A device for the automatic detection of passengers getting in and out of public transport vehicles; by applying said device obtained further device for automatic passenger counting and device for automatically opening and closing of vehicle doors.

A device for the automatic detection of passengers getting into and out of public transport vehicles comprising electric pulses generating means automatically operated by such passengers. According to the Invention the device is characterized by an element which under the Influence of a passenger's weight is caused to move from a starting position, in opposition to a force tending to keep the element in its starting position, to approach an oscillator circuit and thereby to attenuate the oscillations generated by said circuit.
The invention relates to a device for the automatic detection of passengers getting in and out of public transport vehicles comprising electric pulses generating means, said means being automatically operated by said passengers.

It is known to base passenger counting systems of public transport vehicles on rays of light detectors which are provided in the door openings of for example trams and buses respectively. Passengers getting in and out of the vehicle, intersect subsequently two rays of light. The intersection of the rays of light are converted into electric pulses. The order and the frequency of the pulse interruptions were to determine whether a passenger was getting in or out as well as the number of said passengers. Added to this the system included a counting and registration device carried in the vehicle. It appeared that with a counting system of this type there were many reversing faults, that is to say direction interpretation faults as well as counting errors. Despite variation in the position of both the rays to be intersected and/or their mutual distance and also the introduction of various time delays in the signals coming from the light rays sensors, the results with the prior system continued to be insufficient.

Object of the invention is a device for the automatic detection of passengers getting in and out of public transport vehicles which does not comprise the aforementioned drawbacks and which, when combined with an automatic counting system, provide a counting result which match that of countings carried out by hand.

According to the invention a device of the aforementioned type is provided which is characterised by means, which may be brought to approach from its starting position under the influence of the passengers' weight against a force, sustaining the starting position, to an oscillator circuit while damping the oscillations.
The invention is based on the observation that it is not the movement of the passenger's trunk which takes place consistently but rather their step movements. By having the automatic detecting device based on this property of the passengers it is experimentally shown that an automatic passenger counting method for which use is made of so-called sensitive treadles, which are applied on two subsequent footboards in a doorway of a tram or a bus, may provide counting accuracies which indeed at least match that of countings carried out by hand. Accordingly the device according to the invention may be constructed as a composite element to be exchangeably mounted on a footboard in the doorway of a public transport vehicle, for example a tram or a bus, and comprising a bottom or an assembly plate as well as a top plate, being adjusted in about parallel relationship therewith and being movably and cooperatively connected with the bottom plate, which bottom plate is provided with one or more proximity switches which may be electrically parallel connected; electric current conducting leads for the operation of the proximity switches and an output lead, conducting the signals generated under the influence of the passengers getting in and out of the vehicles; the top plate as the oscillations damping element being made of a ferritic material.

The invention will be illustrated by means of the drawing which represents a preferred embodiment of a device constructed as a so-called sensitive treadle which is capable of being additionally provided in step cases of trams and buses without appreciable changes of the coach work, the independent construction of which making it easily exchangeable. In the drawing there is shown by Fig. 1 in top view the bottom plate having the shape of a rectangle with unequal sides;

Fig. 2 the bottom plate in side view, observed from the long side;

Fig. 3, not to the same scale, in bottom view the top plate, being able to be assembled with the bottom plate to provide the sensitive treadle;

Fig. 4 and Fig. 5 in side view the top plate, observed from the long and short side respectively;
Fig. 6, not to the same scale, the top plate in top view;
Fig. 7 schematically in perspective view four sensitive treadles mounted on the footboard in a door case of a tram;
Fig. 8 in cross-sectional view one of the four sensitive treadles, mounted in the door case of a tram, and
Fig. 9 the electric circuit of the proximity switch to be used in the sensitive treadle.

The sensitive treadle comprises a bottom plate on which are mounted:
- inductive proximity switches
- springs
- stop strips
- stop lugs
- accurately positioned nuts for stop-and-guide bolts; and in addition thereto a top plate, optionally provided with an anti-slip covering together with stop-and-guide bolts.

The bottom plate 1 forms the component construction part of the sensitive treadle. The inductive proximity switches 2 have been fitted on it in such positions that the sensitivity is distributed all over the surface as evenly as possible. On the bottom plate springs 3 are mounted, constructed as double leaf springs, which, at rest, hold the top plate at top position. The bottom plate also accommodates evenly distributed stop strips 5, on which the top plate will rest when a passenger stands on it and consequently overcomes the spring tension. The top plate is kept in position in relation to the bottom plate 1 by means of stop - and - guide bolts 7, being screwed in corresponding welded nuts in the bottom plate. When at rest, the springs keep on pressing the top plate upward against two stop lugs 8,9 at the front and against two stop - and - guide bolts on the back of the sensitive treadle. At the underside of the bottom plate 1 the connection to the electric circuit and the output lead is realised by means of a swivel/swivel nut combination. The top plate 6 of the sensitive treadle contains on all four sides bent-over edges 11,12 (Fig. 3, Fig. 4). The height of these edges is limited on both side edges and the rear edge because of the required small
height of the sensitive treadle and furthermore to limit the freezing of moist dirt on these bent-over edges. The front edge 11 of the top plate is higher for the following reasons. Practice has shown that the top plate is mainly stepped on at the front edge so that it is there that the top plate must have its utmost rigidity. Furthermore this higher edge at the front enables holes 13, 14 to be provided, through which the stop lugs 8, 9 mounted on the bottom plate may pass. The sensitive treadle is provided on a footboard 15 (Fig. 8) in a doorway of a tram or a bus in such a way that the bent-over front edge of the top plate hangs freely over the front edge of the footboard.

The bottom plate is made of austenitic stainless steel no. 316 which is a corrosion resistant type material.

The top plate 6 is made of a ferritic stainless steel no. 430. The ferritic properties are necessary to provide the effective damping of the proximity switches.

The stop strips fitted on the bottom plate are made of a synthetic plastic material, because this material has good resistance to chemicals, is quiet and is wear resistant as well as that it offers a slight risk of freezing on. Part of the stop strips on the bottom plate are provided along its periphery in such a way that these stop strips project by about 1 mm from the periphery of the bottom plate. The object of this is that in case the guide holes in the top plate through which the guide bolts have been passed and screwed into the corresponding nuts of the bottom plate, should wear out, the guiding of the top plate is taken over by the stop strips provided along the periphery of the bottom plate.

The springs 3 are of the symmetric leaf spring type, their points of attachment surfaces of the springs on the bottom plate remaining minimum.

The switch elements are inductive proximity switches, their height being 5.5 mm. The electric circuit of the proximity switches permits the external parallel connection of several switches. The protection from moisture of the sensitive treadle has been realised by encapsulating the inductive proximity switch in a moulding resin.
material. Thus the treadle can keep an open construction which enables treadles to be designed without using plastic sealing materials. The absence of plastic sealing materials also facilitates the compliance with the requirement of the even sensitivity all over the top plate in the event of extreme temperatures.

The operation of the sensitive treadle is based on the operation of the inductive proximity switch. This inductive proximity switch contains an L/C oscillator. Part of the oscillator circuit is a coil. This coil is placed in a potcore, being open at one end. The potcore is made of ferroxcube and its open end is directed upwardly. The top plate of the sensitive treadle, made of ferritic material, is applied over the open end of the potcore. When at rest, the top plate is at such a distance from the potcore that the proximity switch is in the undamped state. When a passenger stands on the top plate of the sensitive treadle he pushes it downward. The state of the proximity switch then consequently changes to the damped situation. The damped or undamped condition of the proximity switch is manifested by the voltage level of the output lead of the proximity switch. The electric output circuit of the proximity switch is such that it can be simply connected parallel with the outputs of other proximity switches. Thanks to that it is possible to provide several proximity switches in a sensitive treadle, owing to which the optimum even sensitivity of the sensitive treadle can be realized.

The joint output of the parallel connected proximity switches is manifested as one switch.

The sensitive treadle can be used in doorways of trams and buses for the detection of passengers getting in and out while this detection can be used as a component in complete automatic passenger counting systems as well as for automatic door closing systems.

It will be clear that the device according to the invention as described above and shown in the drawing may be modified without leaving the framework of the invention.

Thus, for example, in a different embodiment, the top plate and the bottom plate may be hinged together along their rear edges.
Under the influence of spring action the top plate is again moved upwards with the top and bottom plates being spaced an increasing distance from each other as viewed from the rear edge to the front edge. According to this embodiment, one single proximity switch, or if necessary two proximity switches will suffice. A single switch will be mounted in the middle of the bottom plate adjacent to the front edge thereof.

In still another embodiment of the invention, the bottom plate is omitted. As a component part of the construction is then used a spring leaf, which is bent-over along its transverse axis to an aperture angle of, for example, 10-20 degrees between the leaf halves. The upper leaf half is fixedly connected to the top plate so that the aperture angle of the folded spring leaf is directed to the front edge of the top plate. A proximity switch is secured to the bottom leaf-half adjacent the end thereof. Naturally it is also possible to have a construction employing a plurality of such combinations of spring leaf and proximity switch.
CLAIMS

1. A device for the automatic detection of passengers getting in and out of public transport vehicles comprising electric pulses generating means, automatically operated by said passengers, characterized by means, which may be brought to approach from its starting position under the influence of the passengers' weight against a force, sustaining the starting position, to an oscillator circuit while damping the oscillations.

2. Device according to claim 1, characterized in that the device is constructed as a composite element to be exchangeably mounted on a footboard in the doorway of a public transport vehicle comprising a bottom or assembly plate as well as a top plate, being adjusted in about parallel relationship therewith and being movably and cooperatively connected with the bottom plate, which bottom plate is provided with one or more proximity switches which may be electrically parallel connected; electric current conducting leads for the operation of the proximity switches; and an output lead conducting the signals generated under the influence of the passengers getting in and out of the vehicle; said top plate as the oscillations damping element being made of a ferritic material.

3. Device according to claim 2, characterized in that the positions of the electrically parallel connected proximity switches are chosen to obtain a sensitivity, distributed all over the surface of the device as evenly as possible.

4. Device according to claims 1-3, characterized by a moisture and corrosion resistant open construction of the space between the top plate and the bottom plate, said bottom plate being made of austenitic stainless steel, the top plate of a ferritic stainless steel and the proximity switches being encapsulated in a moulding resin material.

5. Device for automatic counting of passengers getting in and out a public transport vehicle, characterized in that the output lead of a device according to claims 1-4 is connected with an automatic passenger counting system.
6. Device for automatically opening and closing door systems of public transport vehicles, characterized in that the output lead of a device according to claims 1-4 is connected with an automatic door closing system.
## DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

### TECHNICAL FIELDS SEARCHED (Int. Cl.)

- G 06 M
- G 08 B
- G 08 G
- H 01 H

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**CATEGORY OF CITED DOCUMENTS**

- **T**: theory or principle underlying the invention
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