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(54) **A target apparatus.**

(57) A target apparatus comprising a bag (14) formed of flexible material, means (12) for introducing compressed air or gas to the interior of said bag to cause the bag to be inflated and a projectile detection arrangement adapted to detect a projectile fired at the inflated bag, the projectile detection arrangement comprising at least one transducer (18,19) responsive to an airborne pressure or shock wave generated by the projectile.

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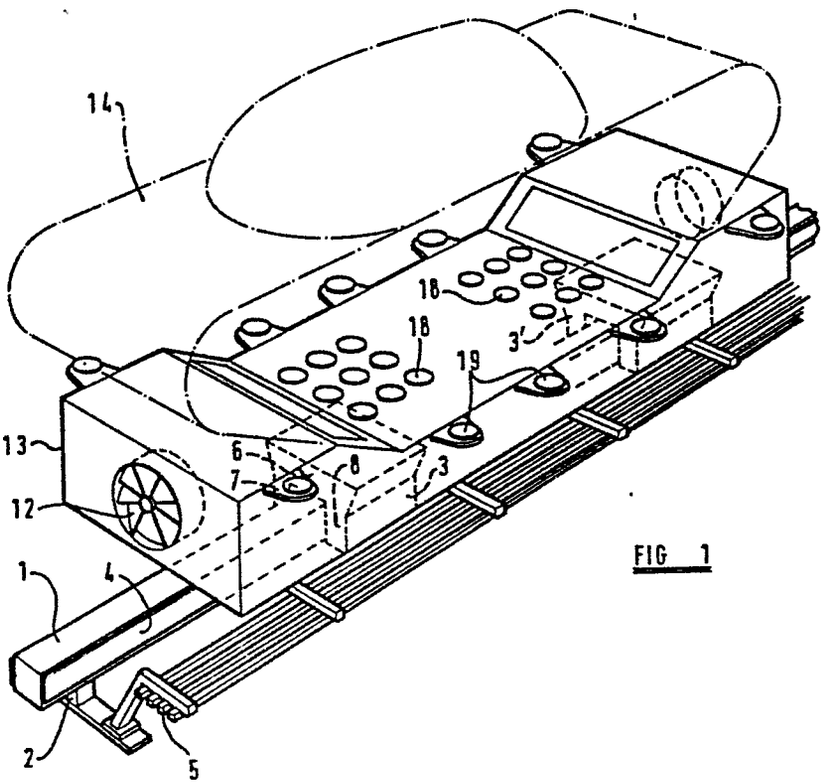

FIG 1

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"A Target Apparatus"

THE PRESENT INVENTION relates to target apparatus and more particularly the invention relates to target apparatus suitable for use in training personnel, such as military personnel, in the art of the marksmanship.

There is a requirement for a target apparatus that can be utilised in producing a life-like simulation of battle conditions. The present invention seeks to provide a target apparatus that can be utilised in such circumstances.

According to the broadest aspect of this invention there is provided a target apparatus comprising a bag formed of flexible material, means for introducing compressed air or gas to the interior of said bag to cause the bag to be inflated and a projectile detection arrangement adapted to detect a projectile fired at the target, the projectile detection arrangement comprising at least one transducer responsive to an airborne pressure or shock wave generated by the projectile.

Preferably the transducer arrangement comprises at least one transducer located within the bag, when inflated, the transducer being responsive to the pressure or shock wave generated within the inflated bag by a projectile passing through the bag. The transducer may be responsive to a pressure or shock wave of at least a predetermined amplitude and/or duration, although preferably a plurality of transducers are provided within said bag, at least one transducer being responsive to a pressure or shock wave of a predetermined minimum amplitude and/or duration and a second transducer being responsive to a pressure or shock wave of a greater amplitude and/or duration. Thus, in a preferred embodiment a plurality of transducers are provided each responsive to pressure or shock waves of different amplitude and/or duration.

Conveniently said transducer arrangement includes an array of at least three transducers located outside of the bag, each transducer being adapted to detect a pressure or shock wave generated by a projectile fired at the bag and either passing through the bag or passing through a region adjacent the bag, said transducer being associated with timing and calculating means adapted to determine the relative instants of arrival of the pressure or shock wave at each transducer and to calculate, from the determined instants, information concerning the trajectory of the projectile. Preferably said transducer array comprises at least three transducers located adjacent one side of the target, and three further transducers located adjacent the opposite side of the target.

The said means for inflating the bag may comprise fan means adapted to direct air into the bag, and said fan means comprise at least one relatively high speed fan, for rapid inflation of the bag, and at least one relatively low speed fan, adapted to be utilised to maintain the bag in an inflated condition. Conveniently said fan means are associated with filters to filter the air directed into the bag. Preferably the fans are of the reversible flow type, to enable the bag to be readily deflated by the exhaustion of air from within the bag. In this way the target apparatus can be made to appear and disappear when viewed from the firing point.

Alternatively the said means for inflating the bag comprises a source of compressed air or other gas.

Preferably means are provided to enable the bag, when inflated, to have a predetermined heat signature. Said means may comprise a heater associated with the means to inflate the bag so the bag is inflated with heated air, certain areas of the wall of the bag being thinner than other areas, the thinner areas thus transmitting more heat than the thicker areas. Alternatively heat emitting patches are mounted on the bag, and each heat emitting patch may comprise a patch of electrically resistive but conductive material, there being means for applying a voltage across the patch. Each said patch may be formed of a plastics material with graphite particles incorporated therein.

Conveniently the said bag is mounted on a trolley, the trolley being

movable along a rail, the trolley being provided with means by which it can be propelled along the rail in either direction. The said means may comprise an internal combustion engine, hydraulic or compressed air devices, towing wires, or electrical devices, either battery powered or provided with sliding pick-up means for co-operation with a bus bar system mounted on or adjacent to the rail to supply electric power to the trolley. In a preferred embodiment the trolley may be provided with a linear motor, the stator for the linear motor being mounted on or formed integrally with the rail, and the trolley may be provided with sliding pick-up means, cooperating with a bus bar system mounted on or adjacent the rail to supply electric power to the trolley. Means may be provided for relaying information to and/or from the trolley, such as a radio-link, or a bus bar arrangement cooperating with contacts present on the trolley.

Advantageously said rail comprises a rectangular member, the trolley having wheels engaging the upper surface of the rectangular member, and jockey wheels engaging the two opposed side surfaces of, or the lower corners of, the rectangular member. Said rectangular member may be a hollow tubular member.

Conveniently the inflatable bag mounted on the trolley provides a representation of a military target.

Preferably two trolleys are provided which are interconnected by means of a rigid platform like structure, the inflatable bag being mounted on the platform and providing a representation of a military target.

Preferably means are provided to retain the inflated bag in position on the trolley, said means comprising elements interconnecting zones on the bag to respective fixed points adjacent the base of the bag. The elements may be rigid elements, which may then be pivotally mounted in position adjacent the base of the bag, but in a preferred embodiment of the invention said elements comprise flexible elongate elements that embrace and/or are connected to the part of the bag that forms the upper part of the bag when it is inflated, said elements being connected to fixed points on the trolley or a platform mounted thereon.

The elongate elements may thus be like cords, ropes, wires or the like.

Advantageously said fixed points comprise a winching means able to winch in said flexible elements, and such winching means may be utilised to deflate the bag rapidly, and also to provide controlled inflation of the bag.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of the invention;

Figure 2 is an end elevational view of part of the apparatus shown in Figure 1;

Figure 3 is a diagrammatic view of the platform illustrated in Figure 1, illustrating a winching arrangement and control cords.

Figure 4 is a diagrammatic side elevational view of a target constituted by the inflated bags carried on the trollies of Figure 1 showing heat emitting patches secured thereto; and

Figure 5 is a perspective view of another target in accordance with the invention.

One embodiment of a shooting range utilising apparatus in accordance with the invention is provided with at least one elongate track 1. The track is formed, for example, of substantially square or rectangular sectioned steel tube, which is manufactured within a fine manufacturing tolerance. The tube is supported above ground level by appropriate support means 2, and the arrangement is such that a trolley 3 can run along the track.

Secured to one or both side edges of the steel tube is a strip of a metal such as aluminium 4, which forms the stator of a linear motor, which

will presently be described. Also mounted on one side of the track is part 5 of a sliding connector bus bar system, constituting the stationary part of the bus bar system.

A trolley 3 is provided which is mounted for movement along the track. The trolley has a portion 6 extending across the top of the track, and two portions 7, 8 extending downwardly on either side of the track. Wheels 9 are provided within the trolley which are vertically mounted and which support the trolley on the top of the track 1, and further jockey wheels are provided within the trolley, the jockey wheels being substantially horizontal and thus engaging the side walls of the track 1. The trolley is provided with a linear motor 11 in each side portion 7, 8 of the trolley adjacent the side of the track 1, so that four linear motors are provided in all. As has been mentioned above the stator 4 for the linear motors is securely connected to the tubular track. The trolley is also provided with a moving connector that cooperates with the fixed part 5 of the bus bar system provided adjacent to the track so that electrical power and various control signals can readily be supplied to the trolley.

In the embodiment illustrated a trolley-train is provided, comprising two trollies, 3, 3' that are interconnected by a rigid platform, 13, the platform being mounted in such a way that each trolley may pivot about a vertical axis with respect to the platform.

Mounted on each end of the platform is a source of pressurized gas 12, - in the illustrated embodiment a high speed fan and an associated motor adapted to drive the high speed fan. Each high speed fan is mounted within a housing which is provided at one end of the platform, the housing being open to permit the ingress of air to the blades of the fan, and having an open upper exhaust port, through which air is driven by the fan.

The top of the platform is substantially air impervious and extends over the side edges of the trolley and may optionally extend over the forward and rearward end of the trolley. Mounted to the periphery of the platform is the open mouth of an inverted bag 14 formed of a resilient plastics material. The bag is intended to be inflated by operation of the fans, the bag then standing in an erect position above the platform. When

the bag is in this erect position it is to be noted that the lowermost portions of the side walls of the bag are relatively thick, thus providing these regions of the side walls of the bag with a certain degree of rigidity, and the upper portions of the bag are progressively thinner.

In one particular embodiment of the invention the bag is provided on the platform 13 which is supported by two trolleys of a train of trollies 3, 3'. When the bag 14 is viewed from the side it resembles a tank, and thus it will be appreciated that the bag 14, when inflated, may be utilised as a target for training personnel in the art of marksmanship.

It will be appreciated that the target can be caused to move along, by means of the linear motors, and the arrangement is such that the target can run along at any appropriate speed upto approximately 65 kilometres per hour in either direction. One trolley of the trolley train is provided with pick-up means which cooperate with the bus bar 5 provided on the rail to ensure that the power can be supplied to the linear motors and to ensure that appropriate control signals can be provided to the trolley and also to ensure that appropriate signals can be led from the trolley to a central processing or control station. These signals may for example, be mains injected on the power line. In alternative embodiments a radio link may be provided between each trolley and a central control position.

Since the trolleys are adapted to travel at a substantial speed it is to be appreciated that a bag constituting a target may be subjected to severe wind pressure. When the bag is in the fully inflated state the material constituting the bag is held taut due to the high internal pressure within the bag. Thus the inflated bag is substantially rigid. When the bag is totally deflated, the bag lies substantially flat on the trolley or on the platform and is not subjected to any wind loads. However, during inflation and deflation, the material constituting the bag is not maintained in a taut condition, and there may be a tendency for the bag to billow about if the bag is subjected to wind loads at that time. This may result the bag becoming damaged.

In order to minimise the risk of any such damage occurring, a plurality of loops of cord 15, or wire or some other flexible element are provided which, when the bag is in the inflated condition, embrace the upper

part of the bag. The cords may, if desired, be connected to the upper part of the bag. The cords pass through small eyelets in the bag, and are then wound round a shaft 17 that extends axially of the trolley. The shaft is driven by means of a motor (not shown), and thus the shaft 17 acts as a winch drum.

When it is desired to deflate the bag an appropriate control valve may be opened to permit the pressurised air to escape from the interior of the bag, or the direction of rotation of the fans may be reversed. As the bag deflates, the winch drum 17 is rotated to wind in the cords 15, thus assisting in the deflation of the bag 15, but constraining the bag to deflate within the periphery of the trolley or platform with a minimum of billowing about. Equally, when the bag is re-inflated the winch drum 17 will be rotated in the appropriate direction to pay out the cords 15 as the fans operate to inflate the bag. Thus, again, the risk of the bag billowing about is minimised.

Whilst a single winch shaft 17 has been illustrated it is to be appreciated that the cords 15 may be connected to separate winches if desired, and also, whilst the cords have been shown as embracing the outer periphery of the target it is to be appreciated that the cords may be connected to the target bag in various ways. For example, the cords may run through fabric sleeves secured to the interior or the exterior of the bag. The cords need not necessarily be in the form of loops and may thus just extend from the appropriate winch to an appropriate point on the bag.

It is to be noted, at this point, that since the trolleys are adapted to travel at a relatively high speed, it is important that both the trolleys and the rails are manufactured to within fine manufacturing tolerances so that, when the trolleys move round corners at a high speed the linear motors do not become separated from the aluminium strips by such an extent that the operation of the linear motors is impeded.

In order to determine whether any particular inflated bag 14 has been penetrated by a projectile it is intended to locate at least one transducer 18 on the platform within the inflated bag. The transducer is adapted to be responsive to a pressure or shock wave generated in the air within the bag by a projectile fired at the bag actually passing through the bag. Thus,

whenever the transducer receives a pressure or shock wave, an output signal will be generated by the transducer, this output signal being indicative of a hit on the target.

It is to be appreciated that a target apparatus as presently described may be utilised with many different types of ammunition being fired at the target simultaneously. It may be necessary to be able to determine, with regard to each particular "hit" the precise type of ammunition utilised. Consequently it is proposed to utilise, within each bag, a plurality of transducers 18, each transducer (together with the signal processing circuitry associated with the transducer) having a separate and distinct threshold with regard to the amplitude and/or duration of the detected pressure or shock wave. Thus, the transdcuer that responds to the shortest and/or lowest amplitude pressure or shock wave will ensure that bullets of the lowest calibre to be fired at the target will be detected. The transducer responsive to the pressure or shock wave of the next largest amplitude and/or duration will ensure that projectiles of the next largest claibre size will be detected. Of course, when a projectile of this next largest calibre size passes through the target both this transducer and the first described transducer will provide output signals since any transducer will respond to any pressure or shock wave that has an amplitude and/or duration greater than the threshold amplitude and/or duration of that transducer.

It is envisaged that a plurality of transducers may be provided, the transducers effectively being "tuned" to detect 7.62 mm projectiles, 30 mm projectiles, 40 mm projectiles, 76 mm projectiles, 95 mm projectiles, 105 mm projectiles and 120 mm projectiles. Of course further transducers may be provided "tuned" to any particular projectile size.

It is important to note that the above described transducers utilised to provide each output signal may not be capable of detecting a pressure or shock wave from a projectile of the appropriate calibre is that projectile has penetrated the inflated bag that constitutes the target at a point remote from the relevant transducer. Consequently it may be necessary to provide a plurality of groups of transducers on the platform supported by the trolley to ensure that, wherever a bullet passes through an inflated target, an appropriate output signal is generated.

The transducers 18 are illustrated as defining a regular square array, but many alternative configurations for the transducers may be acceptable.

Instead of using separate transducers a single transducer may be used with means to measure the amplitude and/or duration of the output signals, the measured values being supplied to an appropriately programmed microprocessor or the like to provide an indication of the size of the projectile.

It may be desirable to be able to provide an output signal indicative of precisely where a bullet or projectile has impinged upon or passed adjacent the target constituted by the inflated bags. In such a case it would be possible to mount, on each side of the trolley, a row of transducers 19, the transducers 19 each providing an output signal in response to detection of a pressure or shock wave generated by a projectile fired at the target, constituted by the inflated bag. These output signals could be processed by an appropriately programmed computer adapted to calculate, from the time delays between the instants of generation of the output signals generated by the transducers, information concerning the trajectory of the projectile. Apparatus of this type has been described, primarily with reference to permanently fixed range equipment, in British Patent Specification No. 1580253 and in published British Patent Application No. 2042696 A. It will readily be appreciated, however, that the operative components of such a system may be mounted on a trolley of the type herein described on appropriate outtriggers. Of course, it may be desirable for the necessary computer to be located at a central point, and thus it is envisaged that the information concerning the time of arrival of the pressure or shock wave at each transducer 19 will be transferred to a computer either by means of mains injection through the power line or by means of an appropriate radio link.

From the foregoing description it will be appreciated that when the inflatable bags 14 of a target apparatus in accordance with the invention are inflated, the complete target will have the visual appearance of a tank or other military target. In order to facilitate night training, and training in connection with the use of heat sensitive sights, it is possible to provide means on each target to generate a heat signature. For example each fan 12

may be associated with a heater adapted to heat the air being introduced into the bag. In this way, the bag, when inflated, is relatively warm and thus the inflated bag can readily be viewed through heat sensitive sights. Whenever a projectile passes through such a bag hot air escapes from the bag, and again this can readily be seen on heat sensitive sights.

It is to be realised that whilst the above outlined proposal provides one way in which training can be given in the use of heat sensitive sights, the resultant training may be rather unrealistic since, in real life, a military target such as tank does not provide an even heat image, but instead there are certain areas that, in use, are much hotter than others. For example, in a normal tank the tracks and the drive wheels tend to get hot in use, and also the zone immediately surrounding the exhaust from the engine of the tank will also be hot in use. It may be possible to provide a corresponding simulated effect by manufacturing the inflatable bag of a material that has thin zones where the target being simulated is hot, in use, and thick zones where the target being simulated is cold, in use. However, it may well be preferred to provide heat emitting patches or zones on the inflatable bag. Such emitting patches or zones may be constituted by appropriately shaped sheets of a conductive plastics material, such as polyethylene incorporating graphite or some other similar arrangement, each such sheet being provided with electrodes along two opposed edges thereof, there being means for applying a voltage across the electrodes. Advantageously the voltage is controllable so that the amount of current flowing through the conductive sheet may be adjusted, and consequently the temperature of the sheet may be adjusted.

It is envisaged that patches 20 of the type described above may be mounted on an inflatable bag target of the type described above in the regions of the target which, in a real target, would be hot- that is to say the regions, in the example of a tank, corresponding to the wheels and the tracks and to the exhaust outlet. One example of such an arrangement is illustrated in Figure 4. If such an expedient is adopted, when the target is viewed through a heat sensitive sight the image of the target is virtually identical with the image of a real target, and thus very realistic training may be provided.

Where a target apparatus of the type described above is to be utilised

on a training range that simulates a theatre of war it is desirable that the bags may be fully inflated from a totally deflated condition in a very short period of time, so that a trolley can advance with the bag deflated, unobserved by trainee marksman within the range, and then, when the trolley is in the desired position, the bag may be rapidly inflated, thus providing a visual representation of the rapid appearance of a tank. In more advanced ranges the trolleys utilised may carry targets resembling "friendly" tanks and targets resembling "enemy" tanks and the marksman within the training area will first have to identify any particular target before firing at the target.

It is to be appreciated that the rapid inflation of any particular bag that constitutes a target is a desirable feature and consequently it is preferred to utilise fans that operate at a high speed, to ensure that the bag can be inflated rapidly. It is, of course, possible to utilise one or more high speed fans for rapid inflation of the target and an additional low speed fan which can be utilised to maintain the target in an inflated condition once the target has been inflated. Alternatively the fans may be driven rapidly during the inflation process and may be driven more slowly when merely maintaining the bag in an inflated condition. This will minimise the power consumption and may prove to be beneficial, particularly where the fans are battery operated. Preferably the fans are provided with appropriate filters to ensure that only pure air is directed to the interior of any particular bag.

Whilst the invention has been described with reference to the use of fans it is to be appreciated that other sources of air or gas may be utilised on such as cylinders of compressed air or gas, or even a central compressor and associated supply lines and valves. Such an expedient may be adopted particularly where inflatable bag targets of the type generally described above are not mounted on a trolley, but are mounted on a permanent or semi-permanent base.

If necessary, when battery operated, a fan may be pulsed to provide optimum performance.

Whilst the invention has been described above primarily with regard to relatively large targets mounted on trolleys which resemble tanks or the

like, it is to be appreciated that the invention may be applied to other targets such as, for example, a relatively small inflatable target 21 having the shape and configuration of an infantry man as shown in Figure 5. Thus, when such a target is utilised, a bag having the shape and appearance of an infantry man can rapidly be inflated, thus providing a visual simulation of an enemy infantry man emerging from a concealed position. One or more transducers 22 will be provided within the inflatable bag adjacent the base thereof, the transducers serving to detect bullets fired at the inflatable bag target. In such an embodiment two fans 23, 24 may be provided, one being a high speed fan for rapid inflation of the target, and the second being a relatively low speed fan, primarily to maintain the target in an inflated condition.

In this embodiment of the invention also a plurality of transducers may be provided in positions adjacent the exterior of the target to provide information concerning the position of a bullet or other projectile fired at the target. Again the arrangements of transducers utilised may be as described in prior British Patent No. 1580253 or prior published British Patent Application No. 2042969 A.It is to be appreciated that when such arrays of transducers are utilised it is possible to determine not only the position of bullets that actually hit the target, but also the position of bullets that, whilst passing in the general vicinity of the target, do not actually hit the target.

It will be appreciated that the above described apparatus may be utilised to fabricate a very realistic and life like training range, offering training facilities during the day and at night, and also specifically offering training facilities in connection with the use of heat sensitive weapon sights.

The features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

CLAIMS:

1. A target apparatus comprising a bag formed of flexible material, means for introducing compressed air or gas to the interior of said bag to cause the bag to be inflated and a projectile detection arrangement adapted to detect a projectile fired at the inflated bag, the projectile detection arrangement comprising at least one transducer responsive to an airborne pressure or shock wave generated by the projectile.

2. An apparatus according to claim 1 wherein the transducer arrangement comprises at least one transducer located within the bag, when inflated, the transducer being responsive to the pressure or shock wave generated within the inflated bag by a projectile passing through the bag.

3. An apparatus according to claim 2 wherein at least one transducer is responsive to a pressure or shock wave of a predetermined minimum amplitude and/or duration and a second transducer is responsive to a pressure or shock wave of a greater amplitude and/or duration.

4. An apparatus according to any one of the preceding claims wherein said transducer arrangement includes an array of at least three transducers located outside the bag, each transducer being adapted to detect a pressure or shock wave generated by a projectile fired at the bag and either passing through the bag or passing through a region adjacent the bag, said transducers being associated with timing and calculating means adapted to determine the relative instants of arrival of the pressure or shock wave at each transducer and to calculate, from the determined instants, information concerning the trajectory of the projectile.

5. An apparatus according to any one of the preceding claims wherein said means for inflating the bag comprises at least one relatively high speed fan, for rapid inflation of the bag, and at least one relatively slow speed fan, adapted to be utilised to maintain the bag in an inflated condition.

6. An apparatus according to any one of the preceding claims wherein means are provided to enable the bag, when inflated, to have a pre-

determined heat signature.

7. An apparatus according to claim 6, wherein said means comprise a heater associated with the means to inflate the bag so the bag is inflated with heated air, certain areas of the wall of the bag being thinner than other areas, the thinner areas thus transmitting more heat than the thicker areas.

8. An apparatus according to claim 6, wherein heat emitting patches are mounted on the bag, each emitting patch comprising a patch of electrically resistive but conductive material, there being means for applying a voltage across each such patch.

9. An apparatus according to any one of the preceding claims, wherein the said bag is mounted on a trolley, the trolley being movable along a rail, the trolley being provided with means by which it can be propelled along the rail in either direction.

10. An apparatus according to claim 9, wherein the trolley is provided with a linear motor, the stator for the linear motor being mounted on or formed integrally with the rail, the trolley also being provided with sliding pick-up means, cooperating with a bus bar system mounted on or adjacent the rail to supply electric power to the trolley.

11. An apparatus according to claim 9 or claim 10, wherein said rail comprises a rectangular member, the trolley having wheels engaging the upper surface of the rectangular member, and jockey wheels engaging the two opposed side surfaces of, or the lower corners of, the rectangular member.

12. An apparatus according to claim 9, 10 or 11 wherein means are provided to retain the inflated bag in position on the trolley, said means comprising elements interconnecting zones of the bag to respective fixed points adjacent the base of the bag.

CLAIMS:

AMENDED CLAIMS

1. A target apparatus comprising a bag formed of flexible material, means for introducing compressed air or gas to the interior of said bag to cause the bag to be inflated and a projectile detection arrangement adapted to detect a projectile fired at the inflated bag, the projectile detection arrangement comprising at least one transducer located within the bag, when inflated, the transducer being responsive to an airborne pressure or shock wave generated within the inflated bag by a projectile passing through the bag.

2. An apparatus according to claim 1 wherein said at least one transducer is responsive to a pressure or shock wave of a predetermined minimum amplitude and/or duration and a second transducer is also provided within the bag which is responsive to a pressure or shock wave of a greater amplitude and/or duration.

3. An apparatus according to any one of the preceding claims wherein said target apparatus additionally includes an array of at least three transducers located outside the bag, each transducer being adapted to detect a pressure or shock wave generated by a projectile fired at the bag and either passing through the bag or passing through a region adjacent the bag, said transducers being associated with timing and calculating means adapted to determine the relative instants of arrival of the pressure or shock wave at each transducer and to calculate, from the determined instants, information concerning the trajectory of the projectile.

4. An apparatus according to any one of the preceding claims wherein said means for inflating the bag comprises at least one relatively high speed fan, for rapid inflation of the bag, and at least one relatively slow speed fan, adapted to be utilised to maintain the bag in an inflated condition.

5. An apparatus according to any one of the preceding claims wherein means are provided to enable the bag, when inflated, to have a predetermined heat signature.

AMENDED CLAIMS

6. An apparatus according to claim 5, wherein said means comprise a heater associated with the means to inflate the bag so the bag is inflated with heated air, certain areas of the wall of the bag being thinner than other areas, the thinner areas thus transmitting more heat than the thicker areas.

7. An apparatus according to claim 5, wherein heat emitting patches are mounted on the bag, each emitting patch comprising a patch of electrically resistive but conductive material, there being means for applying a voltage across each such patch.

8. An apparatus according to any one of the preceding claims, wherein the said bag is mounted on a trolley, the trolley being movable along a rail, the trolley being provided with means by which it can be propelled along the rail in either direction.

9. An apparatus according to claim 8, wherein the trolley is provided with a linear motor, the stator for the linear motor being mounted on or formed integrally with the rail, the trolley also being provided with sliding pick-up means, cooperating with a bus bar system mounted on or adjacent the rail to supply electric power to the trolley.

10. An apparatus according to claim 8 or claim 9, wherein said rail comprises a rectangular member, the trolley having wheels engaging the upper surface of the rectangular member, and jockey wheels engaging the two opposed side surfaces of, or the lower corners of, the rectangular member.

11. An apparatus according to claim 8, 9 or 10 wherein means are provided to retain the inflated bag in position on the trolley, said means comprising elements interconnecting zones of the bag to respective fixed points adjacent the base of the bag.

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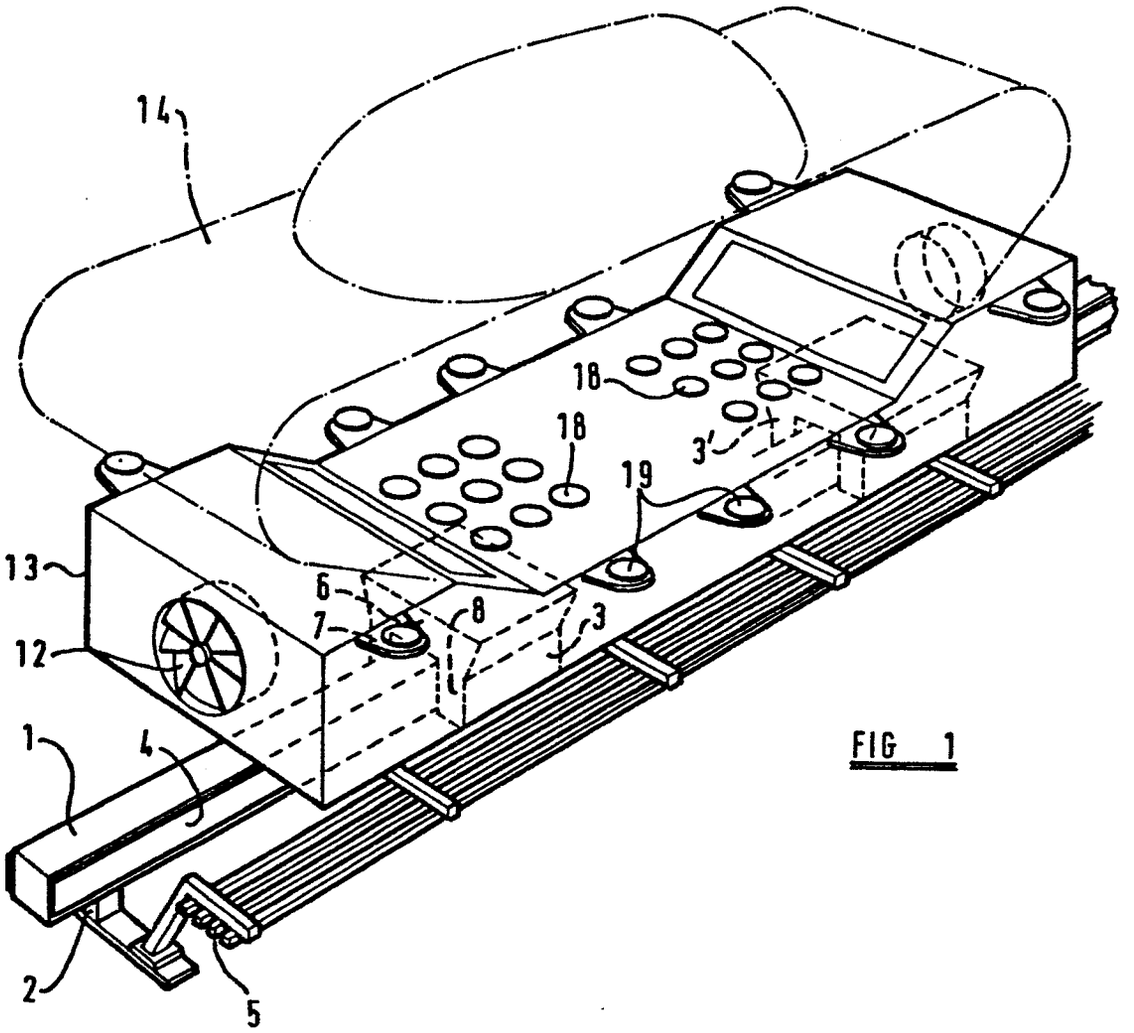

FIG 1

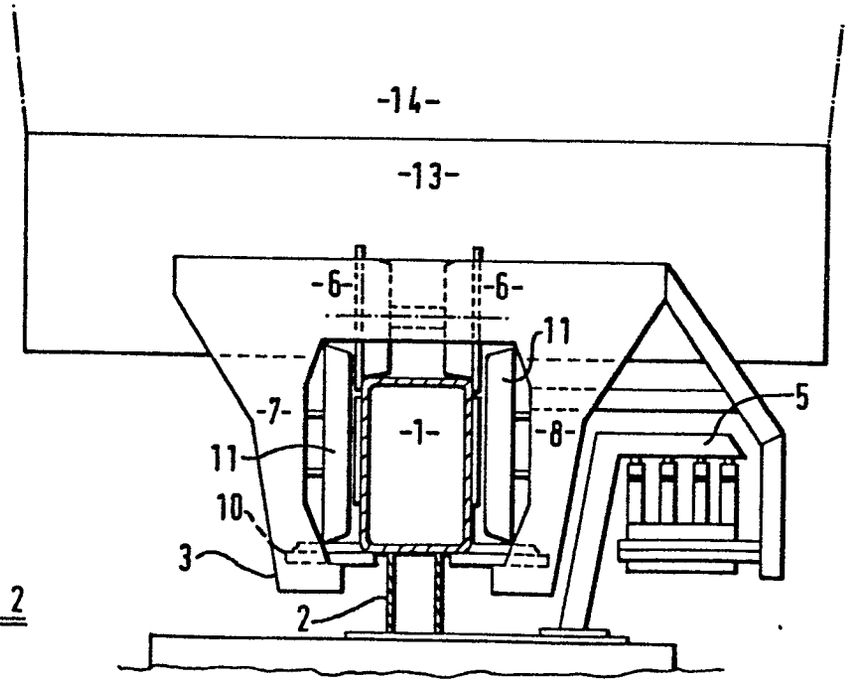

FIG 2

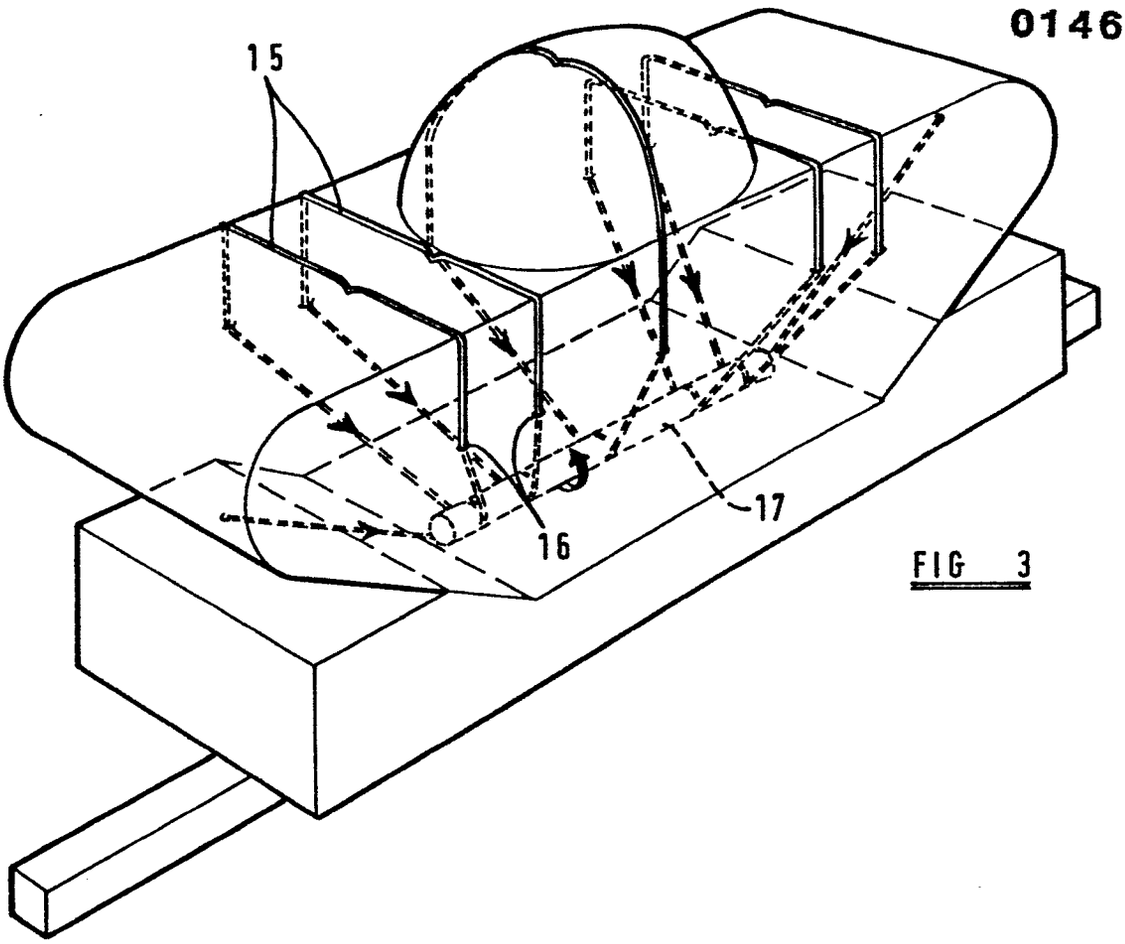

FIG 3

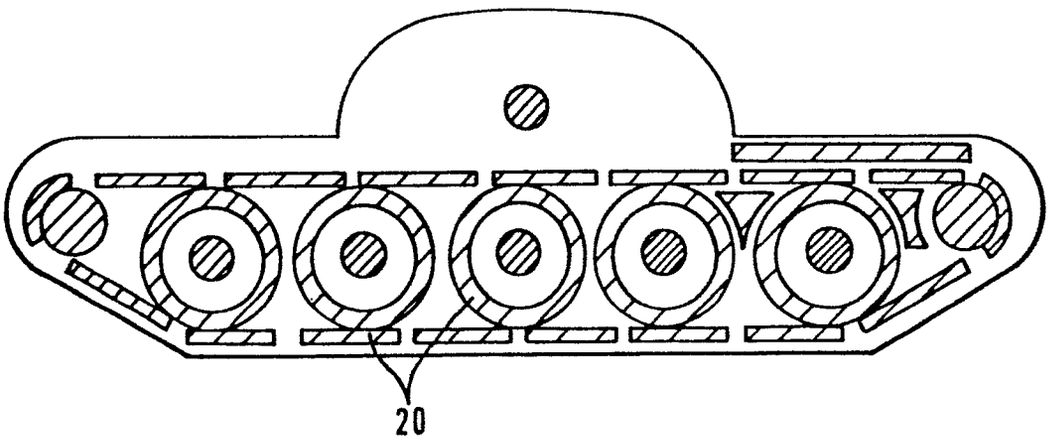

FIG 4

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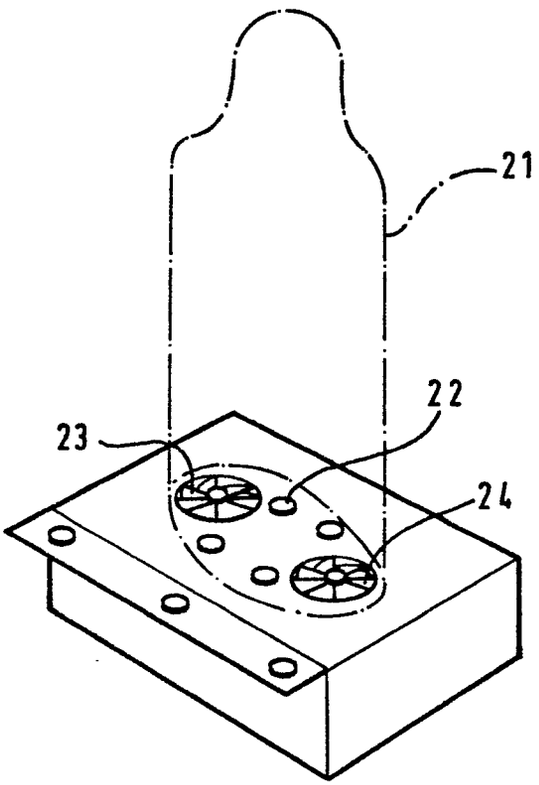

FIG 5