United States Patent [19]

James

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[54] **TICKET ISSUING AND COLLECTION SYSTEMS**

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[73] Assignee: **National Research Development Corporation,** London, England

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[21] Appl. No.: **236,583**

Related U.S. Application Data

[62] Division of Ser. No. 00,014, Jan. 2, 1970, abandoned.

[52] **U.S. Cl.**..... **235/61.7 R;** 194/4 R; 235/61.8 A; 340/149 A

[51] **Int. Cl.**[2]..... **G06K 5/00;** G07F 7/00

[58] **Field of Search**..... 235/61.8 A, 61.7 R, 61.7 B; 340/149 A; 194/4 R, 4 B, 10, 2; 30/124

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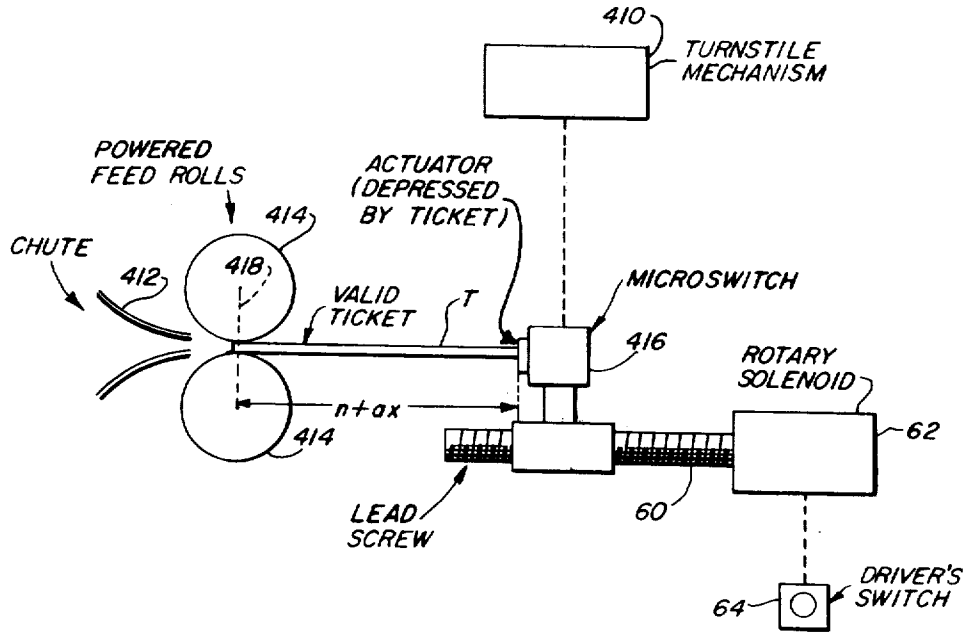
Primary Examiner—Thomas J. Sloyan

Attorney, Agent, or Firm—Cushman, Darby and Cushman

[57] **ABSTRACT**

The invention provides a ticket system for public transport vehicles based on the use of tickets which require to be of a predetermined length when presented for checking as the passenger leaves the vehicle, this length being determined on issue of the ticket by mechanism which allows for the issue point in relation to the complete journey and also in accordance with the fare paid: thus all tickets checked at any particular point should be of the same length irrespective of their several issue points, and any short ticket indicates short payment.

8 Claims, 12 Drawing Figures



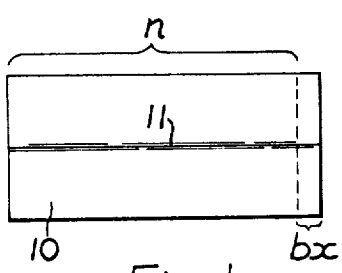


Fig. 1.

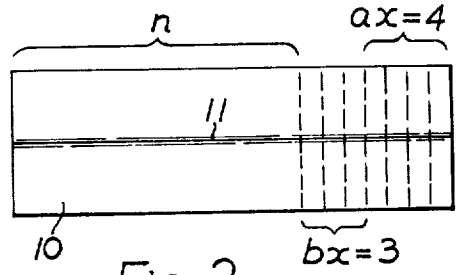


Fig. 2.

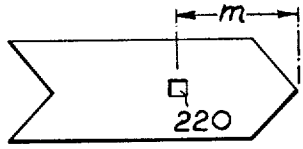


Fig. 3.

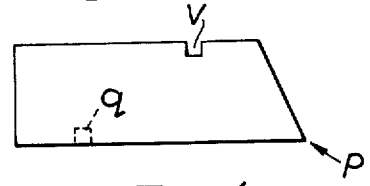


Fig. 4.

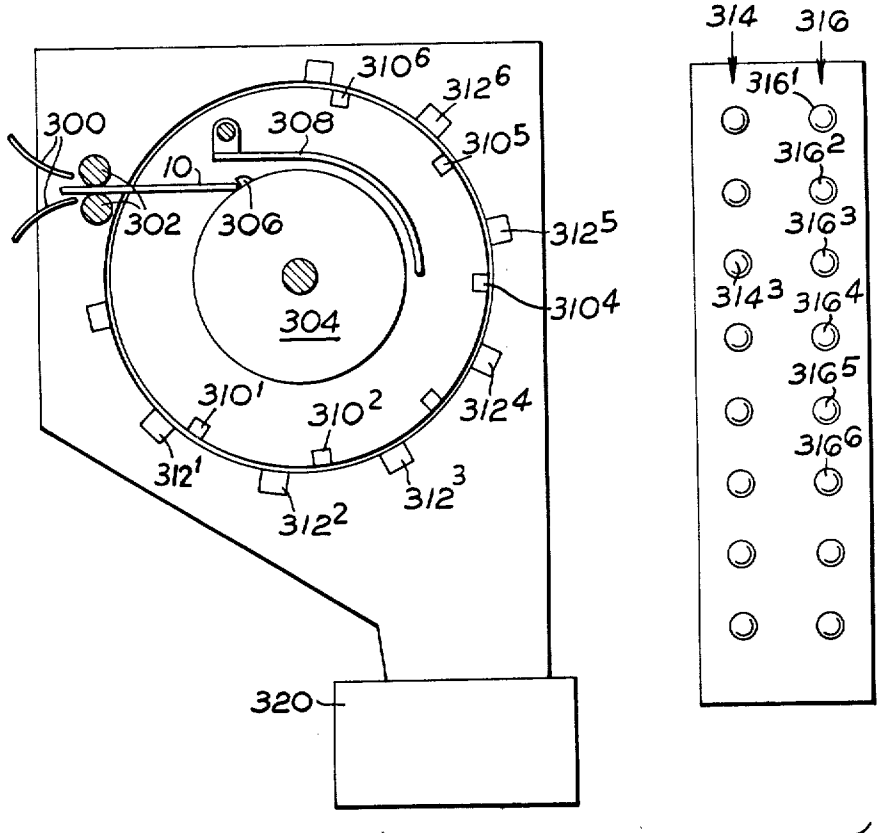
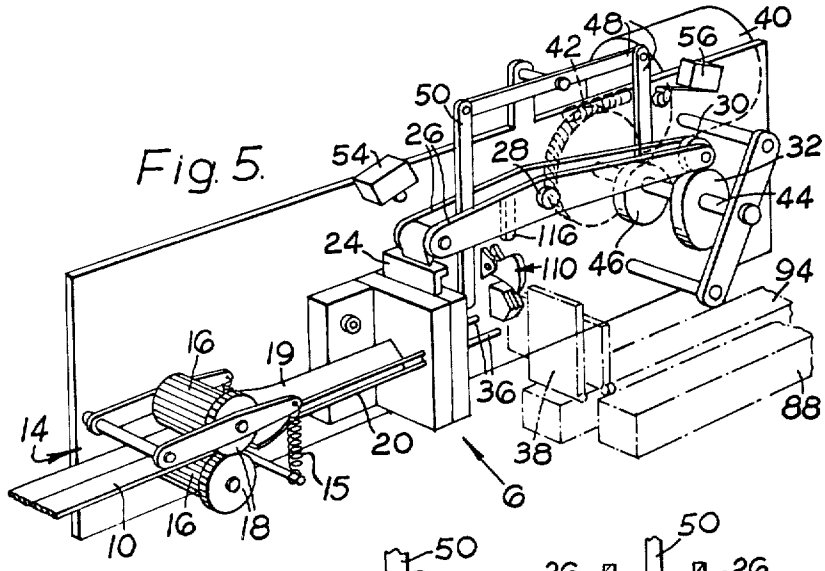


Fig. 11.

Fig. 5.



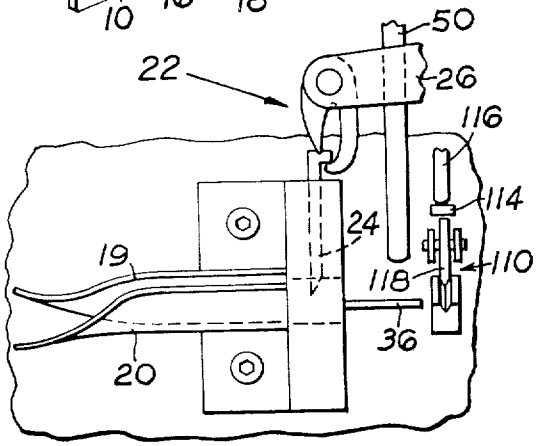


Fig. 6.

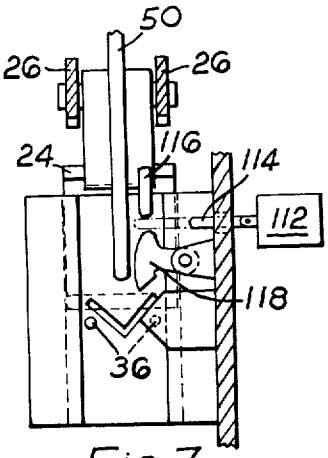


Fig. 7.

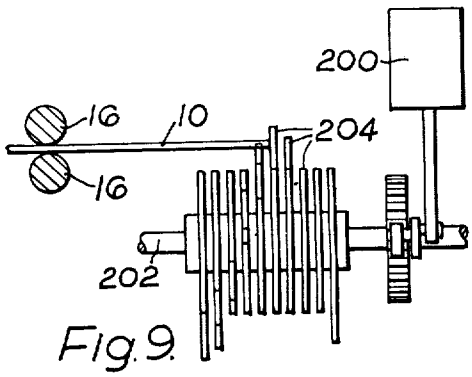


Fig. 9.

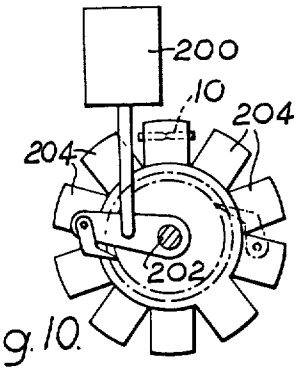


Fig. 10.

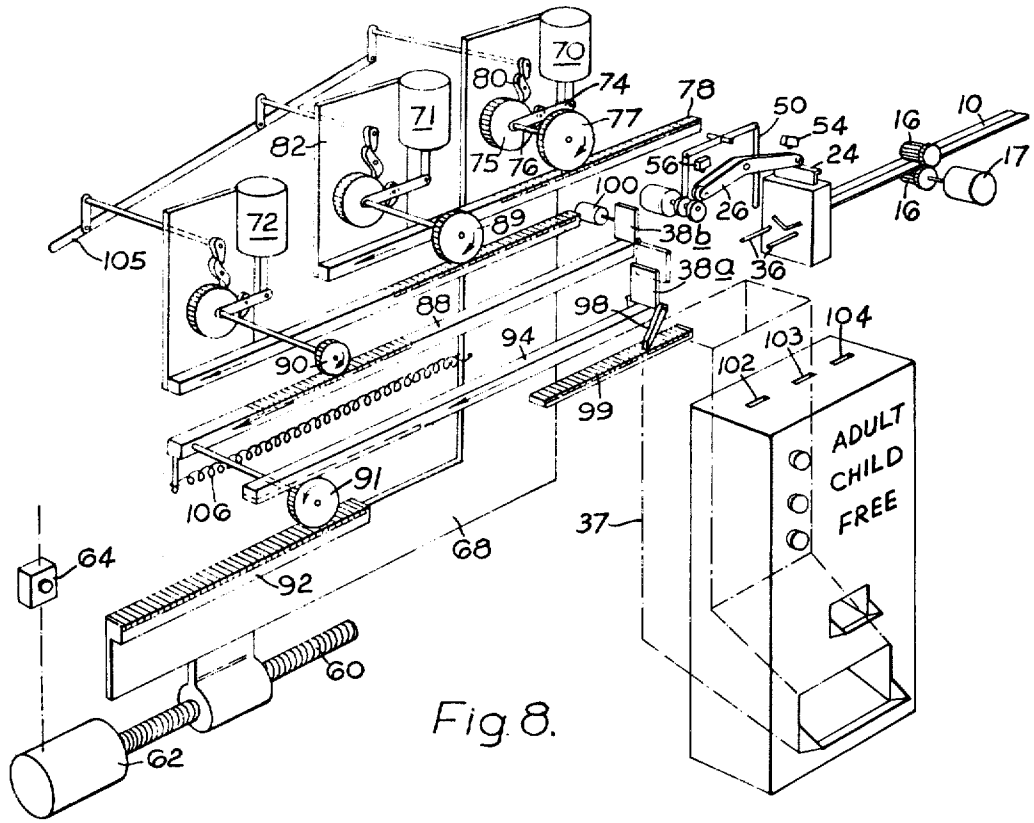

70
71
72
80
74
78
77
82
75
76
50
54
24
56
100
26
38b
38a
36
16
10
17
105
88
98
94
90
99
104
103
102
ADULT
CHILD
FREE
91
106
37
64
68
92
60
62

Fig. 8.

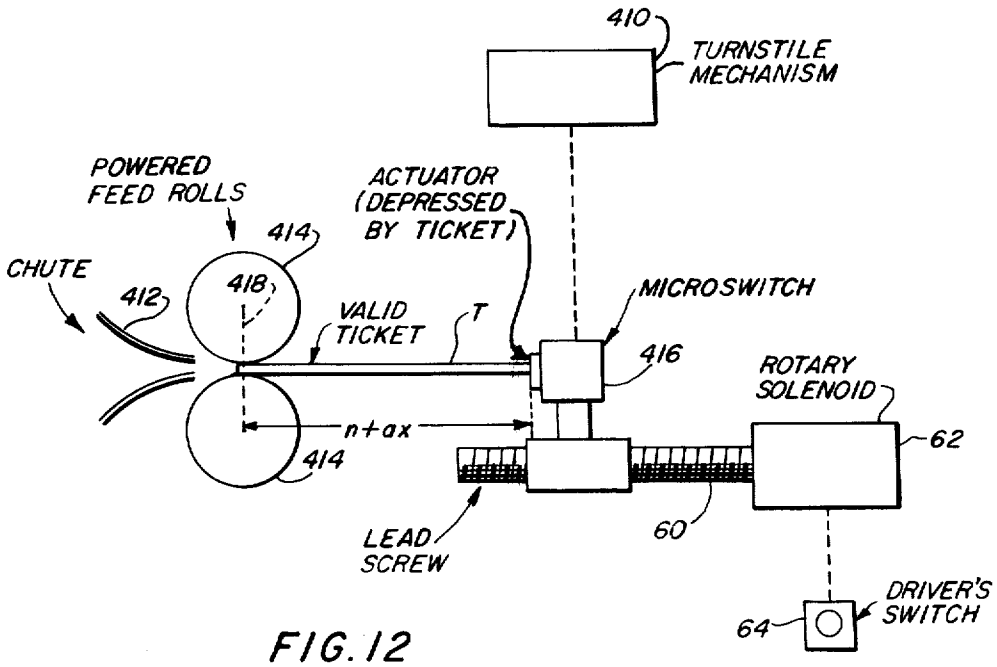

410
TURNSTILE MECHANISM
POWERED FEED ROLLS
ACTUATOR (DEPRESSED BY TICKET)
414
CHUTE
412
418
VALID TICKET
T
MICROSWITCH
416
ROTARY SOLENOID
n+ax
414
62
60
LEAD SCREW
DRIVER'S SWITCH
64

FIG. 12

TICKET ISSUING AND COLLECTION SYSTEMS

This is a division, of application Ser. No. 14, filed Jan. 2, 1970, now abandoned.

This invention relates to ticket issuing and collecting systems for Public Transport vehicles.

The objects of the invention are to provide novel systems and related apparatus for use therewith which are adapted (but not exclusively) for use on so-called "one-man vehicles" or "conductor-less vehicles," e.g. omnibuses, which will minimise delays at ingress and egress doors, and control or prevent passengers freely leaving the vehicle after riding in excess of the fare paid distance. The invention is based on the use of so-called "logical fare structure" where each stage travelled by the passenger (or part stage) incurs unit fare payment.

In accordance with a broad aspect of the invention, a ticket or token system for use in connection with a transport vehicle comprises a ticket having a significant portion of a length corresponding to the formula $a\,x + b\,x$ where a is the number of stages travelled by the vehicle before the ticket is issued and b is the number of units or stages of travel paid for.

Also in accordance with the invention, apparatus for issuing tickets or tokens comprises means for delivering tickets having a significant portion of a length dimension corresponding to the formula $a\,x + b\,x$ where a is the number of stages travelled by the vehicle before the ticket is issued and b is the number of units or stages of travel paid for.

Further in accordance with the invention, apparatus for accepting or rejecting tickets or tokens comprises means for comparing the significant length dimension of a ticket with a standard determined by number of stages travelled by the vehicle at the point of comparison and for accepting tickets equal to or greater than that length, and rejecting others.

The significant length may be the whole of the ticket so that tickets issued at different stages of the journey for a journey to the terminus will be of different lengths.

Alternatively, the tickets may be of standard and invariable length, and have for example a notch or slot cut into the ticket so that the distance between that notch or slot and the end of the ticket comprises the significant length, in which case it may be necessary to provide the said end with a recognisable marking such as another slot or notch; again the tickets may be assymetrical about a longitudinal line, and the notch or the like placed at different positions along one or other side to the same effect.

Instead of using notches or slots to mark one end of the significant portion, the whole ticket length, over the significant portion, may be marked, e.g. with ink, or magnetic ink.

Preferably the whole of the ticket is significant and the formula is $n + a\,x + b\,x$ where n is a constant, and this enables x to be reduced to a small dimension proportional to the sensitivity of a switch or like to be operated by the ticket itself. The invention therefore contemplates the use of relatively rigid tickets, as compared with the very thin paper used e.g. in some conventional ticket printing machines, although a light weight thin section extruded thermoplastic synthetic resin especially one adapted to be folded to Vee section may well be suitable. The addition of n gives a minimum length convenient for handling e.g. of one inch, for a minimum journey effective from the beginning of the vehicle journey, and because x may be small, e.g. one millimetre or one-sixteenth part of an inch, the maximum ticket length, e.g. for a journey of sixteen stages will still be less than 2 inches.

Further details of the invention will be apparent from the following description described with reference to the accompanying diagrammatic drawings, wherein:

FIG. **1** shows one ticket;

FIG. **2** shows another ticket; both the tickets of FIGS. **1** and **2** being issued by an apparatus according to one embodiment of the invention;

FIGS. **3** and **4** show modified tickets useful in other embodiments referred to hereinafter;

FIG. **5** is a perspective view of part of one embodiment of ticket issuing apparatus;

FIG. **6** is an enlarged fragmentary view in the direction of arrow **6**, FIG. **5**;

FIG. **7** is an end elevation of the parts shown in FIG. **6**;

FIG. **8** shows, in enlarged perspective view, another part of the apparatus of FIG. **5**;

FIG. **9** is an elevation and FIG. **10** an end elevation of an alternative apparatus, showing part only; and

FIG. **11** is a diagrammatic view of a ticket collecting and measuring apparatus.

FIG. **12** is a diagrammatic view of a ticket actuated exit control system following the principles hereof.

The system now described is based on use of tickets of predetermined but variable length. The total length of any ticket will be $n + a\,x + b\,x$. The basic length of a ticket $= n$ which may be any convenient short length, for example one inch. This is increased by two factors. Firstly, the factor a represents the issuing stage number. Thus if a ticket is issued at the commencement of the journey, between stages **0** and **1**, the first factor is zero. If issued at or after stage **1** and before stage **2**, the value of $a = 1$ and so on. For example a ticket issued at stage **10** will result in $a = 10$. The value of x may be any convenient small dimension, as will be better understood from a reading of the later parts of the specification, but may be e.g. 1/16 inch.

The value of factor b depends upon the number of stages paid for. Thus, if the logical fare structure is **6***d* (or any like monetary unit) per stage, then **6***d* buys a one stage journey, and $b = 1$. If five shillings is paid (being 10 of said monetary units), $b = 10$ (that is 10 sixpenny stages) and so on.

Hence, using the values quoted, a sixpenny ticket bought at stage **0** will have a length of

$$n + a\,x + b\,x = 1'' + 0 \cdot \frac{1}{16} + 1 \cdot \frac{1}{16} = 1'' + 0 + \frac{1''}{16} = 1\frac{1''}{16}$$

Equally, a two shilling ticket bought at stage **3** will have a length of:

$$n + a\,x + b\,x = 1'' + 3 \cdot \frac{1}{16} + 4 \cdot \frac{1}{16} = 1'' + \frac{3}{16} + \frac{4}{16} = 1\frac{7''}{16}$$

The ticket FIG. 1 and 2 comprises a length of an extruded plastics flat ribbon **10** with longitudinal groove **11** to allow the ribbon to be folded into a Vee to give relative rigidity. The required degree of stiffness and rigidity will be better understood from a reading of the later parts of this specification. FIG. 1 shows a ticket for 1 stage bought between stages **0** and **1**. FIG. 2 shows a ticket issued after stage **4**, for a three stage journey.

Turning now to FIG. 5, the issuing mechanism includes wound spools or magazines of the ticket material, which is fed in the flat condition, in direction of arrow **14** between spring **15** loaded drive rolls **16** which are geared together at **18**. The rolls are driven by a motor **17** not shown in FIG. **5**, which may be constantly driven, or started when the apparatus is brought into use by operating a push button or inserting coins (as later described).

On the output side of the rolls is a forming guide comprising complementary Vee members **19, 20** which form the ticket into like shape and support it.

The guide terminates at a cutter mechanism **22**, see FIG. **6**, including a guillotine **24**, driven via double lever **26**, pivoted at **28**, and with a follower **30** at its opposite end engaged with a cam **32**. At rest, the guillotine closes the guide and the ticket material end abuts the guillotine blade. Beyond the guillotine, in the same direction **14**, is a skeleton guide having parallel lateral members **36**, and a movable stop **38**. The spacing of stop **38** from the guillotine is equal to the $n + a\,x + b\,x$ formula for the next ticket to be issued.

Cam **32** is driven from motor **40** via worm gear **42**, and the shaft **44** carrying the cam **32** also carries a second cam **46** operative on a lever system **48** which includes plunger **50** displaceable between the double lever **26** (and guided thereby) and terminating between the guides **36**.

In operation, the motor is started by the button operation (as described hereinafter) and the cams **32, 46** causes the levers **26** and **48** to pivot (with the aid of spring means not shown) to allow the ticket material to feed forward, along guide **36**, until it hits the stop **38**. As the lever **26** reaches one extreme position, a micro switch **54** is hit, and this stops the motor **40**. Stop **38** incorporates a further micro-switch which restarts the motor to return the lever **26**, and cut the ticket by the guillotine **24**, and in this part of the shaft movement the second cam **46** causes plunger **50** to be displaced downwards into the Vee of the ticket so as to collapse it and displace it through the guide **36** to fall down a delivery chute **37** (not shown in FIG. **5**). The lever system actuates a further micro-switch **56** at this point to stop the motor. The ticket material forming part of the store roll or magazine then terminates at the guillotine so that the cycle is complete and ready for repeat.

The position of stop **38** is adjustable towards and away from the guillotine (never approaching nearer than the dimension n). The adjustment is effected by two control systems. Firstly, a sub-assembly including stop **38** is movable (FIG. **8**) by a lead screw **60** under the control of motor or rotary solenoid **62** operated by a so-called "driversbutton" **64**, which is operated at each stage point, and fires the single revolution motor or solenoid to advance the complete sub-assembly frame **68** one increment x away from the guillotine. Thus at stage **0** the frame is at position zero, at stage **1** is advanced to $1x$ from position zero, and so on. Signal lights may show the frame position for ease of reference.

The frame carries a solenoids set, electrically connected to a coin selector and rejection mechanism which may be of any desired complexity. The arrangement shown is on the assumption that coins of three different values may be used, namely a one unit ($6d$), half unit ($3d$) or one sixth unit ($1d$). Obviously the system would be simplified if the arrangement were to use coins of a single value only, but equally the values could be unit and multiples of one unit, as will be clear from the following description.

Three solenoids are employed, indicated by references **70, 71, 72** and all are alike. Each is connected to a different coin path switch, so that the passage of $6d$ pieces along one path fires solenoid **70**; $3d$ pieces along another path fire solenoid **71**, and $1d$ pieces fire solenoid **72**. Each solenoid armature is connected via a lever and pawl system **74**, to turn pinion **75** and shaft **76** (in the case of the first solenoid) and a gear **77** of e.g. **60** teeth meshes with a first rack **78**. In the solenoid stroke the pinion and gear are turned through a fixed angle, say 36°, and hence the rack **78** is displaced by **6** teeth. A locking pawl **80** holds the pinion in the fired position, whilst the lever system is spring or otherwise returned, so that a succession of like coins will fire the solenoid repeatedly and advance the rack by like increments on each occasion.

The rack **78** is fast with a sub-frame **82** on which the second solenoid is mounted. Hence, coin operated movement of the first solenoid displaces the second solenoid, and as the system is repeated, likewise displaces the third solenoid and rack **88**. The difference between the three parts of the system is that the gear **89** operated by the second solenoid **71** has half the number of teeth and hence displaces its rack by 3 tooth increments when solenoid **71** is fired, and solenoid **72** operates gear **90** with a further reduced number of teeth (e.g. **10** teeth) so that its rack (**88**) is displaced in one tooth increments.

In this arrangement, six rack teeth equal one stage increment, that is the factor x in the formula $n + a\,x + b\,x$.

Rack **88** carries a further pinion **91** which runs on rack **92** (which is fixed on the frame **68**) and on rack **94** (which is displaceable). Hence the two racks **88** and **94** are moved in accordance with the sum of the coins fed, through distances which are respectively $b\,x$ and $2\,b\,x$.

Considering now the logical fare structure frequently employed in this country, children usually travel at half fare, so that a ticket for a four stage journey requires the stop **38** to be moved for $4x$ in return for a payment of two monetary units (one shilling). The movement of rack **94** provides this.

Rack **94** carries a first stop **38***a* which is pivoted for slight movement, and carries a pawl **98** which, when the stop is pivoted by the ticket end impacting the same, moves the pawl into engagement with locking rack **99** which is fixed relative to the whole apparatus, so as to lock that stop **38***a* and prevent the same being displaced. Behind the stop is the micro-switch previ-

ously referred to, which causes lever operation and ticket cutting and ejection.

It will be appreciated that stop **38***a* moves under coin operation at twice the speed of a second stop **38***b* carried by rack **88.** Stop **38***b* is located normally out of the path of the ticket material so as to allow unimpeded feed of the ticket material up to stop **38***a*. Stop **38***b* is pivoted for movement into said path by solenoid **100** and is provided with a pawl for locking rack operation exactly as stop **38***a*.

The apparatus incorporates a selector mechanism, FIG. **8,** conveniently housing the coin-freed mechanism with coin slots **102, 103, 104** and push buttons marked "free," "child" and "adult." Operation is to insert the coins and press the appropriate button. If "adult" is pressed, solenoid **100** is operated, and the ticket is measured to stop **38***b* and cut to that length. If "child" is pressed, solenoid **100** does not operate and stop **38***a* controls the length. If "free" is pressed, and no coins inserted, the ticket reaches the first erected stop (**38***b*) but without any solenoid caused frame and stop movement, and the ticket is measured to $n + a\ x$. This gives a measure of the boarding point only. Should "free" be pressed and money inserted, the result is the same as if "adult" is pressed.

Operation of the lever **26** and micro switch **56,** terminates the cutting and ejection cycle, also operates lever **105,** FIG. **8,** which releases all of the pawls **80,** and frees the pinions and gears for free wheel return motion. Spring **106** then retracts the two sub-frames and closes the three solenoids together to the start position, and similarly at the commencement of a fresh cycle these pawls are re-engaged.

In order to distinguish between half-fare and full fare tickets, a notching device **110,** FIGS. **5–7** is employed. Operation of the "child" button operates solenoid **112,** which displaces an abutment **114** between a stop **116** on the guillotine and a cutter **118,** so that the cutter is displaced when the ticket is cut, to form a notch therein. If the "child" button is not pressed, the cutter is inoperative.

Instead of using series located and arranged solenoids as in FIG. **8,** the arrangements of FIGS. **9** and **10** can be used for example. In this arrangement, a solenoid **200** angularly turns shaft **202** carrying angularly located and spaced stops **204,** so that different ones of the stops in turn are erected into the path of the ticket **10** from feed rolls **16.**

The vehicle driver may select a control position as each stage is reached, by pressing a button, turning a knob or other means, so that the first stop is moved into the path of the material at the first stage, the second at the second stage, and so on. When coins are accepted, further stops are moved according to the value of the coins. Thus at the third journey stage, the third stop is erected by the driver's control, and a one and sixpenny payment (using the value suggested hereinbefore) erects the sixth stop. Movement of any one stop cancels the previously erected one, i.e. takes it beyond the operative position.

Solenoid **200** may be moved by the driver's selector or other means, and at the other end of the shaft is a further stepwise turning mechanism moved by the coin acceptance mechanism. For a journey of say eleven stages, ten stops **204** may be provided (because the minimum journey is one stage) and they may be equiangularly spaced in respect of their operating lobes which project into the path of the ticket material. Alternatively the stops **204** may operate followers to project as aforesaid. The turning mechanism may be rotary solenoids, and another solenoid or motor may return the shaft and cams to the start position after each ticket issuing operation i.e. to the driver's selector switch operated position, or to a zero position at which the driver's selector switch re-sets the shaft to the stage position.

Hence, by suitable and preferably simple electrical or mechanical arrangements, insertion of the coins results in setting of the stops, feed of the material up to the selected stop, and the feed rolls or drive then slips on or relative to the material (and hence there is a relationship between stiffness of the material and the frictional grip of feed rolls on the material or the equivalent, for example by providing a torque limiter clutch in the feed roll drive, although alternatively guide means may hold the material strip in a straight or flat position), and then the guillotine operates. The ticket length thus severed may be fed, or fall by gravity, to the collection point which may include issue rolls used, when the ticket is pulled therethrough, to reset the apparatus, or alternatively re-setting may follow guillotine operation automatically. Also ticket extraction may control ingress to the vehicle.

If the intending passenger pays a fare in excess of the maximum, e.g. boarding at the penultimate stage, a fare for four stages is paid, several possibilities exist: the fare may be rejected, due to a coupling between the coin acceptance mechanism and the driver's selector switch; the excess may be refunded in an automatic change issuing mechanism; or as the simplest possibility in both of the above described with reference to the drawings embodiments, the coins may be accepted and a ticket issued. If the cam mechanism in FIGS. **9** and **10** is entirely rotational, it might be possible for the cams to turn beyond the position in which a maximum length ticket is issued, and therefore if the simplest possibility is followed, a stop may be included to prevent the mechanism turning beyond the maximum length position in any one coin-operated actuation, although this does not apply to FIGS. **5 – 8.**

If desired the severed length, i.e. the ticket may be impressed with some legend by associated punches, e.g. the legends "ticket issued before stage" and "stages of journey paid for" may be punched or printed on the ticket, and numbers added as the final step before issue, corresponding to the setting of the apparatus.

FIG. **3** shows a symmetrical ticket in which the total length is constant, and the position of a notch **220** is fixed by the stage increment and fare paid measuring system, having a significant length *m* from a recognisable end of the ticket.

FIG. **4** shows an assymetrical ticket in which the distance from point *p* to the notch (*q* or *r*) either along one side (*q*) or both (*r*) gives the significant length.

Referring to FIG. **12,** at the exit or doorway, a further apparatus is located and preferably a barrier, turnstile, or (if one is provided at the ingress door) a further barrier or turnstile **410** to control exit. This further apparatus comprises a cup, chute **412,** or other means for collecting an inserted ticket T, aligning the same with powered feed rolls **414,** and for feeding the ticket therethrough. Associated with the feed rolls is a switch **416** adapted to release the turnstile or barrier to allow the passenger to exit from the vehicle.

The switch **416** is positioned at a predetermined and variable distance from the feed rolls **414** and this dis-

tance is equal to $n + a\,x$. Thus when the vehicle is between stages **0** and **1**, the distance (set to the next stage number) is equal to:

$$n + 1\,x = 1 + 1 \cdot \frac{1}{16} = 1\ \frac{1}{16}\text{inches.}$$

The said distance $n + a\,x$ is the dimension between the nip point **418** and the switch **416** in its displaced or operated condition, and if $x = 1/16$, the switch must be adapted to be operated in a distance of displacement less than **1/16** inch. A micro switch is suitable. However, the feed rolls **414** may impart a velocity to the ticket, which may allow the switch **416** to be displaced and operated after the ticket has left the issue rolls, but for reasons which will be apparent from the next following paragraphs, this is only useful within narrow limits: however the ticket material envisaged is light in weight and therefore the momentum may be small even if the velocity is high.

Assuming that the vehicle is approaching stage **8** for example, all ticket holders alighting from the vehicle should be in possession of tickets of $n + 8x = 1\frac{1}{2}$ inches length, and the switch distance is set appropriately, for example at 1-15/32 inches from the roll nip. The ticket length of 1½ inches will be possessed for example by passengers loading at stage **0** who have paid **8** units ($n + 0\,x + 8\,x = 1$ inch + 0 inch + ½ inch) or for example at stage **5** who have paid 3 units

$$n + 5\,x + 3\,x = 1'' + \frac{5}{16} + \frac{3}{16} = 1\tfrac{1}{2}''$$

and so on. These tickets, fed into the apparatus at **412**, will be supported by their trailing 1/32 inch portion as they contact the switch **416**, and due to the sensitivity of the switch the latter will be operated as the tickets emerge from the rolls.

If the passenger has paid excess fare at this point, e.g. has paid for four stages but decides to alight after only one or less than four, a greater portion of the ticket will trail through the roll nip **418**, and the ticket will still operate the switch **416**.

After switch operation the ticket falls or is conveyed to a collection bin, sack or the like, so that the material can be re-processed (and thermoplastics are therefore particularly convenient from this aspect) and more particularly so that a passenger cannot recover the ticket for subsequent use on another journey.

If however the ticket is not of sufficient length, e.g. is for a **3-stage** journey and is used for **4** stages, then the ticket will be (at stage **8** or after stage **7**) only 1-7/16 inches long instead of 1½ inches and when the last 1/32 inch of ticket is in the nip the leading end will be 1/16 inch short of the switch **416** and then will be ineffective to operate the switch **416** when discharged from the nip **418**, and the barrier or turnstile **410** will remain locked. The passenger cannot exit from the vehicle.

At this juncture, several possibilities exist depending upon the degree of sophistication required.

Preferably the ticket is collected, and transferred to a short-payment mechanism including a measuring device which measures the ticket length and short-payment amount, and sets a further mechanism so that insertion of appropriate coins into a device operates another release mechanism at the barrier or turnstile.

The distance of switch **416** from rolls **414** may be varied by a solenoid **62** or other device operated with the driver's selector switch **64** or like, and at the same time a far stop on the measuring device in the short-payment mechanism may be set, by means similar to those used in the ticket issuing apparatus. A second stop may be spring loaded into abutment with the ticket end to hold the ticket between the two stops, and the near stop position relative to a zero position may trigger one of a series of micro switches to set the coin acceptance mechanism at the required level. For example, if two units of payment are short, the ticket will be ⅛ inch short, and the near stop will step to position **2** and the associated micro switch sets the coin mechanism to accept one shilling or the equivalent and then release the barrier. The ticket then joins the accepted tickets or is otherwise collected.

If desired, the ticket may be conveyed in the issue or collection apparatus by any convenient means including blanket conveyors such as adjacent pairs of bands running in endless loops, with the ticket trapped therebetween, and this may for example guide the ticket between the feed rolls and the operating switch. Alternatively or additionally pivotal guide means may direct the ticket first to the switch and then along acceptance or reject channels according to whether the switch is operated or not. These means may enable relatively flimsy ribbon like tickets to be employed.

The feed rolls of the ticket collecting apparatus are preferably of small diameter, and two pairs may be adjacent, and arranged so that the second pair tend to deflect the ticket, for example by driving one roll only of that pair. This may result in the ticket being fed to the switch and subsequently deflected along an acceptance path, or if the trailing end of the ticket leaves the first pair of rolls before the ticket abuts the switch, the deflection may take the ticket along another path for rejection.

Alternatively in a simpler arrangement, ticket rejection actuates an indicator or alarm and the driver may open a trap, remove the ticket manually, measure the ticket on a scale, and collect and accept payment before releasing the barrier or like.

One presently preferred embodiment of collecting apparatus is shown in FIG. **11**. This includes a guide **300**, feed rolls **302**, and a rotary member **304** with abutment **306**. The ticket is fed in, causes the member **304** to move angularly, whilst the ticket is trapped between the member and a guide **308**. When the trailing end of the ticket leaves the rolls, angular movement ceases. The rotary member carries a series of regularly spaced signalling devices e.g. magnetic pads **310**, and the stationary part of the apparatus includes like spaced switches **312**, at a slightly greater spacing. The result is based on the vernier effect, as will be hereinafter explained.

Associated with the driver's position is a panel of lights (for example) including in one column, lights **314**, one of which is illuminated in accordance with the driver's stage position. Thus at stage 3 for example, light 314^3 is lit. In the other column **316**, lights are lit according to which of the switches **312** are actuated by the close proximity of a magnet **310**.

Assuming that a ticket of correct length is inserted, the third switch 312^3 and magnet 310^3 will align and a light 316^3 will be illuminated. As two side-by-side lamps are lit, the driver knows that the fare is correct and may operate a release mechanism in a turnstile.

If however the ticket is short-paid by one penny magnet **310²** will align with switch **312²** and lamp **316²** will be illuminated so that the driver will know by comparison of lamp **316²** with lamp **314³** the amount of extra fare to be paid, and can recover this before releasing the passenger. If the fare tendered is two pennies short, lamp **316¹** will be lit and again the comparison of lamps **316¹** and **314³**.

Operation of the passenger release mechanism, e.g. turnstile, also swings guide **308** away, e.g. axially of the member **304**, and the ticket falls, due in part to its resilience tending to straighten it, into collection box **320**.

Whilst the foregoing description is based on use of the $n + a\,x + b\,x$ ticket length, it may be possible in small number stage journeys to use $a\,x + b\,x$ i.e. eliminate n. This is largely a matter of convenient ticket length. A one inch ticket may be the smallest convenient length for manipulation by gloved fingers or the arthritic for example, and more than a two inch length may be cumbersome, and entail delay unless feed rolls run at high speed. However for a two stage journey, x may be one inch and a ticket of $a\,x + b\,x$ will be satisfactory. Usually in urban passenger transport, journeys of 10–15 stages are common.

Although the invention has been described with reference to a system and apparatus useful for a one-man omnibus, in which the crew consists of the driver only, the invention may be applied using apparatus for ticket issue installed at turnstiles controlling exit to vehicles from stationary buildings and the like, with the collection apparatus at the vehicle exit door. It may also find application on urban (for example) railway lines, when issuing and collection apparatus may be provided at the stations without any modification to the vehicles. The apparatus could also be used for controlling charges proportional to time instead of fare stages, with the length measuring varied by clocks.

Although reference is made to various coins and to multiples of sixpence, it will be appreciated that the same mechanisms are useful with either the forthcoming decimal coinage in Great Britain or with other monetary systems, on the same principles.

I claim:

1. A transport vehicle ticket system designed to collect the exact fare from each passenger boarding a transport vehicle traveling over a multiple time- or spatial-interval route wherein the fare due to be paid by each passenger upon boarding is directly related to the number of intervals to be traveled by that passenger, regardless of whether the passenger is traveling to the end of the line, or is disembarking sooner, said ticket system including:

1. ticket issuing apparatus including:

means for collecting the particular fare tendered by each passenger;

means for determining the amount so tendered; and means for issuing a ticket, to each such passenger, having applied thereon by said issuing means a significant portion of a length $n + (a+b)x$, wherein:

n is a constant length greater than or equal to zero, provided to be greater than zero when needed to permit the significant portion to be long enough for the ticket to be properly handled;

x is a constant increment of length, greater than zero, chosen to represent an individual interval of travel,

a corresponds to the number of intervals the vehicle has traveled along said route prior to the boarding of each particular passenger; and

b corresponds to the number of intervals that passenger wishes to travel between boarding and disembarking from the vehicle; and

2. ticket receiving apparatus, including:

means for tentatively accepting each ticket tendered by each disembarking passenger;

means associated with said tentatively accepting means for registering the lapsing of each of said intervals, as the vehicle travels from one end of the route to the other and for detecting the length of said significant portion of each ticket so tendered, the detecting means including means for discriminating between a ticket for which said length is less than, and, instead, is at least equal to that length which would have been provided on the ticket had the disembarking passenger indeed paid the exact fare for the number of intervals actually traveled.

2. The transport vehicle ticket system of claim **1** wherein the ticket receiving apparatus further includes means for finally accepting tentatively accepted tickets whose said length is found to be sufficiently long and for rejecting those whose said length is found to be too short.

3. The transport vehicle ticket system of claim **1** wherein the ticket issuing apparatus includes means for feeding to a receiving station the leading end of a supply of ticket strip of longer length than that of the individual tickets to be issued; metering and severing means for successively abstracting from the ticket strip extending back from said leading end each said ticket upon the tendering of each respective fare.

4. The transport vehicle ticket system of claim **1** wherein the ticket issuing means includes means for severing ticket material from an end of the ticket being issued, whereby said length is the length of the ticket from one end thereof to the other end thereof.

5. The transport vehicle ticket system of claim **1** wherein the ticket issuing means includes means for severing ticket material from at least one site intermediate the opposite ends of the ticket being issued, whereby the distance along said ticket between said one site and some other site on the ticket constitutes said length.

6. The transport vehicle ticket system of claim **1** wherein the ticket issuing means includes means for marking the ticket with a magnetic medium to demarcate said length thereon.

7. A transport vehicle ticket system designed to collect the exact fare from each passenger boarding a transport vehicle traveling over a multiple time- or spatial-interval route wherein the fare due to be paid by each passenger upon boarding is directly related to the number of intervals to be traveled by that passenger, regardless of whether the passenger is traveling to the end of the line, or is disembarking sooner, and wherein each passenger tendering a fare is issued a ticket having applied thereon a significant portion of a length $n + (a+b)x$, wherein:

n is a constant length greater than or equal to zero, provided to be greater than zero when needed to permit the significant portion to be long enough for the ticket to be properly handled;

x is a constant increment of length, greater than zero, chosen to represent an individual interval of travel;

a corresponds to the number of intervals the vehicle has traveled along said route prior to the boarding of each particular passenger; and

b corresponds to the number of intervals that passenger wishes to travel between boarding and disembarking from the vehicle;

said ticket system including:

ticket receiving apparatus including:

means for tentatively accepting each ticket tendered by each disembarking passenger;

means associated with said tentatively accepting means for registering the lapsing of each of said intervals, as the vehicle travels from one end of the route to the other and for detecting the length of said significiant portion of each ticket so tendered, the detecting means including means for discriminating between a ticket for which said length is less than, and, instead, is at least equal to that length

which would have been provided on the ticket had the disembarking passenger indeed paid the exact fare for the number of intervals actually traveled.

8. The apparatus of claim **7** wherein the detecting means includes:

movable stop means;

feed means for advancing each ticket so tendered toward said stop means;

and means, responsive to said registering means, for moving and setting the stop means at a distance from the feed means which equates to said length, whereby each time another interval of travel has lapsed, the stop means may be correspondingly moved relative to the feed means and set.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,900,715
DATED : August 19, 1975
INVENTOR(S) : Alec P. James

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Heading:

Item [30] Foreign Application Priority Data

Please add:

January 11, 1969 Great Britain....1783

October 22, 1969 Great Britain...51703

Signed and Sealed this

twenty-seventh Day of *April 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks