

[72]	Inventor	Herman H. Flum London, England
[21]	Appl. No.	818,987
[22]	Filed	Apr. 24, 1969
[45]	Patented	May 11, 1971
[73]	Assignee	The Bunker-Ramo Corporation Canoga Park, Calif.

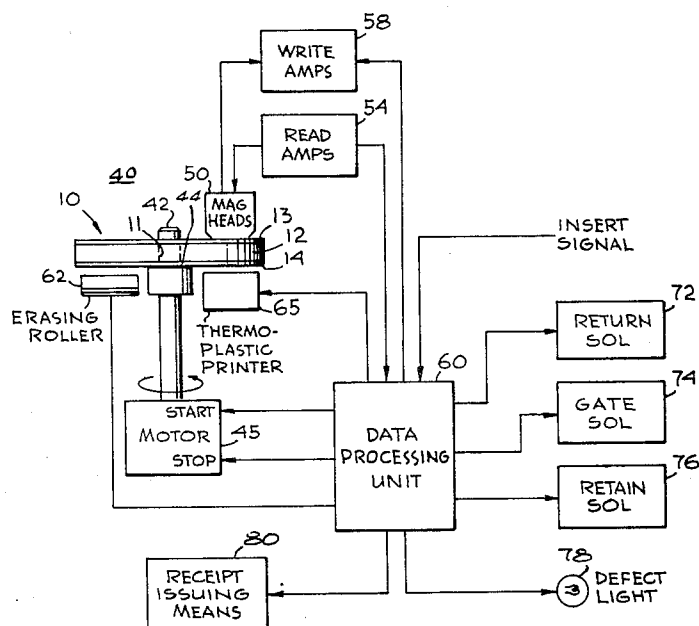
[56]	References Cited		
	UNITED STATES PATENTS		
3,087,018	4/1963	Pferd.....	(194/4)
3,221,304	11/1965	Enikeieff et al.....	(221/2)
3,379,295	4/1968	Varley.....	194/4

Primary Examiner—Samuel F. Coleman
Attorney—Frederick M. Arbuckle

[54] AUTOMATIC FARE COLLECTING SYSTEM
22 Claims, 7 Drawing Figs.

[52]	U.S. Cl.....	194/4R
[51]	Int. Cl.....	G07F 1/06
[50]	Field of Search.....	194/4; 340/149, 149 (A); 222/2; 221/2

ABSTRACT: An automatic fare collection system for collecting fares or other charges from customers using specially constructed passes. The pass comprises a flat circular or rectangular member on which data can be recorded in magnetic form on one side of the pass, and in erasable humanly readable form on the other side of the pass. At the time of purchase, appropriate data is recorded on the pass in both magnetic and erasable humanly readable form, and both forms of data are updated each time the pass is used.



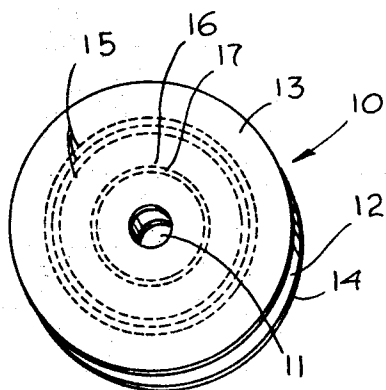


Fig. 1

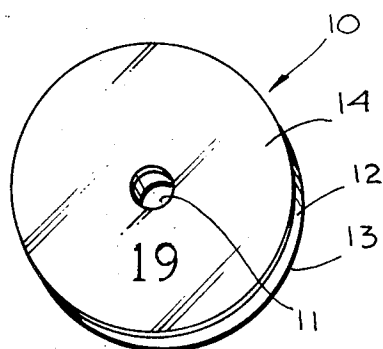


Fig. 2

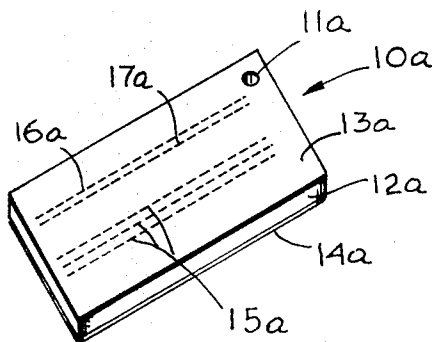


Fig. 4

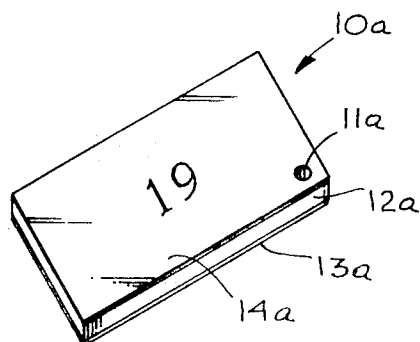


Fig. 5

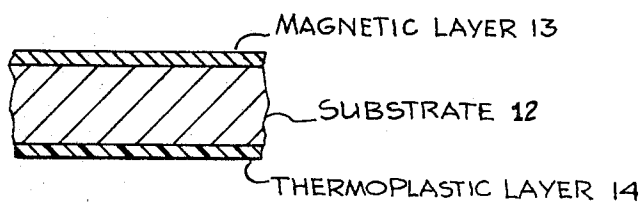


Fig. 3

INVENTOR
HERMAN H. FLUM

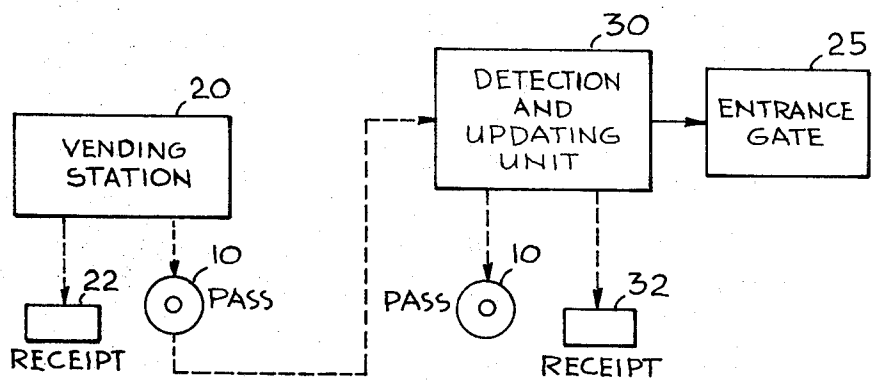


Fig. 6

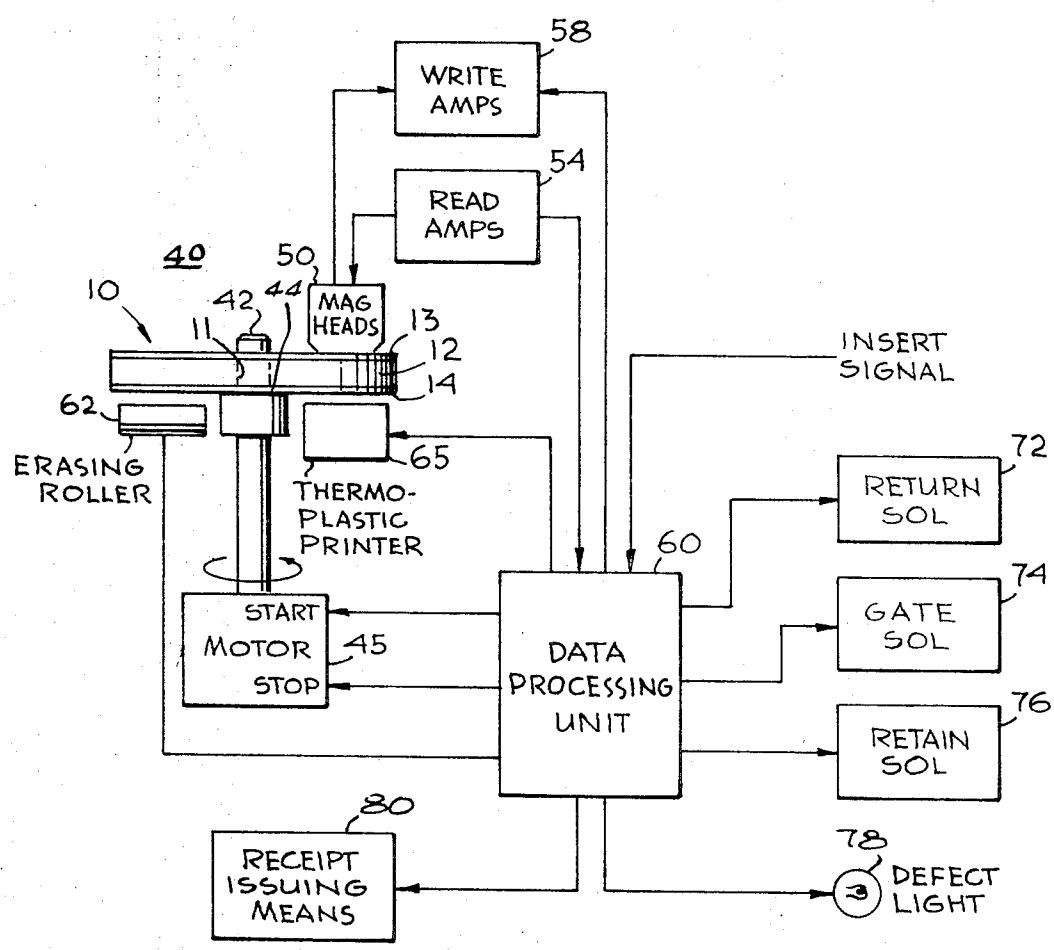


Fig. 7

INVENTOR
HERMAN H. FLUM

AUTOMATIC FARE COLLECTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to automatic fare collecting systems and to improved means for implementation thereof using a pass of novel construction.

2. Description of the Prior Art

Various systems have been devised or proposed in the past for issuing passes, tickets, tokens or the like, for particular goods or services. The earliest systems required a manual operation, such as punching a card. Although such a system obviated the need for counting out change, the manual operation still required too much time to keep up with the traffic, such as on toll roads and bridges, commuter trains and buses, and the like. Accordingly, recently proposed systems have included some means for automatically deducting a charge.

The form most frequently proposed in the prior art for the pass is a magnetically encoded card. In one system proposed for automatically collecting rapid transit fares, the magnetically encoded "ticket" could be issued for several trips. A computer-controlled passenger gate actuated by a valid ticket would then deduct one trip and advise the passenger of how many trips he had remaining, using a visual display panel. Since an important objective of such a system is to expedite traffic through the gate, the system would fail to fully meet its objective if too many passengers forget whether or not their tickets have trips remaining. This is necessarily so because, if no trips remain on a ticket, the passenger must be turned back, thereby impeding the natural flow of traffic through the gate.

SUMMARY OF THE INVENTION

In contrast to such prior art systems, the present invention is directed to a system employing passes having data recorded in both machine and erasable humanly readable form. Preferably, a system in accordance with the invention also provides a printed receipt of the transaction so that the data recorded on the pass may be corrected in case of error, or so that a record may be retained by the passenger.

Accordingly, the broad object of the present invention is to provide an improved automatic collection system.

A more specific object is to provide an improved automatic collection system employing specially constructed passes on which both machine and humanly readable data may be recorded and erased.

A further object of the invention is to provide a pass of novel construction for use in an automatic collection system.

These and other objects of this invention are achieved in an exemplary automatic collection system employing a pass, preferably in the form of a disc or rectangle. The pass has a construction such that machine readable data can be recorded on one side of the pass, and erasable humanly readable data can be recorded on the other side of the pass. A vending machine may be provided for issuing the passes and for recording on each pass the appropriate data in both machine and erasable humanly readable form, such as the quantity of goods or services purchased or the dollar amount paid. The customer uses the pass by inserting it into a machine which reads the quantity or dollar amount recorded on the machine readable side and deducts the quantity or amount to be charged the user. The previous balance is then erased and the new balance recorded on both sides of the pass, in machine readable form on one side and in erasable humanly readable form on the other side. The machine may also provide a printed receipt summarizing the entire transaction.

An important advantage of recording the humanly readable data on the pass in erasable form is that the entire area of the pass is thereby made available for each recording so as to permit the humanly readable data to be recorded in large, easily readable form.

The specific nature of the invention, as well as other objects, advantages and features of the invention, will be un-

derstood from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 illustrate opposite sides of an exemplary circular pass in accordance with the invention;

FIG. 3 is a fragmentary cross-sectional view of FIG. 1;

FIGS. 4 and 5 illustrate opposite sides of an exemplary rectangular pass in accordance with the invention;

FIG. 6 is a block diagram illustrating an exemplary automatic collecting system in accordance with the invention; and FIG. 7 is a block and schematic diagram illustrating pertinent portions of the system of FIG. 6.

Like designations refer to like elements throughout the figures of the drawings.

Referring now to FIGS. 1 to 3, a preferred form of pass is illustrated as a disc 10 having a small registration hole 11 in the center. The disc 10 has a substrate 12 of, for example, aluminum. Affixed to one side of the substrate 12 is a layer 13 of magnetic material, and affixed to the other side of the substrate 12 is a layer 14 of thermoplastic material.

As indicated in FIG. 2, the thermoplastic layer 14 provides for the recording of humanly readable data, for example, the number 19, which is produced by forming an appropriate numerical depression of the number 19 in the thermoplastic layer 14. To aid readability, the surface of the substrate 12 adjacent the thermoplastic layer 14 is preferably made of a high contrasting color with respect thereto.

The magnetic layer 13 of the disc 10 may be conventional form for providing a plurality of magnetic data recording tracks 15, a clock track 16 for synchronizing purposes, and an index track 17 for indexing purposes. It will be understood that, if it is desired to eliminate the clock and indexing tracks 16 and 17, self-clocked data recording and indexing may be employed in a conventional manner.

An alternative form of pass is illustrated in FIGS. 4 and 5 comprising a rectangular card 10a. For ease of comparison, components of the rectangular card 10a having like functions as those of the disc 10 of FIG. 1 have been given corresponding numeral designations, with an *a* following to permit distinguishing therebetween. Thus, the registration hole of the rectangular card 10a is designated 11a, the substrate is designated 12a, the magnetic layer is designated 13a, the thermoplastic layer is designated 14a, the data tracks are designated 15a, the clock track is designated 16a, and the index or reference track is designated 17a.

An exemplary fare collecting system in accordance with the invention will now be described with reference to FIG. 6. Passes are sold at a vending station 20, either automatically or under the supervision of an attendant who not only accepts currency, credit cards, and the like, but also operates a keyboard. In either case, a pass 10 is issued by the vending station 20 containing both machine and erasable humanly readable data corresponding to the number of fares purchased. More specifically, the vending machine 20 magnetically records the number of fares purchased along with the other desired associated data on the magnetic layer side of the pass, and also records the number of fares purchased on the thermoplastic layer side of the pass by forming a corresponding numerical depression therein. A printed receipt 22 of the transaction is also issued by the vending machine 20.

The passenger makes use of the pass 10 at an entrance gate or turnstile 25, where the pass is suitably deposited in a slot of a detection and updating unit 30 located at the gate 25. In normal operation, when at least one fare remains on the pass, the detection and updating unit 30 detects the magnetically recorded data on the pass 10, derives the updated data which, in the exemplary system being considered, is the number of fares remaining, records the updated data on the magnetic layer of the pass, erases the humanly readable data on the thermoplastic layer of the pass, and then records the updated data on the thermoplastic layer, after which the pass is

returned to the passenger along with an appropriate receipt 32, and the passenger gate or turnstile 25 is operated to permit the passenger to pass therethrough. If no fare remains on the pass, or if the pass is otherwise defective, the entrance gate 25 remains locked. To prevent the use of defective passes or passes having no fares remaining, it is advantageous that the detection and updating unit 30 retain the pass if no more fares remain after updating or if a defective pass is inserted.

FIG. 7 illustrates exemplary means which may be employed in the detection and updating unit 30 in accordance with the invention, and for which it will be assumed for exemplary purposes that the pass 10 is in the form of a disc, as illustrated in FIGS. 1 and 2. After being inserted in the detection and updating unit 30 by a passenger, the pass 10, by conventional means, is suitably caused to be transported to a read-write-erase station 40 in FIG. 7 and disposed thereat such that the disc 10 rests on a shoulder 44 of a rotatable drive shaft 42 which passes through the center hole 11 of the disc 10. The shaft 42 is adapted for rotation by a motor 45 of the type which can rapidly be started and stopped in response to appropriate electrical signals applied to respective start and stop inputs thereof from a data processing unit 60.

In order to permit reading and writing on the magnetic layer 13 of the disc 10, the read-write-erase station 40 includes one or more magnetic heads 50 disposed closely adjacent the magnetic layer 13, as illustrated in FIG. 7. These magnetic heads 50 operate in cooperation with associated read and write amplifiers 54 and 58 and the data processing unit 60 so as to permit data to be magnetically read from or recorded in one or more tracks of the magnetic layer 13 of the disc 10 in a conventional manner. Since such magnetic recording techniques are well known in the art, further details thereof are not presented herein.

In order to provide for erasing and writing on the thermoplastic layer 14 of the disc 10, the read-write-erase station 40 in FIG. 7 further includes an erasing roller 62 and a thermoplastic printer 65, the operation of which are controlled in response to respective signals from the data processing unit 60. Also included in FIG. 7 are a return solenoid 72, a gate solenoid 74, a retain solenoid 76, a defect light 78, and a receipt issuing means 80, each being controlled by the data processing unit 60 in response to the updated data derived from the magnetic data read from a disc inserted into the detection and updating unit 30 (FIG. 6) by a passenger.

Typically, operation of the structure of FIG. 7 is as follows. A disc 10 inserted in the detection and updating unit 30 (FIG. 6) by a passenger is suitably transported to the read-write-erase station 40 so as to be disposed in the position shown in FIG. 7. For this purpose, the magnetic heads 50 may be adapted for movement away from the disc in order to permit the disc 10 to be properly disposed at the read-write-erase station 40. The insertion of the disc 10 also serves to cause an insert signal to be applied to the data processing unit 60. In response to the insert signal, and at an appropriate time sufficient to permit the disc to be properly disposed at the station 40, the data processing unit 60 applies a signal to the start input of the motor 45 to start the disc rotating at constant speed. During this rotation, the magnetic data recorded on the disc is read into the data processing unit 60 in a conventional manner via the magnetic heads 50 and the read amplifiers 54. This recorded magnetic data may typically comprise the number of fares remaining on the inserted disc, and may also include other appropriate data, such as a periodically changeable validating code to prevent counterfeiting.

After reading the magnetically recorded data on the disc, the data processing unit 60 derives the updated data therefrom, which, in the example being assumed, may be accomplished merely by subtracting one from the number of fares read from the disc, thereby obtaining the number of fares remaining. This updated data is then written back on the magnetic layer 13 of the disc in a conventional manner via the write amplifiers 58 and the magnetic heads 50. The data processing unit 60 may also cause new validating data to be written on the disc in place of the previous validating data.

After the above-described magnetic reading and writing operations have been performed, the data processing unit 60 next applies a signal to the stop input of the motor 45 to stop the disc 10 at a position such that the erasing roller 62 is over the numerical depression in the thermoplastic layer 14. This may be accomplished using the index track 17 (FIG. 1) which preferably has a signal recorded at a position related to the location of the numerical depression in the thermoplastic layer 14. By detecting this index track signal along with the clock signals, the data processing unit 60 can then apply a signal to the stop input of the motor 45 at a time chosen so that the disc 10 will stop at the desired position with the erasing roller 62 over the numerical depression in the thermoplastic layer 14. When the disc 10 has been thus positioned, the data processing unit 60 controls the erasing roller 62 so that it is brought into rolling contact with the thermoplastic layer 14 in a manner so as to smooth out, and thereby erase, the numerical depression therein, the roller 62 being sufficiently heated so as to rapidly transform the depressed portions of the thermoplastic layer 14 into a smooth surface.

After the numerical depression in the thermoplastic layer 14 has been erased, the data processing unit 60 starts the motor 45 again and this time stops the disc 10 so that the thermoplastic printer 65 is over the portion of the thermoplastic layer 14 which is to receive the numerical depression corresponding to the derived updated data. Again, the magnetic index track 17 (FIG. 1) may be used to stop the disc 10 at the desired position. The data processing unit 60 then controls the thermoplastic printer 65 to form a numerical depression corresponding to the updated data, which may be accomplished, for example, using suitably heated blocks or wheels of metal bearing relief characters.

Concurrently with the above-described operations on the thermoplastic layer 14, the data processing unit 60 also applies appropriate signals to the solenoids 72, 74, and 76 in FIG. 7, the defect light 78, and the receipt issuing means 80 to cause operation thereof in accordance with the derived updated data. More specifically, if at least one fare remains on the disc after updating, the data processing unit 60 energizes the gate and return solenoids 72 and 74 to return the updated disc to the passenger and open the entrance gate 25 (FIG. 6) to permit the passenger to pass therethrough. The data processing unit 60 also causes a receipt 32 (FIG. 6) summarizing the transaction to be provided to the passenger by the receipt issuing means 80. If the derived updated data indicates that no more fares remain on the disc, the gate solenoid 74 is energized as before; however, instead of the return solenoid 72 being energized, the retain solenoid 76 is energized to cause the disc to be retained by the detection and updating unit 30. If the disc is defective or otherwise improper (such as having an improper validating code), only the retain solenoid 76 will be energized so that the entrance gate 25 (FIG. 6) remains locked and the disc is retained. Also, the defect light 78 (FIG. 7) is turned on to visibly indicate that the inserted disc is defective.

It is to be understood that the vending station 20 in FIG. 6 may include similar structure to that shown in FIG. 7, with the difference that the read amplifiers 54 and the erasing member 62 may be omitted. Also, the data processing unit 60 can be simplified, since updating is not required; the data processing unit need only operate to provide for recording fare data on the magnetic and thermoplastic layers 13 and 14 of the disc 10 in accordance with the number of fares requested by the passenger. The return, gate, and retain solenoids 72, 74, and 76 and the defect light 78 can also be omitted; instead, provision is merely made for vending the newly written disc to the passenger.

It is to be understood that the embodiments and descriptions of the invention provided herein are only exemplary and that many variations and modifications can be made in the construction, arrangement, and use thereof without departing from the spirit of this invention. As one example of such a modification, it will be recognized that, instead of applying the invention to a fare collection system as described herein in

which fare data is recorded on the passes, the invention may also be applied to a more generalized type of system in which a dollar amount is initially recorded on the magnetic and thermoplastic layers of a pass, this amount being decremented each time the pass is used in accordance with the charge applicable to each use.

Accordingly, the present invention is to be considered as including all modifications and variations coming within the scope of the invention as defined by the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:
I claim:

1. In an automatic collection system,
a plurality of passes each capable of recording data in both machine and erasable humanly readable form, and
a detection and updating unit to which a pass is applied, said unit including:
means for reading machine readable data from a pass,
updating means for updating the machine readable data read from a pass,
means for recording updated data from said updating means onto a pass in machine readable form,
means for erasing data recorded in humanly readable form on a pass, and
means for recording updated data from said updating means onto a pass on erasable humanly readable form.
2. The invention in accordance with claim 1, wherein each of said passes comprises a substrate having a magnetic layer on one side and a thermoplastic layer on the other side.
3. The invention in accordance with claim 2, wherein the means for recording erasable humanly readable data onto a pass includes a printer for forming a depression in said thermoplastic layer representative of the data to be recorded.
4. The invention in accordance with claim 3, wherein the means for erasing data recorded in humanly readable form on a pass includes means for smoothing out a depression in said thermoplastic layer.
5. The invention in accordance with claim 3, wherein the means for reading machine readable data and the means for recording updated data from said updating means onto a pass in machine readable form include magnetic reading and recording means.
6. The invention in accordance with claim 1, wherein said detection and updating unit additionally includes means responsive to the updated data derived by said updating means for determining whether a pass applied to said unit is returned or retained.
7. The invention in accordance with claim 1, wherein said detection and updating unit additionally includes receipt issuing means.
8. The invention in accordance with claim 1, wherein said automatic collection system includes a passenger gate operable in response to said detection and updating unit.
9. The invention in accordance with claim 1, wherein said automatic collection system includes a vending machine for vending said passes.
10. A pass for an automatic collection system comprising:
a magnetic material portion for magnetic data reading and recording, and
a thermoplastic material portion for erasable humanly

readable data recording, said thermoplastic material portion being deformable in a manner so as to permit humanly readable data to be visually indicated thereon while also being heat-responsive so as to permit removal of any such deformations, whereby different humanly readable data can thereby be repeatably recorded on and erased from said pass.

11. A pass capable of recording both machine readable and erasable humanly readable data comprising:

- a substrate,
- a magnetic material layer affixed to said substrate, and
- a thermoplastic material layer also affixed to said substrate.

12. The invention in accordance with claim 11, wherein said magnetic material layer is affixed to one side of the substrate and said thermoplastic material layer is affixed to the other side of the substrate.

13. The invention in accordance with claim 12, wherein said thermoplastic material layer and the side of said substrate to which it is affixed are of highly contrasting colors.

14. The invention in accordance with claim 12, wherein said pass is in the form of a disc.

15. The invention in accordance with claim 14, wherein said disc has a central aperture.

16. The invention in accordance with claim 12, wherein said pass is of rectangular form.

17. The invention in accordance with claim 12, wherein said thermoplastic layer has humanly readable data recorded thereon by a correspondingly shaped depression.

18. A method for automatically collecting charges for goods or services from a customer, said method comprising:

- issuing to a customer a pass containing data recorded in machine readable form and also in erasable humanly readable form,

reading the data recorded in machine readable form on a pass each time the pass is used by the customer,
updating the machine readable data read from the pass,
erasing the humanly readable data on said pass, and
recording the updated data on the pass in both machine and erasable humanly readable form.

19. The invention in accordance with claim 18, wherein said method includes issuing a receipt at the time of each use summarizing said updating.

20. The invention in accordance with claim 18, wherein the data recorded on an issued pass corresponds to a quantity, and wherein said updating comprises decrementing said quantity in accordance with the nature of each use.

21. The invention in accordance with claim 20, wherein said method includes returning the pass to a customer when the decremented quantity is greater than zero and retaining the pass otherwise.

22. The invention in accordance with claim 18, wherein the data recorded on an issued pass corresponds to the number of fares for which the pass is issued, and wherein said method also includes:

- opening a passenger gate in response to a pass containing at least one fare,
- returning a pass to a customer when at least one fare remains after updating, and
- retaining a pass when no fares remain on a pass after updating or the pass is defective.