

[54] **SAMPLE CUP HOLDER**
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Related U.S. Application Data

[60] Continuation-in-part of Ser. No. 195,363, Nov. 3, 1971, Pat. No. 3,791,509, and a continuation-in-part of Ser. No. 391,571, Aug. 27, 1973, abandoned, which is a division of Ser. No. 189,092, Oct. 14, 1971, Pat. No. 3,799,744.
[52] U.S. Cl. **23/259; 23/253 R; 356/246; 141/130**
[51] Int. Cl. **G01n 1/14; G01n 1/18; G01n 21/24**
[58] Field of Search..... **23/253 R, 259, 292; 356/246; 141/130**

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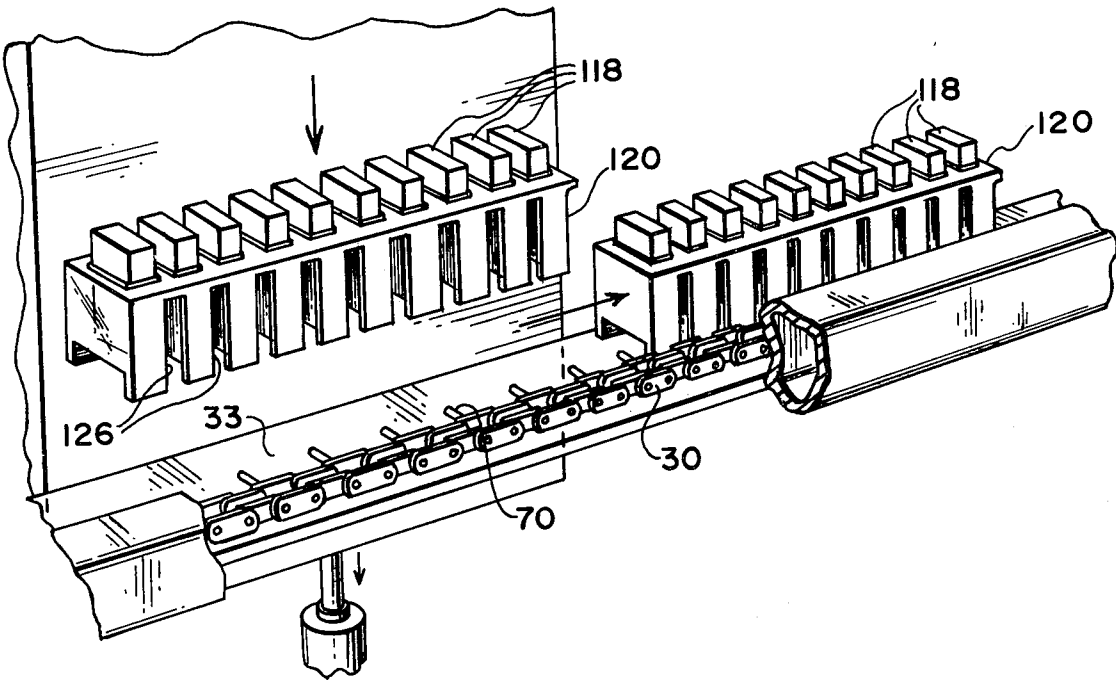
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ABSTRACT

The sample cup holder is formed from a generally rectangular block of non-metallic material and has sample cup receiving pockets therein. Each of the pockets has a generally rectangular cross-section with the long sides of each pocket extending generally transversely of the block. An opaque strip of magnetizable metal extends along one side of the block so that the holder can be magnetically held in a desired position. The metal strip also has machine readable indicia in the form of holes therethrough, there being a different indicia for each sample-cup receiving pocket. A plurality of slots extend through the block transversely of the block, each slot being located between two pockets and extending to a portion of the metal strip having indicia therethrough so that the slots provide light passageways permitting the indicia easily to be read when the holder is passed between a source of illumination and a photo-responsive device. The slots are sized and arranged so that selected ones of the slots define recesses for receiving holder engaging means on a transporting conveyor.

25 Claims, 7 Drawing Figures



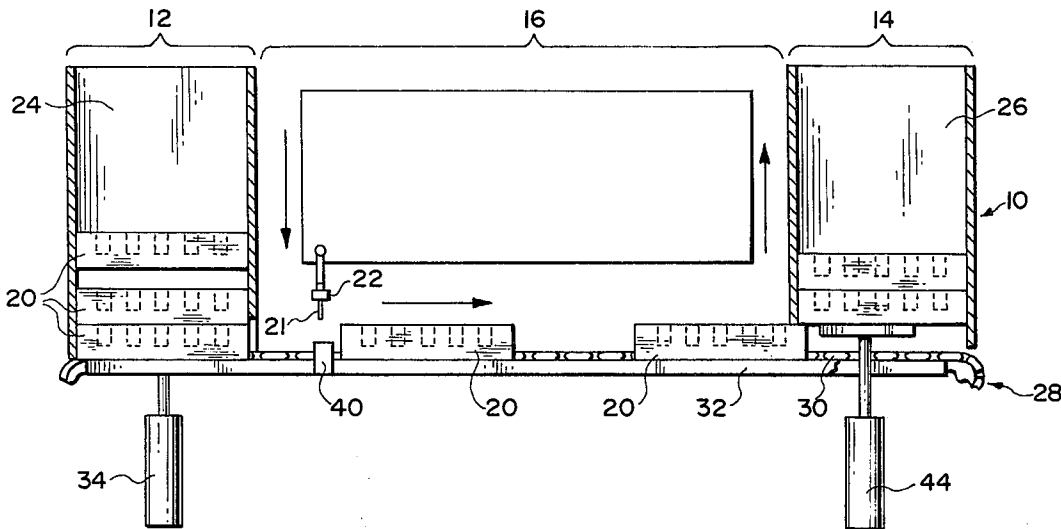


FIG. 1

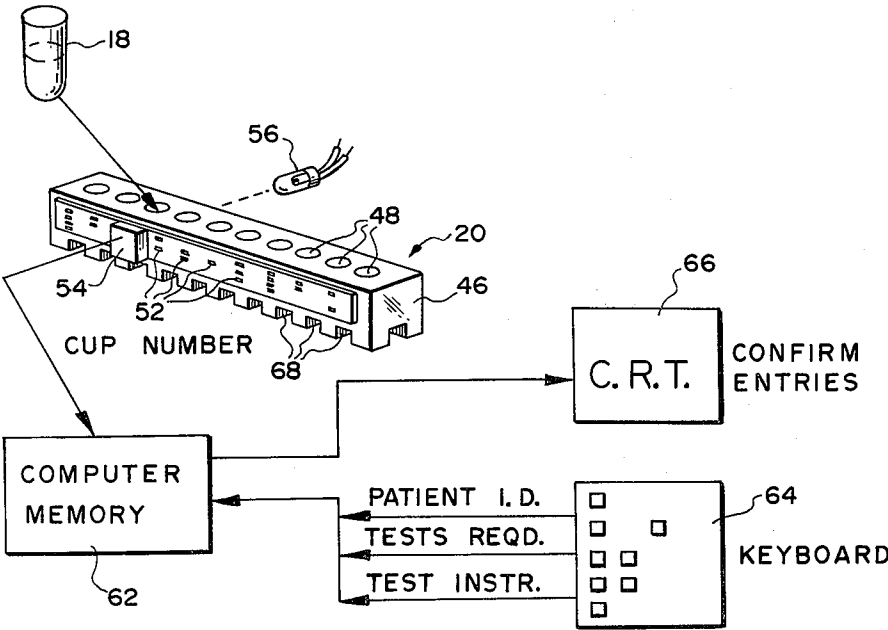
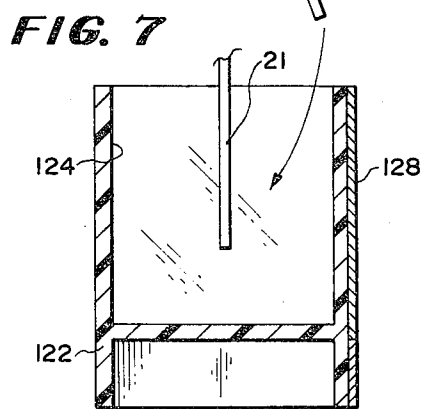
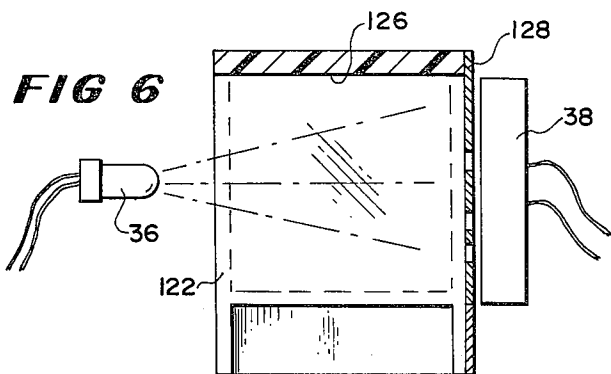
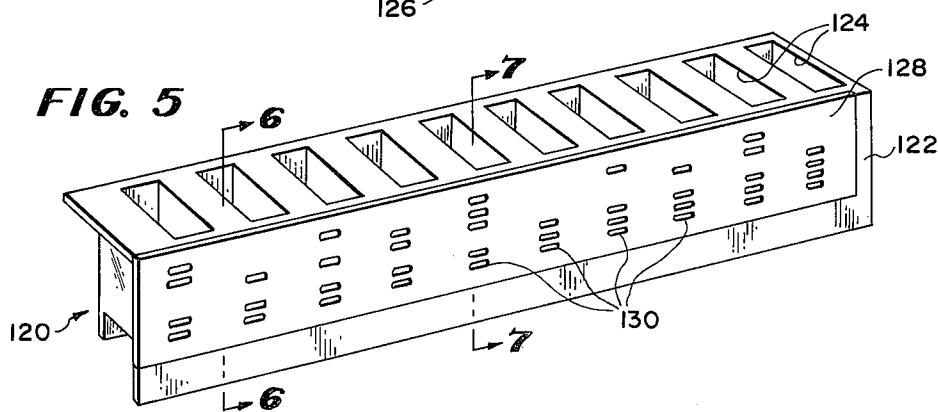
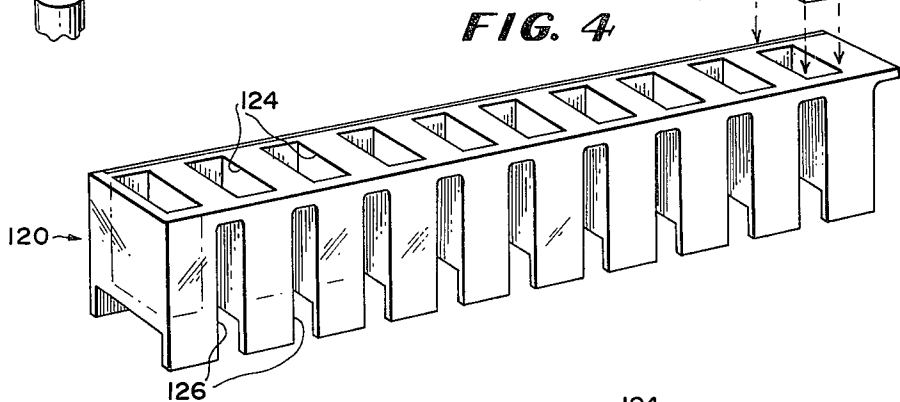
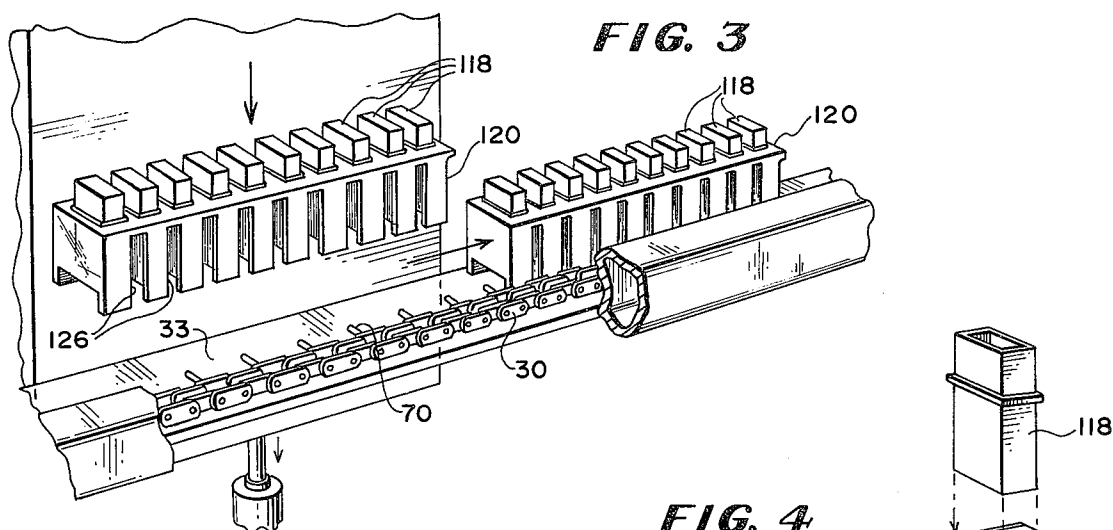


FIG. 2



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SAMPLE CUP HOLDER

CROSS REFERENCE TO APPLICATIONS

This application is a continuation-in-part of my co-pending U.S. application Ser. No. 195,363, filed Nov. 3, 1971 and now issued to U.S. Pat. No. 3,791,509 and of my copending application Ser. No. 391,571, filed on Aug. 27, 1973 now abandoned, which application is a division of my application Ser. No. 189,092, filed Oct. 14, 1971, and now issued to U.S. Pat. No. 3,799,744. Both of the above applications are assigned to the Assignee of the present application.

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to a sample cup holder which is primarily adapted for use in automatic chemistry analysis apparatus. In such apparatus small containers each containing a quantity of liquid sample are passed by a sampling station where a portion of the liquid sample is withdrawn and the diluted or mixed with a reagent and transferred to a reaction tube or container for subsequent analysis of the liquid sample. The small containers are often referred to as sample cups or sample cells. In such automatic chemistry analysis apparatus it is desirable to provide holders or racks for the sample cups. Furthermore, it is desirable that such racks or holders have means therein or thereon for facilitating temporary storage of the holders and to facilitate transport of the holders past the sampling station. Also, it is desirable that such sample cup holder have means thereon by which each sample cup can be identified so that the source of the sample and the results of the test made on the sample can be properly and correctly correlated.

Heretofore, racks or holders for sample cups or test tubes have been proposed. An example of one such sample rack is disclosed in U.S. Pat. No. 3,575,692. However, the previously proposed and presently available sample cup holders do not provide all the desirable features indicated above and provided by the sample cup holder of the present invention. Moreover, the sample cup holder of the present invention differs in many structural respects from the previously proposed sample cup holders as will be apparent from the detailed description of the preferred embodiments of the invention set forth below.

According to the invention there is provided a sample cup holder and carrier having a generally block shape, the holder having machine readable indicia thereon in the form of holes through an opaque surface on one side of the holder, there being a different indicia for each cup received in the holder, and said holder having means permitting light to pass therethrough to the holes so that the indicia can be read easily when the holder is passed between a source of illumination and a photo-responsive device.

Also, according to the invention there is provided a sample cup holder and carrier which is adapted to be temporarily stored in a magnetic hopper of a hopper system in an automatic chemical analysis apparatus, the holder having a generally block shape with a plurality of sample cup receiving pockets therein, and having magnetizable material therein permitting the holder to be magnetically held to a generally upright member of the hopper.

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Further, according to the invention there is provided a sample cup holder including a generally rectangular block having cup-receiving pockets therein and having recesses in at least one side thereof which are sized and arranged to receive therein holder engaging means on a transporting conveyor for effecting positive engagement between the holder and the conveyor.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary elevational view of a portion of an automatic chemistry analysis apparatus showing a magnetic hopper system holding a plurality of sample cup holders with arrows indicating the path travelled by each holder.

FIG. 2 is a block diagram showing the manner in which the sample cup holder and carrier is loaded and the information relating to the same is stored in a computer memory.

FIG. 3 is a fragmentary respective view of the first hopper shown in FIG. 1 and shows one preferred embodiment of the sample cup holder of the invention.

FIG. 4 is a perspective view of the sample cup holder shown in FIG. 3 from the front side thereof and showing a sample or cell removed therefrom.

FIG. 5 is a perspective view of the sample cup holder shown in FIG. 4 but from the back side thereof.

FIG. 6 is a vertical sectional view taken along line 6—6 of FIG. 5 and shows one of the light passageways through the block portion of the holder.

FIG. 7 is another vertical sectional view taken along line 7—7 of FIG. 5 and shows the cross-section of a sample cup receiving pocket in the block portion of the holder.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

In FIG. 1 there is illustrated a magnetic hopper system 10 utilized in an automatic chemistry analysis apparatus. An example of one such magnetic hopper system and one automatic chemical analysis apparatus are disclosed in the applications and patents referred to above, the disclosures of which are incorporated herein by reference. The magnetic hopper system 10 includes a first magazine or hopper 12 and a second magazine or hopper 14, which are located respectively at the upstream and downstream end of a sampling station 16.

Sample cups or cells 18 (FIG. 2) containing a quantity of liquid sample such as blood serum are held in sample cup holders 20. The sample cup holders 20 are temporarily stored in the magazine 12 and then intermittently moved passed the sampling station 16 to the second magazine 14. At predetermined points along the path of travel of sample cup holders 20 past the sampling station 16, the sample cup holder is stopped and a probe 21 of a sampling head 22 is caused to move downwardly into the sample cup to withdraw a quantity of sample therefrom. Only one of these sampling heads 22 is shown in FIG. 1 and it will be understood that there are a plurality of sampling heads at the sampling station 16, each of which, depending upon the different chemical analysis of the sample desired, can dip down into a sample cup to withdraw a predetermined portion of the sample which is then mixed with a reagent or diluent and transferred to another vessel such as a reaction tube for the purpose of making a particular chemical analysis of the sample.

As will be explained in greater detail below, each of the sample cup holders 20 has magnetizable material therein so that each holder 20 can be magnetically held in either of the magazines 12 or 14. For this purpose the magazine 12 includes a generally upright magnetic plate 24. Likewise, the magazine 14 includes a generally upright magnetic plate 26. Extending between the magazines 12 and 14 and beneath the sampling station 16 is a conveyor mechanism 28 including a conveyor chain 30. Also extending between the magazines 12 and 14 beneath the chain 30 is a guide rail 32 having a supporting surface 33 (FIG. 3).

In the operation of the system 10, a plurality of sample cup holders 20 having sample cups or cells 18 therein are placed against the plate 24 in the first magazine 12 and held thereagainst. At predetermined intervals a mechanism (not shown) is operated by a pneumatic device 34 to move the lowermost holder 20 onto the surface 33 and into engagement with the conveyor chain 30. The conveyor chain 30 is then operated to index the sample cup holder a predetermined distance toward the sampling station 16. As will be explained in detail hereinafter each sample cup holder 20 has machine readable indicia thereon for identifying the source of the sample in each sample cup held in the holder. This indicia is read by a photoelectrical system comprising a source of illumination or light source 36 (FIG. 6) and a photo-responsive device 38 (FIG. 6). A bracket 40 mounting the light source 36 is shown in FIG. 1. Typically each sampling head 22 has a photoelectric system comprising one light source 36 and one photo-responsive device 38 associated therewith so that at the time one sampling head 22 is operated to withdraw a portion of liquid sample from a sample cup in the sample holder the photo-responsive device 38 "reads" the indicia on the sample cup holder 20 associated with the particular sample cup from which liquid sample is being withdrawn so that the source of the sample can be correlated with the analysis that is made on the portion of liquid sample withdrawn by the one sampling head 22.

As stated above, at predetermined intervals, the conveyor mechanism 28 is operated to index the chain 30 toward the second magazine 14 and to a position where the sample cups in the holder 20 are located beneath another group of sampling heads 22. When the leading holder 20 is moved to a position beneath the magazine 14 a pneumatic device 44 is operated to push the sample cup holder 20 upwardly into the magazine 14 where it is held against the magnetic plate 26. Any sample cup holders previously moved into the magazine 14 then will be moved upwardly. Both of the magazines 12 and 14 are open at the front thereof so that an operator can easily insert or withdraw sample cup holders 20 into or out of the magazines 12 and 14.

Referring to FIG. 2 the sample cup holder or carrier 20 comprises an elongate block 46 of transparent or translucent material. A plurality of pockets or cavities 48 are formed in the block along its length and open onto the upper surface of the block 46. The pockets or cavities 48 are equally spaced apart and spaced from the ends of the block by half the distance between the pockets so that two holders 20 situated end to end will provide a continuous line of pockets all equally spaced apart. Each of the pockets 48 contains one of the sample cups 18 and each sample cup is adapted to carry a

quantity of liquid sample such as blood serum, which is individual to a single patient.

Each block 46 has an opaque strip 50 adhered to the back side surface thereof. The strip 50 has character indicia 52 along its length, there being a different indicia associated with each pocket 48 for identifying the particular sample cup received in that pocket 48. In the illustrated embodiment the strip 50 is preferably a steel strip which is magnetizable and which therefore facilitates the storing of each sample cup holder 20 in the magazine 12 or the magazine 14.

The character indicia 52 is typically formed by punching or drilling holes in the metal strip to produce a different number in binary code for each sample cup receiving pocket or cavity 48. In this way, once a sample cup or cell 18 is placed in one of the pockets 48 it assumes the indicia character 52 individual to that pocket and carries that character as its address through the sampling station as test and analysis are made upon the liquid sample carried in the sample cup in that pocket.

The character indicia 52 individual to a particular pocket and cup received therein can be read electronically by an array of photo-diodes in a photo-responsive device which functions as an electronic reader when light transmitted from the opposite side of the holder 20 is passed through the holes 52 of the binary code and energizes the photo-diodes. Such an electronic reader is indicated at 54 in FIG. 2 and is adapted to receive light through the holes 52 from a light source 56.

When the sample cup holder and carrier 20 is loaded it preferably is placed in a form of loading apparatus (not shown) that is connected with the memory of a computer schematically indicated at 62 in FIG. 2. The holder and carrier 20 preferably is moved into a tunnel which has an opening on the top thereof and which exposes only one pocket 48 and sample cup 18 received therein at one time. The electronic reader 54 is aligned with the hole so that it is reading the character individual to the pocket 48 and cup 18 when the cup 18 is exposed. When the operator places a serum sample in the cup 18 that is exposed by pouring the same from a container, the character is already being transmitted to the computer memory 62. At this time, the operator may also operate one or more keyboards, diagrammatically indicated at 64 to transmit information to the computer memory 62 including the complete patient identification, the identifications of the different tests that are to be made on the particular sample of serum, and information as to the nature of the test. In this latter respect, means conveniently may be provided for running standards and blanks in addition to the carrying out of the regular testing procedures.

Conveniently a cathode ray tube terminal 66 driven by the computer enables the operator visually to verify all the information being transmitted to the computer memory 62. When all the information is entered and stored at a suitable command signal available under the control of the operator, thereafter the only address required for all of this information consists of the character represented by indicia 52 that was aligned with the sample cup 18 when the sample cup 18 was being filled.

Subsequently, the holder 20 is taken from the loading apparatus and placed in the magazine 12. From there it is moved downwardly onto the conveyor chain 30 and then moved to the sampling station 16 where selected ones of the sampling heads 22 are operated to

aspirate specific quantities of sample from the sample cups 18. Each sampling head 22 has a valve mechanism therein, which can be of the type disclosed in U.S. pat. No. 3,747,412, for obtaining the specific quantity desired.

The position of any one of the sample cups 18 opposite any one of the plurality of sampling heads 22 is sensed by one or more of the photo-responsive devices or electric readers 38 (FIG. 6). As described above a plurality of the lamps 36 and a plurality of the photo-responsive devices or readers 38, are situated along the path of travel of the sample cup holders 18 through the sampling station 16 and opposite respective ones of the sampling heads 22.

As shown in FIG. 2 the block 46 has a plurality of notches or recesses 68 on the bottom thereof which open onto at least one side surface of the block 46. These notches 68 are sized and arranged so that selected ones of the notches 68 will register with and receive therein a pin 70 extending from selected ones of the pintles of the chain 30 (FIG. 3) when the sample cup holder and carrier 20 is lowered onto the surface 33. In the embodiment of the sample cup holder 20 shown in FIG. 2 the sample cup receiving pockets or cavities 48 are generally cylindrical in shape to receive a cylindrical, test-tube shaped, sample cup or cell 18. It is to be understood however, that the sample cell and the pockets for receiving same can take another shape as is the case with the modified embodiment of the sample cup holder shown in FIGS. 3-7.

Referring now to FIGS. 3 and 4 there is shown therein a sample cell or cup 118 which has a generally rectangular cross-section. These sample cells 118 are held and carried by a sample cup holder and carrier 120. As best shown in FIG. 4 the sample cup holder 120 includes a generally elongate block 122 of non-metallic material. The block 122 may be made of a plastic material and may, or may not be translucent. As shown in FIGS. 4 and 5, a plurality of pockets or cavities 124 are formed in the block 122 and are equally spaced apart along the length of the block 122. Each of the pockets 124 has a rectangular cross-section and is adapted to receive one of the rectangular cells 118 therein. In FIG. 3 all the pockets of the holders 120 shown therein are filled with the sample cells 118. It will be noted that the pockets 124 have their long sides extending transversely of the longitudinal axis of the block 122. In this way a greater space is provided between each pocket 124 than is provided between the cylindrical pockets or cavities 48 in the sample cup holder 20 shown in FIG. 2. By providing more space between the pockets 124, a plurality of slots 126 can be formed between the pockets 124. Each of the slots 126 extend into the block 122 from the front face thereof to a metal strip or plate 128 secured to the back side of the block 122 as shown in FIG. 5. Preferably and as shown the block 122 is recessed on the back side thereof so that the plate 128 is flush with the remaining back side surface of the block 122. The plate 128 has machine readable indicia 130 therein which serves the same function as the indicia 52 in the sample cup holder 20 shown in FIG. 2. These indicia 130 are formed in the same manner as the indicia 52 and are in the form of holes defining a binary code number for each of the pockets 124. Consequently, the indicia 130 associated with each of the pockets 124 provides a code number or identification for the sample cell 118

received in that pocket 124. The slots 126 extend through the block 122 to the indicia 130 in the plate 128 and provide light passageways for light passed through the block to the indicia 130 as best shown in FIG. 6. It will be appreciated that the light passageways formed by the slots 126 provide for better transmission of light to the indicia 130 then is provided by the translucent block 46 of the holder 20 shown in FIG. 2. Also, it will be understood that the plate 128 is made of magnetizable material, such as steel, so that the holder 120 can be stored in the magnetic hopper system 10 shown in FIG. 1.

In order to have proper spacing between the sample cup receiving pockets 124 in adjacent sample cup holders 120 as they travel through the sampling station 16, the pocket 124 at one end of the holder 120 is located closely adjacent that end and is separated only by a thin wall 134 whereas the pocket 124 at the other end of the sample cup holder 120 is separated by a ledge 136 from the other end of the sample cup holder 120. The ledge 136 extends outwardly from the remainder of the block 122 and the space therebeneath forms another light passageway for light to pass through the block 122 to indicia 130 in the plate 128 adjacent the pocket 124 at that end of the sample cup holder 120. The outward extent of the ledge 136 and the thickness of the wall 134 equal the spacing between each of the pockets 124 so that when several of the sample cup holders 120 are placed end to end on the supporting surface 33 all the sample cup receiving pockets 124 in the holders 120 are equally spaced apart.

The slots 126 are also sized and arranged so that selected ones of the slots 126 will register with and receive therein the pins 70 on the transporting conveyor chain 30 for effecting engagement between the sample cup holder 120 and the chain 30 for the transportation of the sample cup holders 120 through the sampling station 16 to the second magazine 14. Thus, the slots 126 serve a dual function.

Also, it is to be noted that the rectangular cross-section of the pockets or cavities 124 facilitates the arcuate downward movement of the probe 21 of a sampling head 22 into and out of a sample cell 118 received in the pocket or cavity 124 as best shown in FIG. 7.

As a further modification the strip 128 can be eliminated and the holder 120 can be of unitary construction being formed out of one piece of sheet metal in a punching operation. In this further embodiment one side wall of the block-shape holder will be continuous between the ends of the holder, will be of metal, and will have the indicia 130 punched therein. The pockets will be punched during the forming operation, the slots being defined by the space therebetween and the metal side wall being a bent over side flange connected along one edge to the top wall of the holder.

From the foregoing description it will be apparent that the sample cup holders 20 and 120 of the present invention provide simple, efficient and convenient means for holding and carrying sample cells and that the sample cup holders 20 and 120 have a number of advantages some of which have been described above and others of which are inherent in the sample cup holders 20 and 120. Accordingly, the scope of the present invention is only to be limited as necessitated by the accompanying claims.

What is desired to secure by Letters Patent of the United States is:

1. A cup carrier comprising a block of translucent material, an opaque covering on one side of the block and the other side adapted to be illuminated, said covering having holes therein arranged in machine-readable indicia, there being a different indicium for each cup, and said covering being made of magnetizable material whereby said carrier can be easily stored in a magnetic hopper, and said carrier being adapted to be passed between a source of illumination and a photoresponsive device to enable said indicia to be read.

2. The cup carrier according to claim 1 wherein said magnetizable material is a steel strip.

3. The cup carrier according to claim 1 having means for engaging a transporting conveyor.

4. The cup carrier according to claim 3 wherein said conveyor engaging means includes a plurality of recesses in said carrier, said recesses being sized and arranged to receive carrier engaging means on the conveyor for effecting positive engagement between said carrier and the transporting conveyor.

5. A sample cup holder and carrier which is adapted to be temporarily stored in a magnetic hopper of a hopper system in an automatic chemical analysis apparatus, said holder having a generally block shape with a plurality of sample cup receiving pockets therein, and having magnetizable material therein permitting said holder to be magnetically held to a generally upright member of the hopper.

6. The sample cup holder according to claim 5 having machine readable indicia on one side thereof, there being a different indicium for each pocket.

7. The sample cup holder according to claim 5 including means for engaging a transporting conveyor.

8. The sample cup holder according to claim 6 wherein said holder has a plurality of recesses therein which are sized and arranged to receive holder engaging means on a conveyor for effecting positive engagement between said holder and the conveyor for transporting said holder.

9. The sample cup holder according to claim 6 wherein said machine-readable indicia is defined by holes in an opaque surface on one side of said holder.

10. The sample cup holder according to claim 9 wherein said opaque surface and said magnetizable material are defined by a metal wall on one side of said holder.

11. The sample cup holder according to claim 9 wherein said holder is made of a translucent material through which light can pass so that said indicia can be read when said holder is passed between a source of illumination and a photo-responsive device.

12. The sample cup holder according to claim 9 wherein said holder has slots therein each of which extends to said opaque surface and is aligned with a group of holes forming the indicium for one of said pockets, said slots providing light passageways so that said indicia can be read easily when said holder is passed between a source of illumination and a photo-responsive device.

13. The sample cup holder according to claim 12 wherein said pockets each have a rectangular cross section with said slots extending between said pockets to said opaque surface.

14. The sample cup holder according to claim 13 comprising a unitary piece of sheet metal formed into a generally block shape with pockets and slots formed therein, said opaque surface and said magnetizable ma-

terial being defined by a metal side wall on one side of said holder.

15. The sample cup holder according to claim 5 wherein said magnetizable material comprises a metal strip secured to one side of said holder.

16. The sample cup holder according to claim 5 comprising a block of non-magnetic material, said pockets being located in said block and having a rectangular cross section.

17. A sample cup holder having a generally block shape, said holder having machine readable indicia thereon in the form of holes through an opaque surface on one side of said holder, there being a different indicium for each cup, said opaque surface being made of magnetizable material whereby said holder can be easily stored in a magnetic hopper, and said holder having means permitting light to pass therethrough to said holes so that said indicia can be read easily when said holder is passed between a source of illumination and a photo-responsive device.

18. The sample cup holder according to claim 17 comprising a unitary piece of sheet metal formed into a generally block shape with generally rectangular pockets and with slots defined between said pockets and extending transversely of said block from one side thereof to portions of said opaque surface having said indicia, said opaque surface being defined by a metal side wall on the other side of said holder and said slots defining said means permitting light to pass through said holder to said holes.

19. The sample cup holder according to claim 17 wherein said holder includes a block of material with a strip of opaque material having said holes therein secured to one side of said block, and said block having slots extending therethrough between said pockets to said strip and defining said means permitting light to pass through said holder to said holes.

20. The sample cup holder according to claim 17 wherein said pockets are generally rectangular.

21. The sample cup holder according to claim 17 including means for engaging a transporting conveyor.

22. The sample cup holder according to claim 18 wherein several of said slots define recesses which are sized and arranged to receive therein holder engaging means on a conveyor for effecting positive engagement between said holder and the conveyor for transporting said holder.

23. A sample cup holder comprising a generally rectangular block of material with sample-cup receiving pockets therein, each of said pockets having a generally rectangular cross section, the long sides of each pocket extending transversely of said block, a magnetizable metal side wall extending along one side of said block whereby said holder can be magnetically held in a hopper of a magnetic hopper system in an automatic chemical analysis apparatus, said metal side wall having machine readable indicia in the form of holes therethrough there being a different indicium for each sample-cup-receiving pocket, and a plurality of slots extending through said block transversely of said block, each slot being located between two pockets and extending to a portion of said metal side wall having indicia therethrough such that said slots provide light passageways permitting said indicia easily to be read when said holder is passed between a source of illumination and a photo-responsive device, and said slots being sized and arranged so that selected ones of said slots

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define recesses for receiving holder engaging means on a conveyor for effecting positive engagement between said holder and the conveyor for transporting said holder.

24. The sample cup holder according to claim 9 wherein said holder comprises a piece of magnetizable sheet metal which is bent and punched so as to form a top surface of said holder with generally rectangular pockets therein and to form a long side surface of said holder, said side surface defining said opaque surface and having said holes forming said indicia therein, and so that a space is provided from the other side of said holder to said long side surface, said space permitting

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light to pass through said holder to said holes.

25. The sample cup holder according to claim 17 wherein said holder comprises a piece of magnetizable sheet metal which is bent and punched so as to form a top surface of said holder with generally rectangular pockets therein and to form a long side surface of said holder, said side surface defining said opaque surface and having said holes forming said indicia therein, and so that a space is provided from the other side of said holder to said long side surface, said space defining said means permitting light to pass through said holder to said holes.

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