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(54) A gun aiming arrangement.

(57) A fire control system is often used to determine the elevation and trasverse angles which are necessary to aim a gun to enable a target to be engaged. A significant amount of time is needed to determine the elevation and trasverse angles for a particular target as a large number of variables relating to the nature of the ammunition being used, the range of the target and prevailing weather conditions etc. must be taken into account. A gun aiming arrangement in accordance with this invention enables aiming data (14) to be determined and calculated prior to the actual engagement of a target so that elevation and traverse angles can be stored (18, 31) for a number of potential targets. When the potential targets materialise they can be engaged extremely rapidly even if a number of targets appear almost simultaneously. The invention is particularly advantageous for use with a main battle tank operating in a defensive position and its use considerably reduces the time taken to engage targets.

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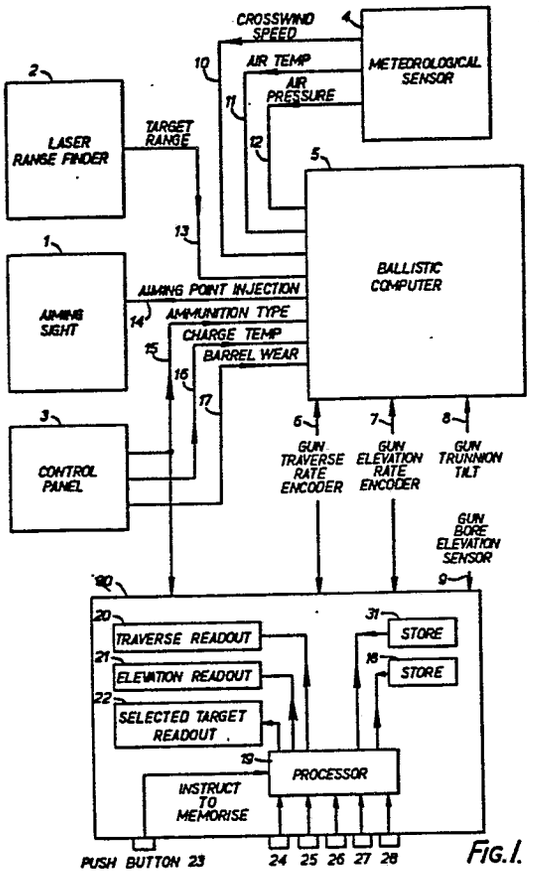

CROSSWIND SPEED
METEOROLOGICAL SENSOR
AIR TEMP
AIR PRESSURE
LASER RANGE FINDER
TARGET RANGE
BALLISTIC COMPUTER
AIMING SIGHT
AIMING POINT INJECTION
AMMUNITION TYPE
CHARGE TEMP
BARREL WEAR
CONTROL PANEL
GUN TRAVERSE RATE ENCODER
GUN ELEVATION RATE ENCODER
GUN TRUNNION TILT
GUN BORE ELEVATION SENSOR
TRAVERSE READOUT
ELEVATION READOUT
SELECTED TARGET READOUT
STORE
STORE
PROCESSOR
INSTRUCT TO MEMORISE
PUSH BUTTON 23
24 25 26 27 28

FIG. 1.

A gun aiming arrangement

This invention relates to a gun aiming arrangement which is particularly suitable for use with armoured vehicles. The invention can advantageously be used in combination with a fire control system of the kind which is becoming increasingly common as fitments on main battle tanks. Fire control systems can greatly enhance the capability of battle tanks to strike a target successfully on commencement of an engagement, but even so it is first necessary for a gunner to accurately identify a potential target and to lay his optical aiming sight very precisely on to the target before allowing control of the firing procedure to pass to the fire control system. Thus any response can take appreciable time, and it may be difficult to realise the potential effectiveness of the fire control system when the battle tank is in a defensive position in which it could come under attack from, or wish to engage, a number of possible targets in different directions at different ranges. The present invention seeks to provide a gun aiming arrangement which can enhance the strike capability of a gun under such circumstances.

According to this invention, a gun aiming arrangement includes means for accepting elevation and traverse aiming data from an associated fire control system; means for storing the data for a plurality of predetermined targets; and means for utilising the stored data for enabling a gun to be aimed at a selected one of the predetermined targets as the need subsequently arises.

Preferably the utilisation means comprises elevation and traverse indicators linked to the boresight of the gun, with the indicators being arranged to indicate when the direction of the boresight is in agreement with the stored elevation and traverse aiming data.

Preferably again means are provided for storing sets of aiming data for each predetermined target, wherein each set of data relates to the use of a particular type of ammunition.

Conveniently, the gun aiming arrangement also includes means for accepting data from a rangefinder which is indicative of the range and direction of possible targets.

Preferably one of said predetermined targets is designated a reference target and means are provided for modifying the aiming data stored for all targets when movement of the position of the gun occurs relative to that of the reference target.

The invention enables a battle tank to assume a defensive position and to prepare itself in anticipation of the appearance of potential targets. Preparation can be completed before the targets themselves materialise in such a way that the time to engagement is reduced significantly when the targets eventually appear and pose a real threat. Typically, when a squadron of battle tanks moves into a defensive position, the vehicle spacing will be dictated by the front to be covered. Each vehicle will be put into the best defensive position available to it in the area allocated, and the most likely points in the field of view at which targets could appear are noted by the tank commander. One of these potential target positions which can be clearly identified at night as well as by day is designated the reference target, and the position of this target is identified in terms of the elevation and traverse co-ordinates of the aiming sight when this reference target is correctly laid on to the aiming point of the sight itself (usually crosswires). The positions of potential targets are then noted in terms of traverse and elevation relative to the reference target, and data enabling these potential targets to be engaged is calculated by the fire control system and stored by the gun aiming arrangement so that the data can very rapidly be retrieved and utilised as the need arises.

The invention is further described by way of example with reference to the accompanying drawings, in which

Figure 1 illustrates a gun aiming arrangement in combination with a fire control system, and

Figure 2 is an explanatory diagram illustrating a typical field of view presented to a battle tank in a defensive position.

Referring to Figure 1, the system illustrated is mounted on board a main battle tank, but only those items necessary for an understanding of the present invention are illustrated. The gunner's aiming sight 1 is coupled to a ballistic computer 5

forming part of a main fire control system. This ballistic computer 5 is able to calculate the boresight direction of a gun which is required to strike a target at a predetermined position and range. The boresight direction is dependent on a large number of variables, particularly if the gun engages a moving target.

The true range of a target is of particular importance, and for this reason a laser rangefinder 2 is provided. It can be contained within the gunner's aiming sight 1, or possibly within a tank commander's sight, or it could even be a unit separate from a sight.

The prevailing weather conditions influence the trajectory, and therefore a meterological sensor 4 is mounted on the tank, typically on the roof of the turret. This sensor generates signals indicative of crosswind speed 10, air temperature 11, and air pressure 12. These signals are input to the ballistic computer 5, as shown in Figure 1, and from the temperature 11, and pressure 12 the air density factor can be calculated.

A control panel 3 is operated by the tank commander. From this panel 3 information is given to the ballistic computer 5 regarding ammunition type 15 being used, the temperature 16 of the ammunition charge, and the state of wear 17 of the gun barrel. Other sensors are mounted in the turret and these also supply information to the ballistic computer 5. These are a traverse rate encoder 6, driven by the traverse drive system in the turret; an elevation rate encoder 7, driven by the elevation drive system on the gun; and a trunnion tilt sensor 8. The barrel of a gun in a battle tank is mounted on a trunnion bearing so as to be rotatable in elevation, and the trunnion bearing is rigidly mounted on the turret which is rotatable as a whole in azimuth so as to provide the necessary traverse movement. The information concerning trunnion tilt is necessary to take into account the angular off-set which occurs when the vehicle is positioned on a hillside with one track being below the other.

When the necessary boresight angle of the gun has been computed, by the computer 5, the corresponding aiming data is passed over line 14 to generate an optical aiming mark which

appears in the aiming sight 1 as an offset which represents the elevation and traverse adjustments calculated as being necessary. The gunner then readjusts the position of the gun (hence also his sight) to bring the inserted optical aiming mark onto the target. At this point, the boresight of the gun has been moved in elevation and traverse to the extent necessary to achieve a strike and the gun can then fire.

A slightly more complicated aiming procedure is used when a moving target is engaged, since the gunner must follow the movement of the target with his aiming sight 1 for a short period to enable the ballistic computer 5 to determine the nature of the movement and to calculate the necessary angular off-set which is required to enable a strike to be achieved under these conditions. Again, an optical aiming mark is injected into the aiming sight 1 when the necessary calculations have been performed. Fire control systems of the kind represented by block 5 and the associated periperhal sensors etc. are in themselves well known and one suitable fire control system is produced by Marconi Radar Systems Limited under the designation SFCS 600.

The gun aiming arrangement in accordance with this invention is designated generally by block 30. It contains its own processor 19 which routes data into particular locations of a store 31 as required, and it also contains a small display 22 which is capable of displaying the target identity of an engaged target. Gun traverse and elevation data are displayed on small indicators 20 and 21.

The block 30 is provided with an additional input 9 which indicates the true elevation angle of the barrel.

As previously described, when the tank is put into a defensive position, the tank commander establishes an easily identifiable reference target 36 which is somewhere near the centre of the arc to be covered by his vehicle (see Figure 2). The aiming sight 1 is laid accurately on to this target, and if this reference target is a true potential target as opposed to merely a reference point, the normal fire control engagement drill is then carried out as for a stationary target.

First, the aiming sight 1 is positioned on to the target centre

and the enter button 23 is pressed. This has the effect of transferring the aiming data presented to the aiming sight 1 by the computer 5 into a reference store 18 via a local processor 19. In practice, the reference store may simply be a predetermined location of the larger store 31. The data held in reference store 18 consists of the azimuth angle and elevation angle of the aiming sight 1.

Then the normal fire control sequence is initiated to enable the ballistic computer 5 to compute and enter an aiming mark in the eye piece of the aiming sight 1. The aiming sight 1 is adjusted to bring the aiming mark exactly on the target. When this has been done button 24 is pressed which enters into the gun aiming arrangement 30 the aiming data in terms of the traverse and elevation angles to which the gun must be set to engage the target. This data is stored in the store 31 and can be accessed by subsequently specifying the target identity. These angles are also displayed as required on the gun traverse indicator 20 and the gun elevation indicator 21 relative to the aiming angle of the reference target.

A similar fire control sequence is carried out for the same target in respect of each of the different kinds of ammunition which are available for use. Corresponding data is then entered into the store 31 for subsequent use.

Other potential targets, e.g. Alpha, Bravo etc. (37-41) are engaged in a similar fashion and aiming data entered into store 31 on operation of respective push buttons 24-28; that is to say, the aiming sight 1 is laid on to the target so that the ballistic computer 5 can calculate the boresight elevation and traverse angles needed to obtain a strike for each kind of ammunition. In this case the elevation and traverse angles are given with respect to the reference target.

It is desirable to establish left of arc and right of arc limits to prevent the gun inadvertently being pointed outside of these limits during an operational engagement. During the setting-up period the gunner traverses left and right respectively to what he considers to be safe limits and then presses appropriate left of arc and right of arc buttons (not shown) to operate on the processor 19 to enter the

traverse angles into the store 31. Then, during subsequent engagement, a warning which may be visible or audible, or both, can be given if at any time the gun traverses outside the pre-set safe arc.

As an additional safeguard the angles and range of each target could be manually recorded by the tank commander as the data is generated. This will allow for subsequent complete failure of the fire control system and the gun aiming arrangement, and such a record could be a diagram of the kind, shown in Figure 2, but with boresight elevation and traverse angles added for each potential target position.

Once the data for all potential targets has been obtained, the gun can respond rapidly and accurately when a real target eventually appears at any of the predetermined potential target positions.

In practice, these potential target positions are likely to be features such as a bend in a road, the corner of a wood or the brow of a hill. Subsequently, when the real target appears, its predetermined code number e.g. Alpha, Bravo etc. is entered into the gun aiming arrangement via an appropriate input button or keyboard and the corresponding gun traverse and elevation angles appear at indicators 21 and 22. Typically these indicators consist of digits which reduce to zero as the boresight direction of the gun barrel is moved to its required position. Alternatively, or in addition to the indicators 20, 21 the aiming sight 1 could be used for this purpose. For example, the aiming mark could be moved hard over to one side of the gunner's sight, and the gun would be moved in the direction of the mark. As the correct line-up position is reached the computer would acknowledge the fact by moving the aiming point from the edge of the sight field. When the gunner has laid the aiming point over the ballistic zero mark in his sight, the correct off-set for the target corresponds to the stored value and the gun can be fired.

In the case of a stationary target, the gun can be fired immediately the indicators 21 and 22 indicate an all zero state. However, in the case of a moving target, control may be

passed back to the ballistic computer 5 to generate an off-set aiming mark which allows for the calculated rate of movement of the target.

It will be appreciated that if the fire control system itself fails, the auxiliary gun aiming arrangement completely allows the gun to maintain accurate engagement of a stationary target.

It could happen that if the tank is standing on sloping ground, its precise position could be disturbed at some stage as the turret is turned or the gun is fired, causing errors to appear in the gun laying angles indicated by the indicators 20 and 21. To correct for this, the gun can at any time simply be laid again on to the reference target and its position co-ordinates re-entered. This automatically enables the original data to be modified for all other targets held in the memory, since the pattern of these other targets is constant with respect to the reference target.

Thus even if a number of targets appear almost simultaneously each can be very rapidly and accurately engaged using the data acquired previously. This greatly increases the likelihood of a successful target strike on commencement of an engagement.

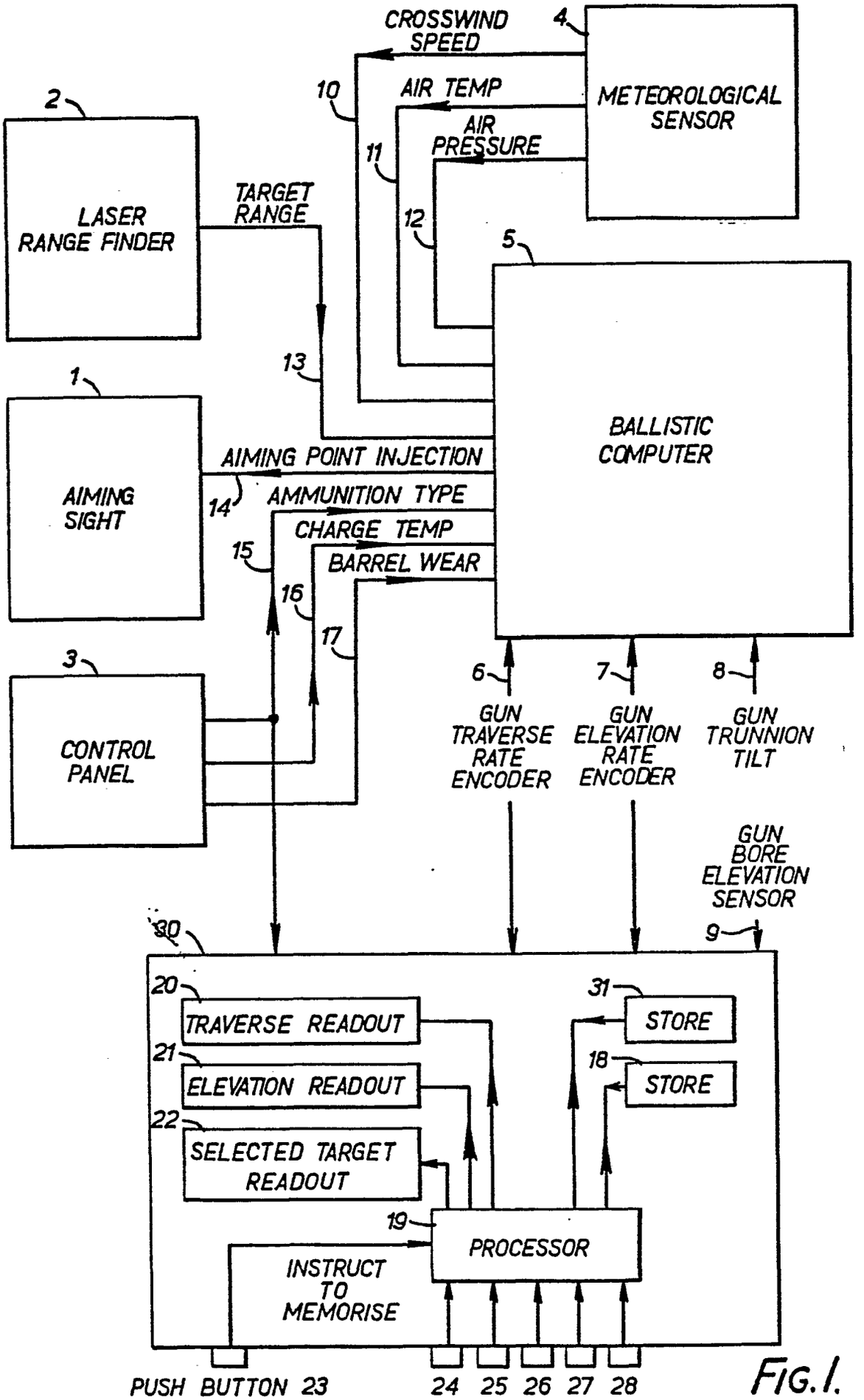
Claims

1. A gun aiming arrangement including means for accepting elevation and traverse aiming data from an associated fire control system; means for storing the data for a plurality of predetermined targets; and means for utilising the stored data for enabling a gun to be aimed at a selected one of the predetermined targets as the need subsequently arises.

2. An arrangement as claimed in claim 1 and wherein the utilisation means comprises elevation and traverse indicators linked to the boresight of the gun, with the indicators being arranged to indicate when the direction of the boresight is in agreement with the stored elevation and traverse aiming data.

3. An arrangement as claimed in claim 2 and wherein means are provided for storing sets of aiming data for each predetermined target, wherein each set of data relates to the use of a particular type of ammunition.

4. An arrangement as claimed in any of the predetermined targets and wherein one of said predetermined targets is designated a reference target and means are provided for modifying the aiming data stored for all targets when movement of the position of the reference target occurs relative to that of the gun.


CROSSWIND SPEED
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METEOROLOGICAL SENSOR
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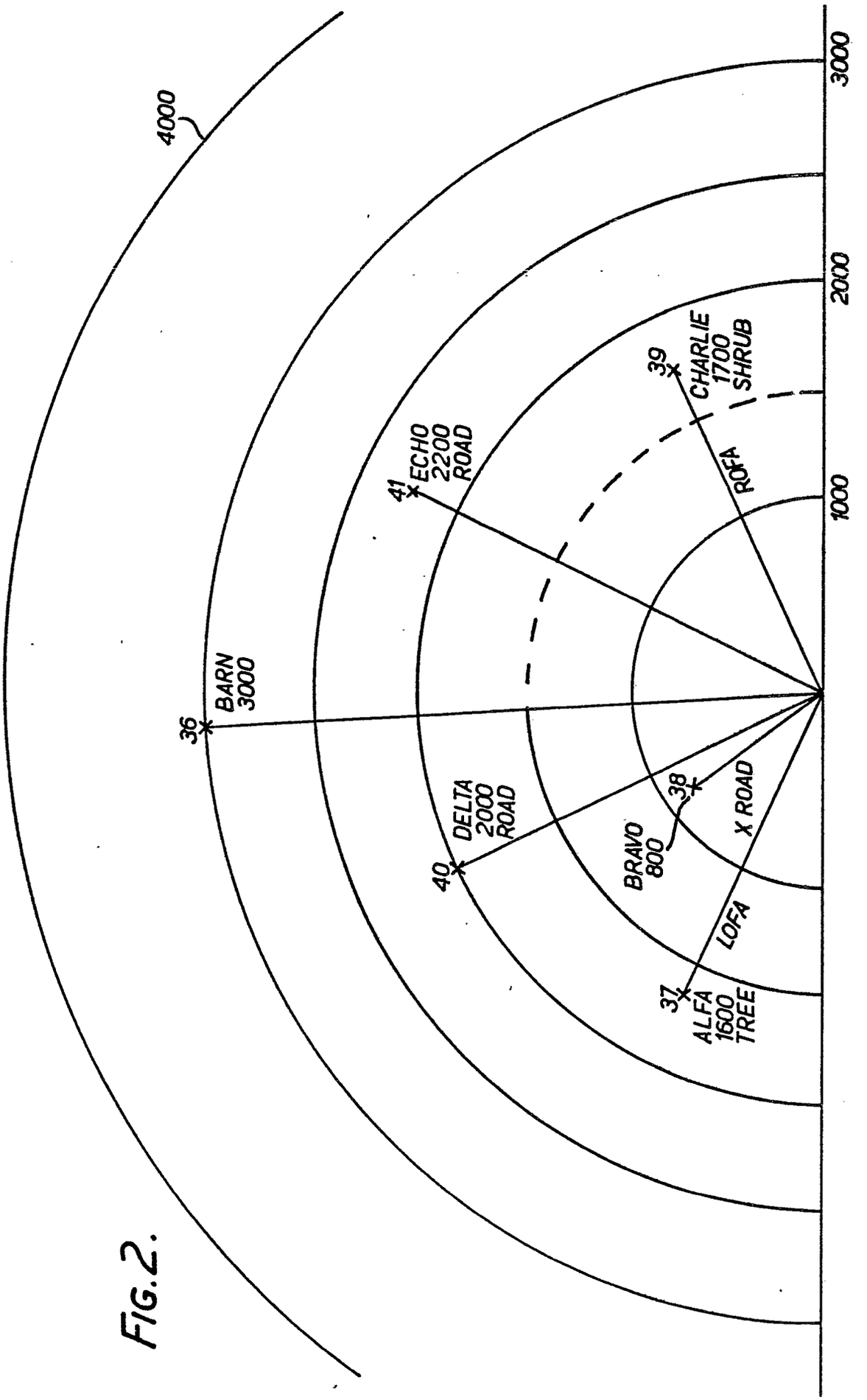
AIR TEMP
AIR PRESSURE
11
12
2
LASER RANGE FINDER
TARGET RANGE
5
BALLISTIC COMPUTER
13
1
AIMING SIGHT
AIMING POINT INJECTION
14
AMMUNITION TYPE
CHARGE TEMP
15
BARREL WEAR
16
17
3
CONTROL PANEL
6
7
8
GUN TRAVERSE RATE ENCODER
GUN ELEVATION RATE ENCODER
GUN TRUNNION TILT
GUN BORE ELEVATION SENSOR
9
30
20
TRAVERSE READOUT
31
STORE
21
ELEVATION READOUT
18
STORE
22
SELECTED TARGET READOUT
19
PROCESSOR
INSTRUCT TO MEMORISE
PUSH BUTTON 23
24
25
26
27
28

FIG. 1.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38
BRAVO
800
X ROAD
LOFA
37
ALFA
1600
TREE

FIG.2.

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EUROPEAN SEARCH REPORT

Application number

EP 82 30 2278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	GB-A-1 549 690 (VICKERS) * Figure 1; page 1, lines 26-80; page 2, lines 4-121 *	1-3	F 41 G 3/00 F 41 G 5/00
A	US-A-3 618 456 (G. MINDEL) * Whole document *	1,2	
A	US-A-3 575 085 (W.E. McADAM)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 41 G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-08-1982	CHAIX DE LAVARENE C.

CATEGORY OF CITED DOCUMENTS

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