

Sept. 21, 1965

S. A. HORNING

3,207,266

ELEVATOR PASSENGER COUNTER

Filed Oct. 1, 1962

2 Sheets-Sheet 1

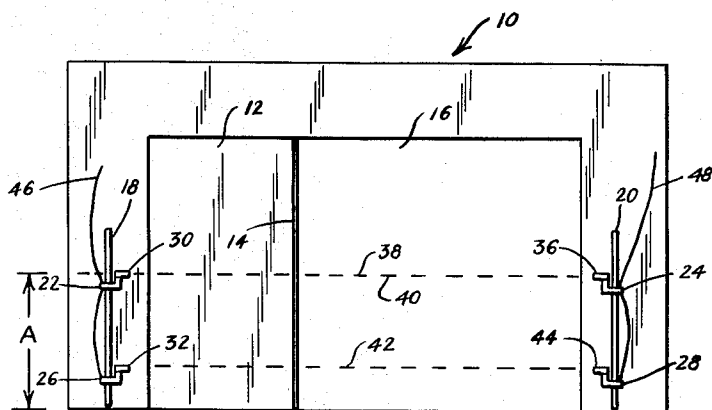


Fig. 1

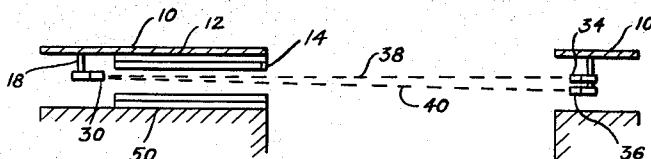
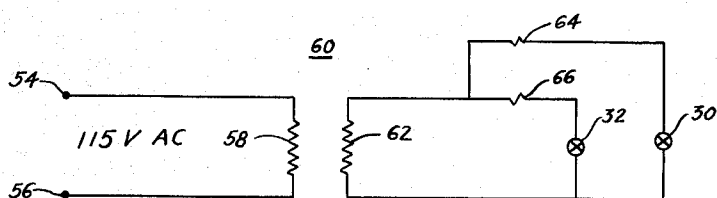


Fig. 2



TRANSFORMER

Fig. 3

INVENTOR

STEPHEN A. HORNING

BY

LeBlanc & Shur

ATTORNEYS

Sept. 21, 1965

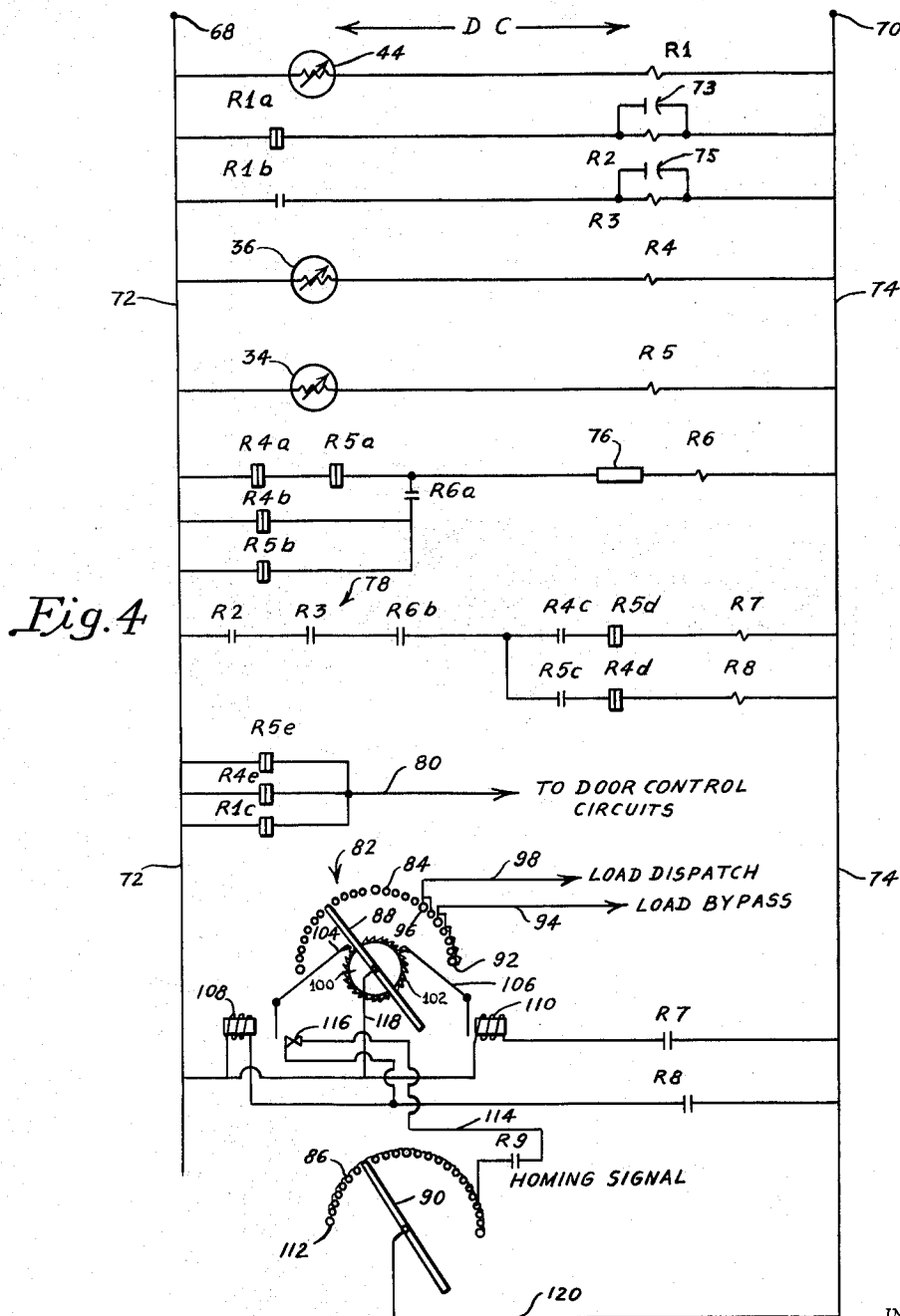
S. A. HORNING

3,207,266

ELEVATOR PASSENGER COUNTER

Filed Oct. 1, 1962

2 Sheets-Sheet 2



INVENTOR

STEPHEN A. HORNING

BY *Le Blanc & Shur*

ATTORNEYS

1

2

3,207,266

ELEVATOR PASSENGER COUNTER

Stephen Anthony Hornung, Louisville, Ky., assignor to
K. M. White Company, Inc., Louisville, Ky., a corporation of Kentucky

Filed Oct. 1, 1962, Ser. No. 227,161

11 Claims. (Cl. 187—29)

This invention relates to a counting device and more particular to a passenger counting and totalizing system particularly suited for use in conjunction with automatic elevators.

Photo tube counting systems for use with automatic elevators are well known and one such unit is disclosed in U.S. Patent 1,827,796. Systems of this type depend upon a pair of light beams traversing the entrance way of an elevator car which when interrupted actuate suitable circuitry to give an indication of a number of people entering and leaving the car. Since the weight load of the car is roughly proportional to the number of adult occupants the counters may be used to indicate when a car is full or nearly full and actuate suitable control circuits to dispatch the car ahead of time and if completely full to by-pass hall calls from intermediate floors.

A serious disadvantage common to known elevator passenger counters lies in their susceptibility to interference resulting in an erroneous indication of the number of passengers in a car. In some instances this interference is caused by the occupants of the elevator car who may be impatient to have the car dispatched and deliberately interrupt the light beams with their hands so as to produce an erroneous indication and early operation of the dispatching circuits.

The present invention avoids the above-mentioned difficulties by providing an automatic elevator passenger counting system which is much less susceptible to interference and which gives a more accurate and reliable indication of the total number of occupants. In addition to increased accuracy the system of the present invention is of relatively simple and inexpensive construction and is completely electrical in operation thus eliminating the necessity for any moving parts such as brushes and commutators.

It is therefore a primary object of the present invention to provide a novel counting system.

Another object of the present invention is to provide a counting and totalizing system particularly suited for use with automatic elevators.

Another object of the present invention is to provide a simplified elevator passenger load indicator.

Another object of the present invention is to provide an elevator car passenger counter having increased reliability.

Another object of the present invention is to provide a novel elevator car passenger indicator substantially less susceptible to interference.

These and further objects and advantages of the invention will be more apparent upon reference to the following specification, claims and appended drawings wherein:

FIGURE 1 is a front view of an elevator car incorporating the novel counter of the present invention;

FIGURE 2 is a partial horizontal section through the entrance way to the elevator car of FIGURE 1;

FIGURE 3 is a circuit diagram of the power supply for the lamps of the counter system of FIGURE 1; and

FIGURE 4 is a detailed circuit diagram of the passenger counting system of FIGURE 1.

While the counting system of the present invention is generally applicable wherever it is desired to count the number of persons or objects passing through an entrance way it is particularly suited for use in conjunction with automatic elevators and especially with the elevator dis-

patching and control system disclosed in U.S. Patent 2,854,096.

Referring to the drawings FIGURE 1 shows an elevator car generally indicated at 10 including a conventional double track sliding entrance door 12 which when moved outwardly to the position illustrated in FIGURE 1 provides an entrance way 16 to the interior of the elevator car. The car door 12 is provided with the usual cushion edge 14.

Mounted on opposite sides of the car 10 closely adjacent the door 12 are a pair of supporting rods 18 and 20 carrying a pair of upper brackets 22 and 24 and a pair of lower brackets 26 and 28.

Secured in the lefthand brackets 22 and 26 are lamps 30 and 32. Lamp 30 directs a beam of radiant energy onto a pair of photocells 34 and 36 as best seen in FIGURE 2. The inner portions 38 of the beam impinges upon photocell 34 while the outer portion 40 of the beam impinges on photocell 36. Lower lamp 32 similarly directs a beam of radiant energy 42 to a photocell 44 mounted in bracket 28. Suitable leads 46 and 48 supply electrical energy to the lamps and photocells.

As can be seen in FIGURES 1 and 2 the lamps direct beams of radiant energy across the entrance way 16 of the elevator car in the area between the elevator door 12 and a similar double track hoistway door 50. These beams are interrupted by passengers passing through the entrance way 16 either into or from the car 10 to actuate counting circuits more fully described below. The direction of movement of a passenger is determined by the sequence of interruption of the beam portions 38 and 40 to the photocells 34 and 36 while lower beam 42 assures a minimum of interference from the occupants of the car.

Lamps 30 and 32 may give off visible light but preferably emit energy outside the visible spectrum and may for example be infra-red sources since infra-red sources are less likely to attract the attention of the occupants of the car. Because of the limited amount of space available between the car door and the hoistway door it is necessary that the two photocells 34 and 36 be spaced very close together and should not be more than a few inches apart. In the preferred embodiment photocells 34 and 36 are spaced approximately 1 inch apart in the same horizontal plane. Furthermore it is preferred that the height A of the beam making up beam portions 38 and 40 with respect to the floor of the car be carefully chosen so as to assure an accurate account. The height of the lamp 30 and its associated photocells 34 and 36 should be at the level of the neck of an adult male and the head of an adult female. Preferably they should be in the order of from 52 to 56 inches above the floor of the car to produce an accurate indication of the number of adults in the car.

While the upper photocells 34 and 36 are illustrated as intercepting light from the single source 30 it is apparent that separate sources can be utilized if desired. Similarly one or both of the sources 30 and 32 can be placed on the side of the car other than that illustrated in FIGURE 1 with the corresponding photocell or photocells similarly reversed so that the light beam from one or more of the sources travels in the opposite direction.

FIGURE 3 illustrates the power supply circuit for the lamps 30 and 32. Energy from a suitable 115 volt A.C. source carried by the car is supplied to terminals 54 and 56 leading to the primary 58 of transformer 60. The secondary 62 of the transformer supplies energy to the lights 30 and 32 through a pair of overload protective relays 64 and 66 which relays act in the manner of fuses to break the circuits to the lights if the current flow through the relays becomes excessive.

FIGURE 4 shows a detailed circuit diagram of the counting system of the present invention. Terminals 68 and 70 are connected to a suitable source of D.C. poten-

tial and supply energy to the various elements of the circuit by way of main power supply lines or bus bars 72 and 74. Lower photocell 44 is connected across the supply lines in series with a relay R1. Interruption of the light beam impinging upon photocell 44 causes the photocell to increase in resistance in a well known manner so as to de-energize relay R1. Reestablishing the light to the photocell causes the relay to again become energized.

Normally closed relay contacts R1_a are connected across the power lines in series with a relay R2 in turn shunted by capacitor 73. Normally open contacts R1_b of the relay R1 are in series with the coil of relay R3 in turn shunted by capacitor 75. The outermost one of the upper two photocells 36 is connected in series with relay R4 while the inner photocell 34 is connected in series with relay R5.

Relay R6 is connected across the power lines in series with a delay resistor 76 in turn coupled to normally open contacts R6_a and the series combination of normally closed contacts R4_a and R5_a. Contacts R6_a are also in series with each of the normally closed contacts R4_b and R5_b.

An interference minimizing circuit is generally indicated at 78 and is composed of the three sets of contacts R2, R3 and R6_b all of which as indicated are normally open. The interference minimizing circuit is in turn coupled to the counting relays R7 and R8, first to the add relay R7 through normally open contacts R4_c and normally closed contacts R5_a, and second to the subtract relay R8 through normally open contacts R5_c and normally closed contacts R4_d. Normally closed contacts R5_b, R4_e and R1_c are connected in parallel and by way of lead 80 to suitable door control circuits such as those disclosed in U.S. Patent 1,822,152.

Also connected across bus bars 72 and 74 is a totalizer switch generally indicated at 82 comprising a first bank or level including an arcuate series of 24 separate contacts 84 and a second similar bank or level 86. The totalizer may take any desired form but is preferably of the stepper switch type construction shown and by way of example only may be of the type manufactured by the General Electric Co. Ltd. of England as disclosed in their Catalogue Leaflet No. UNL 3A and referred to as "Both Way Uniselectors." The contacts are sequentially swept by the ends of a pair of swingers 88 and 90. Bank 84 is utilized for indicating the total number of passengers in the elevator car while bank 86 is used to zero the indicator when the car changes direction so as to avoid cumulative error.

The last few contacts such as contacts 92 of the bank 84 are all shorted together and connected by way of lead 94 to suitable load bypass control circuitry. A next preceding group of contacts such as 96 are likewise shorted together in bank 84 and are connected by way of lead 98 to suitable load dispatch control circuitry. The load dispatch circuitry and load bypass circuitry to which leads 94 and 98 are connected may be of the type illustrated in U.S. Patent 2,854,096.

Wiper 88 of upper bank 84 is mounted on a wheel or drum 100 having a plurality of annular teeth 102 engageable by pawls 104 and 106 to provide a stepwise ratchet drive for the wiper 88 in either direction. Pawl 104 is actuated by solenoid 108 connected in series with normally open subtract relay contacts R8. Pawl 106 is similarly actuated by a solenoid 110 connected in series with the normally open add relay contacts R7. An impulse supplied to solenoid 108 causes the pawl 104 to engage the teeth 102 to move the wiper 88 the distance of one contact in the counterclockwise or subtract direction. Similarly solenoid 110 supplies an impulse to pawl 106 to cause the wiper 88 to move the distance of one contact in the clockwise or add direction.

All of the contacts in bank 86 are shorted together with the exception of the first or home contact 112. The common connected contacts of lower bank 86 in addition are connected to the normally open contacts R9 of a homing signal relay (not shown). These contacts are in turn

connected in series by way of lead 114 with a pair of self-interrupting contacts 116. The wiper arms 88 and 90 are connected to opposite sides of the power supply by way of leads 118 and 120.

In operation the passage of a person through the entrance way 16 towards the interior of the car 10 causes the light beams to photocells 34, 36 and 44 to be interrupted. Since photocells 34 and 36 are separated preferably approximately an inch apart in a horizontal plane the outer portion of the light beam 40 is first interrupted and then the inner portion 38. As a result the light to photocell 36 is interrupted before the light to photocell 34. The counting portion of the circuit including photocells 34 and 36 acts as follows.

Interruption of the light to photocell 36 increases the resistance of the photocell and deenergizes relay R4. A short time later the light to photocell 34 is interrupted causing relay R5 to drop out. As a result relay R6 is energized through normally closed contacts R4_a and R5_a. Resistor 76 is provided in the circuit to impart a small delay in the operation of relay R6 so as to prevent too fast a count. Once relay R6 is energized it remains energized through normally open contacts R6_a as long as light to either photocell 34 or 36 is interrupted.

After a person has passed through the door the light to photocell 36 is reestablished, energizing relay R4 which in turn energizes add relay R7 through contacts R4_c and R5_a by way of the interference minimizing circuit 78 more fully discussed below. Energization of add relay R7 pulses the bi-directional switch 82 by way of contacts R7, solenoid 110 and add pawl 106 to cause wiper 88 to move one contact in the clockwise or add direction. When the light to photocell 34 is reestablished, R5 is energized and as a result R6 and R7 are deenergized.

A passenger leaving the car causes an operation similar to that described above except that the light to photocell 34 is first interrupted and first reestablished so that upon reestablishment of the light to photocell 34 subtract relay R8 is energized through contacts R5_c and R4_d to actuate solenoid 108, and subtract pawl 104 to cause the wiper arm 88 to move one contact in the counterclockwise or subtract direction. In this way it is possible to keep a continuous record of the number of people in the elevator car 10.

When the number of people in the car reaches a predetermined level so that the wiper 88 engages one of the contacts 96 a load dispatch circuit is energized by way of lead 98 and the car is immediately dispatched to the upper floors from the main lobby. If prior to closing of the car doors the number of people in the car reaches a value such that the wiper arm engages one of the contacts 92 a load bypass circuit is energized by way of lead 94 and the car bypasses all hall calls until such time as the number of people in the car drops below a value where the wiper 88 engages one of the contacts 92.

An important feature of the present invention involves the interference minimizing light beam 42 impinging upon photocell 44. Interruption of the light beam to photocell 44 increases its resistance and deenergizes relay R1. This causes the contacts R1_a to return to their normally closed position so as to energize relay R2. At the same time contacts R1_b which have previously held relay R3 energized are opened. Relays R2 and R3 are shunted by capacitors 73 and 75 and hence both act as delayed drop-out relays. Hence relay R3 remains energized for a short time after relay R1 is deenergized so that the counting relays R7 and R8 may be energized through the closed contacts R2, R3 and R6_b of the interference minimizing circuit 78. If, however, the beam to lower photocell 44 is continuously interrupted for a period exceeding one or two seconds permitting capacitor 75 to discharge relay R3 will drop-out and the counting relays cannot be actuated. In this way continuous interruption of the lower beam for more than one or two seconds acts to disable the counter which may be desirable during periods

of manual operation of the elevator. A delay is incorporated in relay R2 for a short period of approximately $\frac{1}{4}$ or $\frac{1}{2}$ a second to insure coincidence between interruption of the upper beams and the lower beams to provide an accurate count. Hence the counter will operate upon reestablishment of the first intercepted one of the upper beams if the lower beam to photocell 44 has been interrupted within the preceding $\frac{1}{4}$ or $\frac{1}{2}$ second.

Most automatic elevators incorporate door protective devices which consist of a so-called safety-edge. This usually takes the form of a retractable rubber or plastic edge such as that illustrated at 14 in FIGURE 1 which when touched will operate a contact and cause the doors to reopen if they were closing or to remain open a slightly longer time. In addition many conventional elevators incorporate two light ray units mounted on the car door, one approximately eighteen inches from the floor and the other about three feet from the floor. If either one or both of the beams is interrupted the operation is similar to the safety-edge or rubber safety shoe as it is sometimes called. One additional operation is sometimes assigned to these two door control light rays, that of reducing the initial door open time to a second shorter time. For example if the door open time is set for five seconds, someone promptly passing through the door might reduce it to approximately one and one-half seconds.

In the present invention the lower beam 42 to photocell 44 not only acts to zone or gate the counter but serves the second additional function of operating the door control circuitry which may be of the type disclosed in U.S. Patent 1,822,152. In this way interruption of any one of the light beams, that is the light to any one of the photocells 34, 36 or 44 acts to drop out one of the relays R1, R4 or R5 and complete a connection to lead 80 by way of one of the contacts R5_a, R4_e or R1_c to the door control circuits. This provision insures that the door control circuits will be operated even by a child entering or leaving the elevator since interruption of the beam to the lower photocell 44 alone will actuate the door control circuitry.

It is apparent from the above that the present invention provides a novel elevator passenger counter for assuring rapid dispatch and control of automatic elevator cars. Important features of the present invention include the minimization of interference and particularly deliberate interference by passengers impatient to get to their desired floors. The totalizer switch in the present invention is actuated after the interruption of the first counting beam but prior to the reestablishment of the last counting beam so as to insure accurate zoning or gating of the count by the lower beam. In this way it is possible to avoid a fast count by the two upper beams which might not be registered due to the fact that the lower beam had not yet been interrupted and insures coincidence between beam interruptions. The provision of the additional lower zoning beam in no way increases the number of beams required since the zoning beam may do simultaneous double duty in operating the door control circuits.

The system of the present invention is of relatively simple construction involving no moving contacts other than a conventional stepper switch and does not rely on wiper contacts, brushes, commutators or the like which are subject to wear and faulty operation. The provision of the novel interference minimizing circuitry of the present invention in conjunction with its simplicity assures that an accurate and reliable count roughly approximating the weight load in the elevator can be obtained at all times.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and

range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A counting system comprising an entranceway, a pair of closely spaced radiant energy beams horizontally traversing said entranceway, means responsive to successive interruptions of said beams for indicating the number and direction of objects passing through said entranceway, a third radiant energy beam traversing said entranceway, and means responsive to interruption of said third beam for gating said indicating means.

2. A system according to claim 1 wherein said pair of beams are spaced not more than several inches apart in substantially a common horizontal plane and said third beam is below said pair of beams.

3. A system according to claim 1 wherein said pair of beams are from approximately 52 to 56 inches above the floor of said entranceway.

4. A counting system for elevator cars comprising a pair of photoelectric cells mounted adjacent the door of an elevator car, radiant energy source means directing radiant energy across the doorway of said elevator car onto each of said cells, said cells being spaced less than a few inches apart in a common horizontal plane, whereby persons entering and leaving said car successively intercept the radiant energy to each of said photocells, indicating means, means responsive to overlapping periods of interception of the radiant energy to both of said photocells for enabling said indicating means, means responsive to the reestablishment of radiant energy to the photocell whose energy was first intercepted for actuating said indicating means, additional radiant energy source means directing a beam across said entranceway, and means responsive to interruption of said beam for gating said indicating means.

5. A system according to claim 4 wherein said indicating means comprises a bi-directional counter for indicating the number of people in said car.

6. A system according to claim 5 wherein said radiant energy is visible light.

7. A system according to claim 5 wherein said radiant energy is in the infrared region.

8. A counting system comprising an elevator car having an entranceway, a pair of photoelectric cells mounted on said car adjacent said entranceway, radiant energy source means mounted on said car adjacent the side of said entranceway opposite from said photo cells whereby radiant energy traverses said entranceway and impinges on each of said photocells, said cells being in side by side relation whereby persons entering and leaving said car successively intercept the radiant energy to each of said photocells, a bi-directional counter for indicating the number of people in said car, means responsive to an overlap in the interception of radiant energy to both of said photocells for enabling said counter, means responsive to the reestablishment of energy to the photocell whose energy was first intercepted for correspondingly actuating said counter in the appropriate direction, means responsive to the reestablishment of radiant energy to the other of said photocells for deactivating said enabling means, a third photocell adjacent said entranceway, a radiant energy traversing said entranceway and impinging on said third photocell, and means responsive to interruption of radiant energy to said third photocell for gating said counter.

9. A counting system according to claim 8 wherein said gating means includes a short delay for insuring coincidence with the actuation of said counter.

10. A counting system comprising an elevator car having an entranceway, a pair of photoelectric cells mounted on said car adjacent said entranceway, radiant energy source means mounted on said car adjacent the side of said entranceway opposite from said photocells whereby radiant energy traverses said entranceway and

7

impinges on each of said photocells, said cells being in side by side relation whereby persons entering and leaving said car successively intercept the radiant energy to each of said photocells, a third photocell adjacent said entranceway, radiant energy traversing said entranceway and impinging on said third photocell, a bi-directional stepper switch for indicating the number of people in said car, means responsive to an overlap in the interception of radiant energy to both of said photocells for enabling said counter, means responsive to the reestablishment of energy to the photocell whose energy was first intercepted for correspondingly actuating said counter in the appropriate direction, and means responsive to the reestablishment of radiant energy to the other of said photocells for deactivating said enabling means, means responsive to interruption of radiant energy to said third photocell for gating said stepper switch, means

8

for coupling at least one contact on one bank of said stepper switch to a load bypass control, and means for coupling at least one preceding contact on said bank to a load dispatch control.

11. A counting system according to claim 10 wherein said pair of photocells is at the level of the neck of an average adult male passing through said entranceway and said third photocell is near the floor of said car.

References Cited by the Examiner

UNITED STATES PATENTS

2,047,665	7/36	Beggs	250—221 X
2,779,439	1/57	Borden	187—29
2,838,136	6/58	Nikazy	187—29
2,900,521	8/59	Eames	250—221 X

ORIS L. RADER, *Primary Examiner*.