

DOOR CONTROL

The invention relates to the control of the opening and closing of doors by power means arranged to
5 detect the presence of an obstruction and halt or reverse the closing movement when an obstruction is found to be present.

Such doors are widely used in road and rail
10 vehicles, either sliding linearly, as in tube trains, or moving in arcs as in many public service vehicles used on the road. They are also used in buildings, for example in lifts.

Many proposals have been made involving a sensitive edge on the door to detect the presence of the obstruction. In one type there is a closed
15 pneumatic tube running the length of the edge of the door and connected to a diaphragm-operated electrical switch which halts the closing movement when
20 compression of the tube is detected. Another known system involves a rubber tube containing electrically conducting strips which are brought together for the same purpose when the wall of the tube is deflected by
25 an obstruction. In a third type the edge of the door is a hard rubber solid strip designed to move bodily relative to the door when an obstruction is encountered, the movement being detected by microswitches.

30 These systems are equally applicable to a simple door moving towards a fixed doorpost, or to two doors which come together in the middle of the opening. They are more or less satisfactory where the
35 obstruction is large, such as a person or a suitcase, but it is by no means unknown for such doors to fail to

react to a yielding item or a thin item such as an umbrella or the strap of a handbag. There is a particular danger where a handbag is trapped with the owner one side of the doors and the bulk of the bag the other side, only the strap of the handbag extending through the gap between the doors and remaining undetected. Indeed such a situation has been known to lead to a fatal accident.

Further systems are known which rely not on a sensitive edge on the door or doors but on detecting the change in the load on the driving system when the door encounters the obstruction. Where the drive is electric the rise in the armature current of the motor is detected and used to trip the supply so as to halt or reverse the movement. In the case of a pneumatic drive the hesitation in the smooth travel of the piston of the ram is detected by a pressure-sensitive switch on the exhaust side.

However even these do not respond to the presence of, for example, a handbag strap trapped between the doors. The aim of the present invention is to overcome this drawback and, if possible, eliminate the dangers mentioned above.

EP 0 018 239 describes a system for detecting the non-closure of automatic sliding doors. The system incorporates a spring-loaded plunger which passes into a close-fitting hole as the door is fully closed. The system is of complicated construction and is designed to detect even extremely thin obstructions to the door closure. If an obstruction is detected then the doors are, after a delay, automatically opened and re-closed.

The present invention provides a power-operated door and actuating system comprising a door and a door post or a pair of doors having cooperating edges fast therewith which are of inter-engaging shape, at least one of the edges being of bifurcated profile with at least a portion of the other edge entering an appreciable distance between the limbs of the bifurcated edge in the fully-closed position of the door or doors; first sensing means for detecting resistance to the closing movement; second sensing means for detecting when the door or doors are fully closed; and means for either halting or reversing the closing movement of the door or doors in the event that the first sensing means detects resistance to the closing while the second sensing means fail to detect that the door or doors are fully closed; wherein the cooperating edges are shaped and dimensioned such that the presence of even a thin obstruction between the cooperating edges will prevent the door or doors from closing by an amount at least equal to the said appreciable distance so as to ensure that the second sensing means does not detect that the door or doors are fully closed.

In the simplest case the one edge is of U-section and the other edge is a blunt blade which enters it. Both are moulded from hard rubber. If an object such as a stick or umbrella or strap is between the doors as they close it straddles the U-section and when the other edge engages it the door is held well away from its fully closed position so the detecting system responds.

In a typical case of a pair of doors for a public service road vehicle the U-section may be 40mm deep, and the portion or blade is likewise 40mm long but is flanked by two shoulders which, when the doors are

closed, are engaged by the free ends of the limbs of the U, thus giving three separate lines of sealing between the doors.

5 The invention will now be briefly described with reference to the accompanying drawings, in which:-

Figure 1 shows mating edges of a pair of doors about to complete their closing movement; and

10 Figure 2 is a diagrammatic layout of the pneumatic door operating system.

15 The doors 1 and 2 are of a public service road vehicle and in the example shown they move in arcuate paths but this is not important, the essential thing being that they move directly towards one another in the direction of the plane of their free edges during the final part of their closing movement. Each door

20 has an edge of hard moulded rubber, the female edge 3

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having limbs 4 and 5 between which the blade 6 on the male edge 7 enters, and it will be noted that the male edge has shoulders 8 which, in the fully closed position, are engaged by the limbs 4 and 5, so that the doors are sealed together at three separate sealing lines when closed. The hollow nature of the edge 7 gives it sufficient flexibility to allow the sealing to take place at all three points despite manufacturing tolerances.

It will be appreciated that if a strap or umbrella or walking stick (or a child's arm) is still between the doors when the blade 6 first enters the limbs 4 and 5 there will be resistance to further closing, and this will occur at least 40 mm before the final closed position. This is in contrast to known arrangements where two male blades simply come to abut against one another.

A simplified form of pneumatic circuit is shown in Figure 2. One of the door-actuating rams is shown at 10 approaching the fully closed position. Air passes from a source to the left-hand end of the ram through a double bleed valve 11, which has been moved to the position shown by actuation of the 'close' valve 12.

As the piston of the ram moves it exhausts air through a pipe 13 and restriction 19 to atmosphere. In the normal course of events this continues until a limit switch 14 is operated when the door is fully closed, which changes over a pilot valve 15 thus preventing air going to a diaphragm valve 20. To open the door subsequently an 'open' button 18 is pressed, allowing free communication to atmosphere and causing

the valve 11 to move to the left in order to admit air to the right-hand end of the ram 10.

If, during the closing movement, even during the last fifty or so millimetres of travel, the ram is slowed down by an obstruction, the pressure in the pipe 13 falls; this is because the right-hand end of the cylinder has up to then been exhausting at a steady rate through the restriction 19 on the exhaust side of the valve 11 and which has kept the pressure up as long as the flow was constant. When it falls the balance in the diaphragm valve 20 changes and air from the open side of the double bleed valve 11 passes through both the pilot valve 15 and the diaphragm valve 20 and discharges to atmosphere, venting the line 16 and causing the double bleed valve to move towards the left. The door then re-opens.

When the obstruction has been removed and the door is again closed by operating the valve 12, the movement is completed as described earlier.

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CLAIMS

1. A power-operated door and actuating system comprising a door and a door post or a pair of doors having cooperating edges fast therewith which are of inter-engaging shape, at least one of the edges being of bifurcated profile with at least a portion of the other edge entering an appreciable distance between the limbs of the bifurcated edge in the fully-closed position of the door or doors;

first sensing means for detecting resistance to the closing movement;

second sensing means for detecting when the door or doors are fully closed; and

means for either halting or reversing the closing movement of the door or doors in the event that the first sensing means detects resistance to the closing while the second sensing means fail to detect that the door or doors are fully closed;

wherein the cooperating edges are shaped and dimensioned such that the presence of even a thin obstruction between the cooperating edges will prevent the door or doors from closing by an amount at least equal to the said appreciable distance so as to ensure that the second sensing means does not detect that the door or doors are fully closed.

2. A system according to Claim 1 wherein a first edge is of U-section.

3. A system according to Claim 2 wherein a second edge is in the form of a blunt blade.

4. A system according to Claim 3 wherein the blade is flanked by a shoulder on either side.



5. A system according to Claim 4 wherein free ends of limbs of the U-section abut the two shoulders when the door is fully closed.
- 5 6. A system according to Claim 5 wherein the doors are sealed together along three separate sealing lines.
7. A system according to any preceding claim wherein at least one of the edges is hollow.
- 10 8. A system according to Claim 6 wherein the first edge has a hollow portion located between the U-section and a portion of the edge engaging with the door.
- 15 9. A system according to Claim 7 or Claim 8 wherein the second edge has a hollow portion located between the blade and a portion of the edge engaging with the door.
- 20 10. A system according to any preceding claim operated by a pneumatic circuit.
- 25 11. A system according to Claim 10 wherein the closing movement of the doors is stopped when an obstruction is detected.
- 30 12. A system according to any one of claims 1 to 9 wherein the closing movement of the doors is reversed when an obstruction is detected.
- 35 13. A system according to Claim 11 or Claim 12 wherein an obstruction is detected by a decrease in the rate of movement of the door.



14. A system according to Claim 11 or Claim 12 wherein an obstruction is detected by an increase in the load of the circuit.

5 15. A power operated door and actuating system substantially as described with reference to the accompanying drawings.

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