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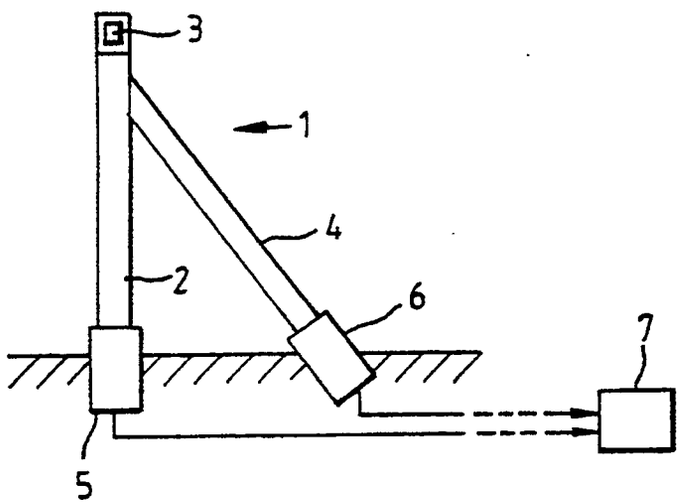
(54) Barrier structures.

(57) A crowd control barrier comprising a wall (14), crush barrier (12,13), handrail, fence, etc. has one or more strain gauges (5,6,11) or other sensors (15,16,17) built in,to sense the force applied to the barrier due to crowd pressure. The outputs of the sensors are fed to a central monitoring station (7) where any increase in monitored force can provide a warning of potential danger. Manual or automatic opening or closing of gates can be effected, as a result of the warning, to ease the crowd pressure.

Fig.1



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BARRIER STRUCTURES

This invention relates to barrier structures for controlling crowds, primarily of people,and to a method of detecting a potential or actual crowd control problem.

The term "barrier structure" herein is intended to include any structure which prevents or impedes the movement of people or animals including temporary or portable structures.

Barrier structures of various kinds are used to control crowds of people, such as spectators at sports events. In the event of crowd disturbances or overcrowding in, in the vicinity of, or in the approaches to, stadia, sports grounds, arenas or other public enclosures, the crush barriers, handrails, walls and/or fences may be subjected to high, and even excessive, loading, possibly resulting in failure of the structures.

In order to prevent such failure, the structures are currently very strongly constructed, and consideration has been given to good design and layout of the barriers, handrails and fences. For example, guidelines have been issued by the British government ("Guide to Safety in Sports Grounds" ISBN 0 11 3408404).

However, the use of such unyielding structures can result in injury or even death amongst spectators who are subjected to excessive crowd pressure.

It is an object of the present invention to provide improved barrier structures for crowd control. It is a further object of the invention to provide a method of detecting a potential or actual crowd control problem.

According to one aspect of the invention there is provided a crowd control barrier structure comprising barrier means ; and means to sense the magnitude of force applied to the barrier means by pressure of a crowd thereagainst.

The sensing means preferably comprises means to produce an electrical, ultrasonic, optical or hydraulic signal which varies in dependence upon the magnitude of said pressure. Said means may comprise at least one strain gauge, load cell or displacement-responsive transducer. The sensing means is preferably coupled to a remote monitoring station at which the effect of the force can be monitored. A plurality of barrier means may be provided in a particular installation, each provided with respective sensing means, and all of said sensing means may be coupled to a common monitoring station.

The or each barrier means may comprise a barrier rail, a handrail or a fence supported by a plurality of support members, or may comprise a wall.

According to another aspect of the invention there is provided a method of detecting a potential or actual crowd control problem, comprising monitoring a parameter of a barrier structure, which parameter varies in dependence upon the magnitude of pressure exerted against the barrier structure by the crowd.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawing, in which

Figure 1 is a schematic end view of a barrier structure comprising a barrier with supporting posts and braces ;

Figure 2 is a schematic end view of a barrier structure comprising a barrier with supporting concrete posts ;

Figure 3 is a schematic pictorial view of a barrier structure comprising a fence supported by posts; and

Figure 4 is a schematic pictorial view of a barrier structure comprising a wall.

Referring to Figure 1, a barrier structure 1 comprises a plurality of upright posts, such as a post 2, which support a rail 3 or a plurality of rails. At least some of the posts are braced by inclined braces 4. The posts, the rail or rails and the braces may be made of steel, for example. A sensor 5 is provided at the base of at least one of the posts to sense a parameter which varies in dependence upon the force applied to the structure 1 as a result of crowd pressure thereagainst.

The sensor 5 may comprise a strain gauge, the output of which varies as a result of bending of the post under the applied force. Alternatively, or additionally, a sensor 6 may be provided at the base of at least one of the braces. Such sensor may sense tensile or compressive stress induced in the brace. Alternatively, or additionally, sensors (not shown) may be provided in association with the rail itself.

Each sensor may comprise an individual sensor element or a pack of sensor elements, and each element may comprise a load cell, a strain gauge or a displacement-responsive transducer, depending upon the parameter which is to be sensed. The sensors may operate electrically, electronically, magnetically, ultrasonically, by electromagnetic radiation or hydraulically.

The or each sensor is preferably coupled by wire, a fibre optic cable, a radio, light or ultrasonic link, or a hydraulic line, as the case may be, to a central receiving station 7, at which the signal from the or each sensor can be monitored.

Further barrier structures may be provided around the enclosure, each provided with sensors, each of which is coupled to the central receiving station 7 or to another receiving station (not shown).

When the barrier structure or structures are in use, signals generated by the sensors are continuously monitored by personnel and/or by automatic monitoring devices at the receiving station or stations. If pressure against any of the barriers reaches a predetermined level at which a potential crowd control or overcrowding problem is indicated, an audible and/or

visual alarm is operated and/or automatic or manual means is operated to counter the problem. For example, gates may be manually or automatically closed to prevent the entry of further people into the enclosure or into a section of the enclosure. Alternatively or additionally, gates may be opened manually or automatically to allow people to escape from the enclosure. Such automatic monitoring devices may be implemented by hardware and/or by a suitable data processor and software.

Figure 2 shows an alternative form of barrier structure 8 which comprises concrete posts, such as a post 9, supporting a rail 10. A sensor 11 is provided at the foot of the post 9 to detect tensile or compressive stress in the post, depending upon the direction of the force applied to the structure by the crowd. Otherwise, the arrangement can be similar to the Figure 1 embodiment.

Figure 3 shows a similar arrangement, but in which the barrier comprises a fence 12 supported by posts, such as a post 13.

Figure 4 shows a wall 14 which includes panels incorporating sensors for sensing pressure exerted against the panels by a crowd. Merely for the sake of example, panels 15,16 and 17 of various shapes are illustrated.

It will be apparent that, in each of the described embodiments, alternative and/or additional sensors may be provided at any part of the barrier structure where a parameter changes due to force applied to the structure by pressure from the crowd.

The monitoring method according to the invention may be used in relation to existing barrier structures by the addition thereto of suitable sensors and associated monitoring equipment. Alternatively, purpose-built barriers incorporating the sensors may be installed.

The continuous monitoring of pressure against the barrier structure or structures will provide the operators or staff of the enclosure with an early warning of a potential or actual crowd problem, so that action can be taken before the situation reaches an advanced stage at which injury to persons could result. This clearly provides a considerable advantage over the previous ideas of merely providing very strong barrier structures and/or careful design of the barrier layout.

The provision of sensors in the barrier structures may also assist in the design of suitable structures for a particular situation.

The barrier structures may be used in relation to, for example, stadia, sports grounds, arenas and other public enclosures, and may be permanent structures or temporary or portable structures, such as structures erected temporarily for processions, festivals, outdoor meetings or rallies.

Although the invention is primarily for use in relation to crowds of people, it might be used in relation to animals.

Claims

1. A crowd control barrier structure characterised by barrier means 1 ;8 ;12 ;14 ;) and means (5,6 ;11; 15-17) to sense the magnitude of force applied to the barrier means by pressure of a crowd thereagainst.

2. A structure as claimed in Claim 1, characterised in that the sensing means (5,6 ;11 ; 15-17) comprises at least one strain gauge for sensing strain induced in the barrier means (1 ;8 ;12 ;14) due to said applied force.

3. A structure as claimed in Claim 1 or Claim 2, characterised in that the sensing means (5,6 ;11; 15-17) comprises at least one load cell for detecting loading of the barrier means (1 ;8 ;12 ;14) as a result of said applied force.

4. A structure as claimed in any preceding claim, characterised in that the sensing means (5,6 ;11; 15-17) comprises at least one displacement sensor for sensing displacement of or within the barrier means (1 ;8 ;12 ;14)caused by said applied force.

5. A structure as claimed in any preceding claim, wherein the barrier means (1 ;8) comprises at least one barrier member (3 ;10 ;12) supported by a plurality of support members (2,4 ;9 ;13) ; and wherein said sensing means comprises at least one sensor (5,6 ;11) coupled to a said support member.

6. A structure as claimed in any preceding claim, characterised in that the barrier means is a temporary or portable structure.

7. A crowd monitoring system including a structure as claimed in any preceding claim, characterised in that the sensing means (5,6 ;11 ; 15-17) is coupled to a receiving station (7) at which the effect of the force can be monitored.

8. A system as claimed in Claim 7, characterised in that the receiving station (7) includes means to operate an alarm if the monitored force rises above a predetermined level.

9. A system as claimed in Claim 7 or Claim 8, characterised in that the receiving station (7) includes means responsive to an increase of the monitored force above a predetermined level to cause operation of means to limit the crowd

pressure.

10. A system as claimed in Claim 9, characterised in that the limiting means comprises a gate which is automatically opened or closed in response to said increase in monitored force.

11. A method of detecting a potential or actual crowd control problem, characterised by monitoring a parameter of a barrier structure (1 ;8 ;12 ;14), which parameter varies in dependence upon the magnitude of pressure exerted against the barrier structure by the crowd.

12. A method as claimed in Claim 11, characterised in that said parameter is strain induced in the barrier structure (1 ;8 ;12 ;14) as a result of said pressure.

13. A method as claimed in Claim 11, characterised in that said parameter is loading of said barrier structure (1 ;8 ;12 ;14) caused by said pressure.

14. A method as claimed in Claim 11, characterised in that said parameter is displacement of or within said barrier structure (1 ;8 ;12 ;14) caused by said pressure.

Fig.1

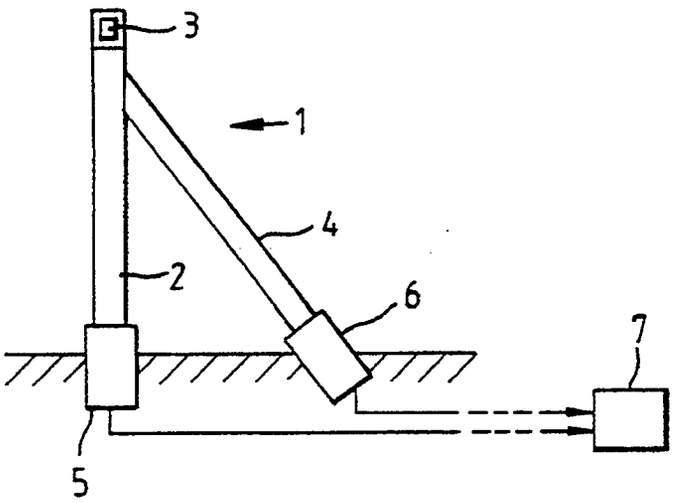

Fig.2

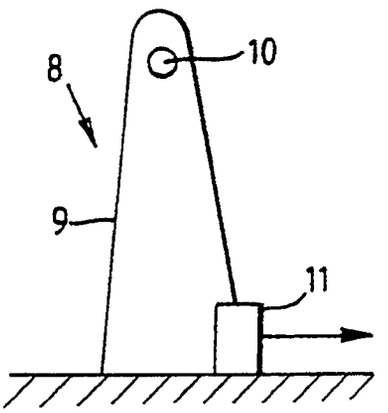

Fig.3

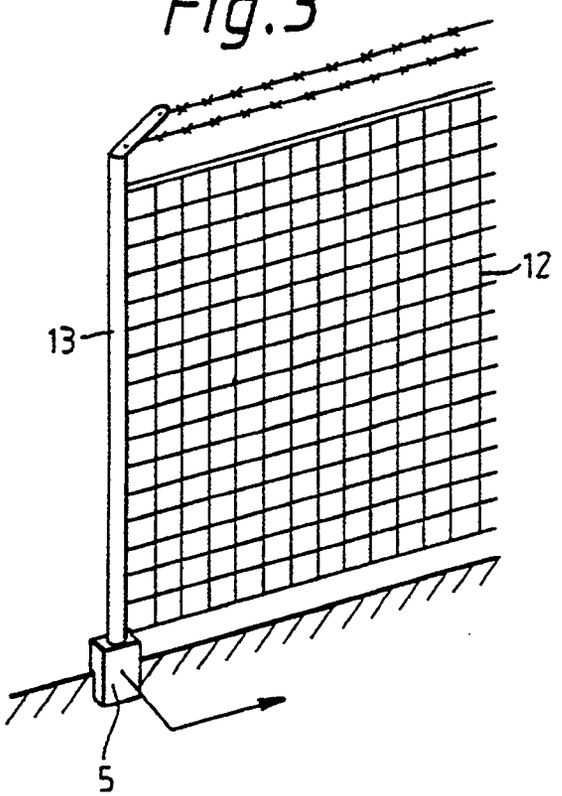

Fig.4