barrel. The device then, furthermore, comprises a relay 62 carried, for example, by the frame 14 and aligned on  
10 the axis 12. This chain is then initiated by the percussion of the pinion 2 or of the worm 10 on the detonator 61 upon, for example, impact of the projectile.

More generally, the system according to the invention permits the alignment of a second chain of  
15 elements or of a third chain or of an  $n^{\text{th}}$  chain, each of the chains not necessarily being initiated by the same principle (percussion in the preceding example).

If a device of this type is used in a projectile, the explosive charge is, for example, arranged behind the  
20 frame 14, in contact with the relay 54. In the same type of application, the realignment command, that is to say the rotation of the shaft 1, is, for example, supplied by a turbogenerator, ensuring, moreover, the electrical supply to the projectile, set in motion by the projectile  
25 on its trajectory, this being effected, optionally, by means of an angular speed reducing or increasing system.

Figure 2 represents a variant embodiment of the device according to the invention.

In this figure, the detonator 50 and the relay 51  
30 have been replaced, respectively, by a detonator 56 and an end plate 55 for the electrical supply.

In addition, the variant consisting in producing a second chain with the aid of the elements 61 and 62 in Figure 1 has not been represented, nor have the various  
35 safety and locking devices 71 to 73 in Figure 1.

Functioning of this device is similar to the preceding functioning: rotation of the barrel 3 causes alignment on the axis 53 which is common to the elements

55, 56 and 54; in this manner, the detonator 56, aligned with the relay 54, is capable of receiving the electrical energy necessary for its detonation by means of the end plate 55.

5           Figures 3a, 3b and 3c represent an embodiment of a locking and safety device capable of being used in the device according to the invention, in various phases of its functioning.

10           In Figure 3a, the system has been represented in its initial storage, non-armed, state.

15           In this figure, the barrel 3, of axis 40, equipped with its toothed sector 4 and with the bore 31 in which the pinion 2 is arranged may be seen again. Rotation of the barrel 3 is blocked by the finger 71 and, more precisely, by the lower bulged part of this finger, referenced 87, which is engaged in the notch 32 of the barrel. A plate 90 is arranged on the worm 10, screwed into the pinion 2.

20           The locking and safety device comprises the finger 71 and the finger 72, the movements of which are rendered dependent on one another by a shutter 81 in the following manner. The upper part of the finger 71 comprises a groove 86 interacting with a tongue 83 of the shutter 81 such that any vertical movement of the finger 25 71 is prevented. The lower front part 96 of the shutter 81 interacts with a cutout 95 made in the finger 72 so that any rotational movement of the shutter 81 about its axis 97 gives rise to a translational movement of the finger 72. The device further comprises a spring 84, 30 fixed at one of its ends (85) on the shutter 81 and at its other end on a frame to which the whole device is fixed, the spring being, for example, of helical type with axis 97. Finally, the finger 72 is extended by a small blade 88 substantially parallel to the plate 90 and 35 positioned, in the rest position, substantially on the plate 90 opposite a stud 91 arranged on this plate. In this manner, the small blade 88, interacting with the stud 91, prevents rotation of the plate 90.

By way of example, the shutter 81, the finger 72, the plate 90 and the top of the finger 71 may be located, with reference to Figure 1, to the left of the frame 13; a bore 92 is then provided in the frame 13 in order to allow the finger 71 to pass; the bottom of the finger 71 (Figure 3a) and the barrel 3 are located, as represented in Figure 1, to the right of the frame 13. A spring 91 (partially represented) is arranged between the frame 13 and the bottom (93) of the groove 86 in order to hold the finger 71 in the high position.

In this storage position, a protection cap, of which only the broken lateral line 89 has been represented, is nested over the whole device, from top to bottom, and it is arranged so as to drive in the finger 72 (arrow 100). This action gives rise to an angular displacement of the shutter 81 about its axis 97 (arrow 101), causing the tongue 83 to penetrate into the groove 86 while stressing the spring 84. The finger 71 thus abuts mechanically upwards due to the spring 91; it opposes any rotation of the barrel 3 (via the notch 32); finally, the finger 72 blocks the rotation of the worm 10 (via the small blade 88, the stud 91 and the plate 90).

Figure 3b represents the same device when the storage cap is removed.

Upon removal of the cap, the shutter 81, through the action of the spring 84, rotates by a few degrees (arrow 102) and releases the groove 86 of the finger 71. The heel 82 of the shutter 81 then abuts laterally against the head 94 of this same finger. During this movement, the shutter 81 causes a slight translational movement (dx) of the finger 72 (arrow 103), which translational movement is insufficient to permit rotation of the worm 10: in fact, the small blade 88 always prevents free rotation of the stud 91 of the plate 90.

It thus appears that the finger 71 is held free in translation, but blocks the rotation of the shutter 81.

Figure 3c represents the device in the released position, that is to say when the finger 71 is retracted downwards (arrow 103) through the effect, for example, of an acceleration. Its lower bulge 87, which, hitherto, locked the barrel 3, is now disengaged from the notch 32 and thus permits a possible rotation of the barrel. The upper end 94 of the finger 71, having escaped from the heel 82 of the shutter 81, enables this shutter to continue its rotation (arrow 104) until it is in an abutting position. This has two consequences:

- the finger 71, driven in, can no longer rise up despite its return spring 91: it is, in effect, blocked by the heel 82;
- the finger 72, driven in translation by the shutter 81 (arrow 105) totally releases the plate 90 and the stud 91, which then permits rotation of the plate/worm/pinion assembly in order to operate its arming function when the time comes.

The locking device described hereinabove makes it possible, moreover, to perform a test of the finger 71 through the effect of an acceleration, then to return the assembly into its initial position simply by pressing on the end of the finger 72 and replacing the cap, without requiring any dismantling.



CLAIMS

1. Device for aligning, on command, one element with a chain of elements, comprising:
- an internally threaded pinion (2);
  - 5 - a worm (10) screwed into the pinion;
  - a barrel (3) whose axis of rotation (40) is substantially parallel to that of the pinion, carrying the element to be aligned (51, 56, 61);
- 10 the device being characterised in that the barrel comprises a bore (31) in which the pinion is capable of being engaged;
- means (4) having the same axis as the barrel and integral with the latter, interacting with the pinion in order:
- 15 \* to block the rotation of the pinion when the latter is engaged in the barrel;
- \* to impart to the barrel a rotational movement through the action of the pinion when the latter is released from the barrel; the command consisting of the
- 20 application of a rotational movement to the worm which results in a translational movement of the pinion until it is released from the barrel, then, in a second phase, a rotation of the barrel capable of thus ensuring the desired alignment.
- 25 2. Device according to Claim 1, characterised in that the means (4) ensure the free rotation of the worm (10) after the second phase.
3. Device according to Claim 1, characterised in that the means (4) comprise a toothed sector whose teeth
- 30 interact with the teeth of the pinion.
4. Device according to one of the preceding claims, characterised in that it also comprises means forming a stop (11) for the pinion (2).
5. Device according to one of the preceding claims,
- 35 characterised in that the barrel (3) carries a plurality of elements, its movement permitting the alignment of the latter, respectively, with a plurality of chains of elements.



6. Device according to one of the preceding claims, characterised in that it also comprises means (71-73) for locking the movement of one or more of its components.

7. Device according to Claim 6, characterised in that it comprises a first finger (71) ensuring the locking of the rotational movement of the barrel (3) and a second finger (72) ensuring the locking of the rotational movement of the worm, the movements of the two fingers being rendered dependent on one another by a shutter (81).

8. Device according to Claim 7, characterised in that the first finger (71) has a bulge (87) at one of its ends which ensures the locking of the barrel by engagement in a notch of the barrel, unlocking being produced by the longitudinal translational movement of the first finger.

9. Device according to one of Claims 7 or 8, characterised in that the first finger (71) has a groove (86) and in that the shutter (81) has a tongue (86) [sic] ensuring the locking of the longitudinal movement of the first finger by engagement in the groove, unlocking being produced by rotation of the shutter, then disengaging from the groove.

10. Device according to one of Claims 7 to 9, characterised in that the second finger (72) has a cutout (95) in which the shutter (81) is engaged, ensuring the integrity of the longitudinal translational movement of the second finger with the rotational movement of the shutter.

11. Device according to Claim 10, characterised in that it also comprises a plate (90) equipped with a stud (91), which are integral with the worm (10), and in that one end (88) of the second finger (72) ensures locking of the worm by blocking the movement of the stud, unlocking being ensured by the longitudinal translational movement of the second finger.

12. Application of the device according to one of the preceding claims to a projectile comprising a fuse,



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characterised in that the said chain is a pyrotechnical chain forming the fuse.

13. Application according to Claim 12, characterised in that the projectile comprises a turbogenerator and in that the rotational movement is provided to the worm by the rotation of the shaft of the turbogenerator.
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