Nov. 23, 1965 K. VAN DYCK ETAL 3,218,719

PERCENTAGE READER FOR CAPILLARY TUBES AND THE LIKE

Filed Sept. 30, 1963 4 Sheets-Sheet 1

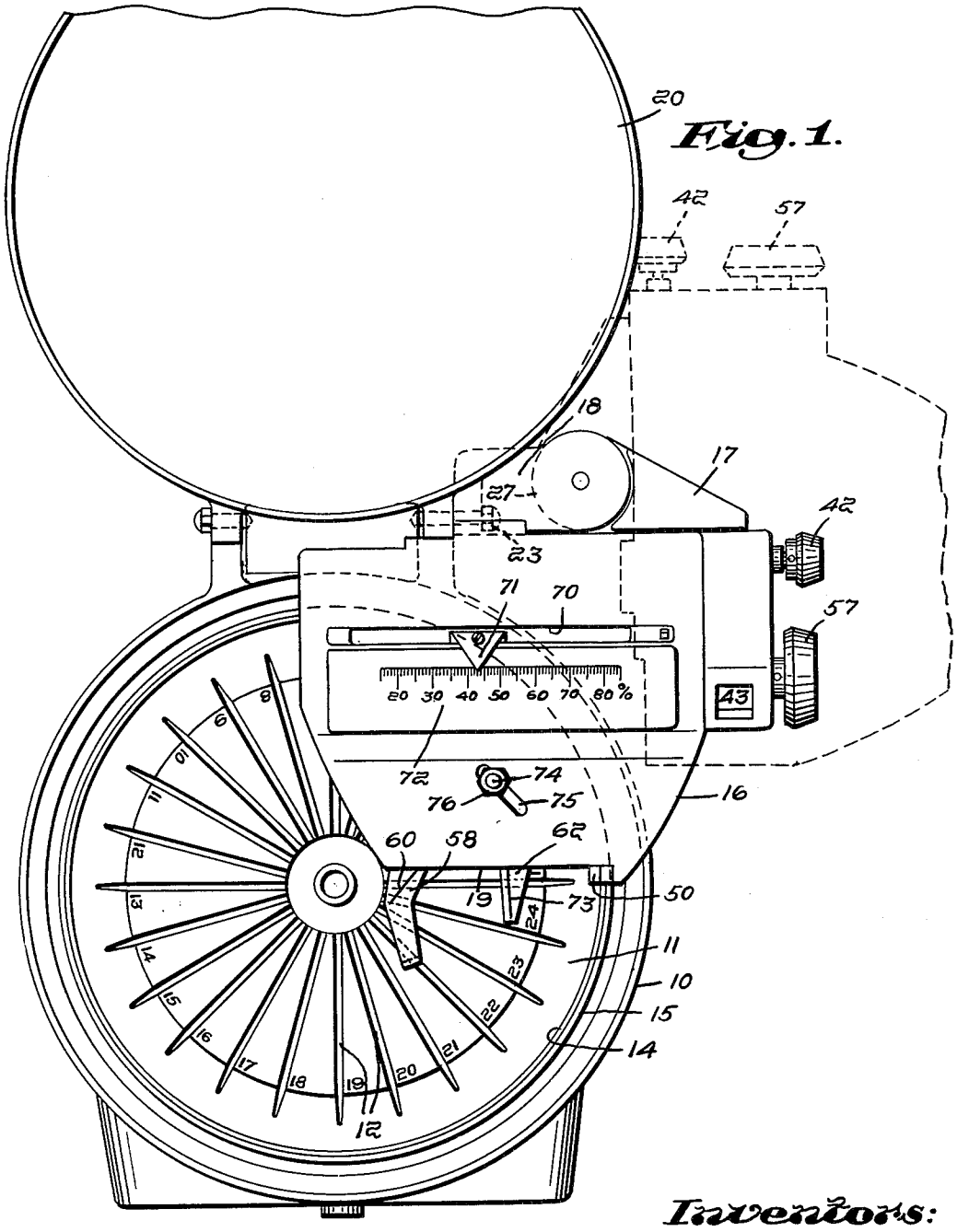


Fig. 1.

Inventors:
Kenneth Van Dyck,
Henry S. Jones,
by Abbott Spear.
Attorney

Nov. 23, 1965 K. VAN DYCK ETAL 3,218,719

PERCENTAGE READER FOR CAPILLARY TUBES AND THE LIKE

Filed Sept. 30, 1963 4 Sheets-Sheet 2

Fig. 3.

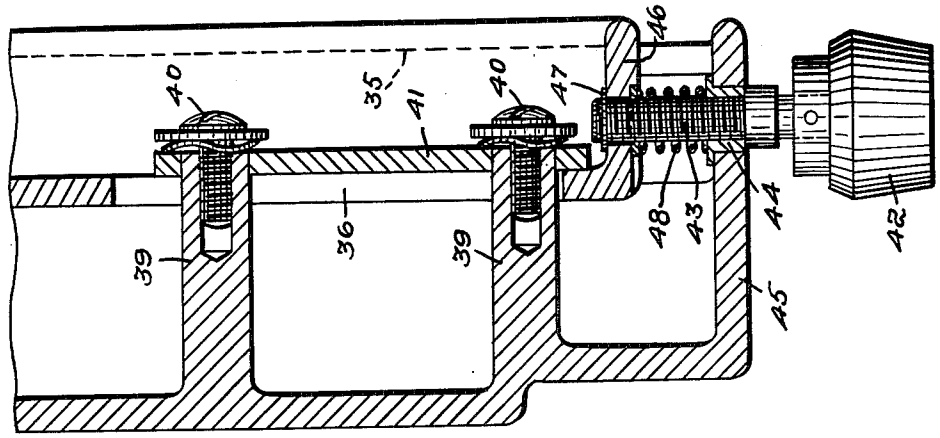
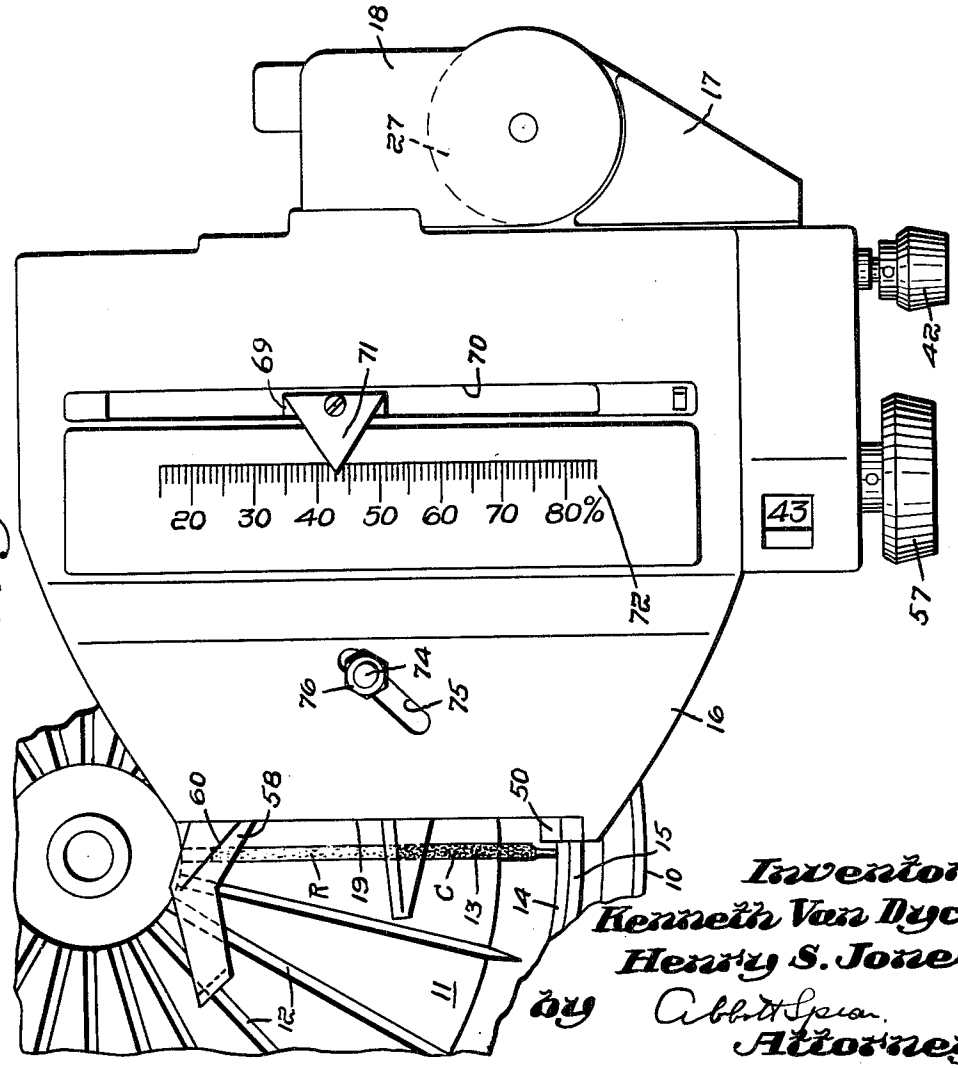


Fig. 2.



Inventors:
Kenneth Van Dyck,
Henry S. Jones,
by Abbott Spear.
Attorney

Nov. 23, 1965 K. VAN DYCK ETAL 3,218,719

PERCENTAGE READER FOR CAPILLARY TUBES AND THE LIKE

Filed Sept. 30, 1963 4 Sheets-Sheet 3

Fig. 5.

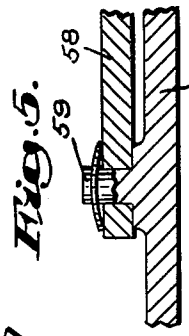


Fig. 6.

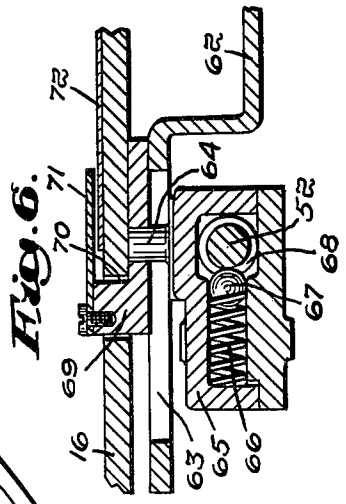
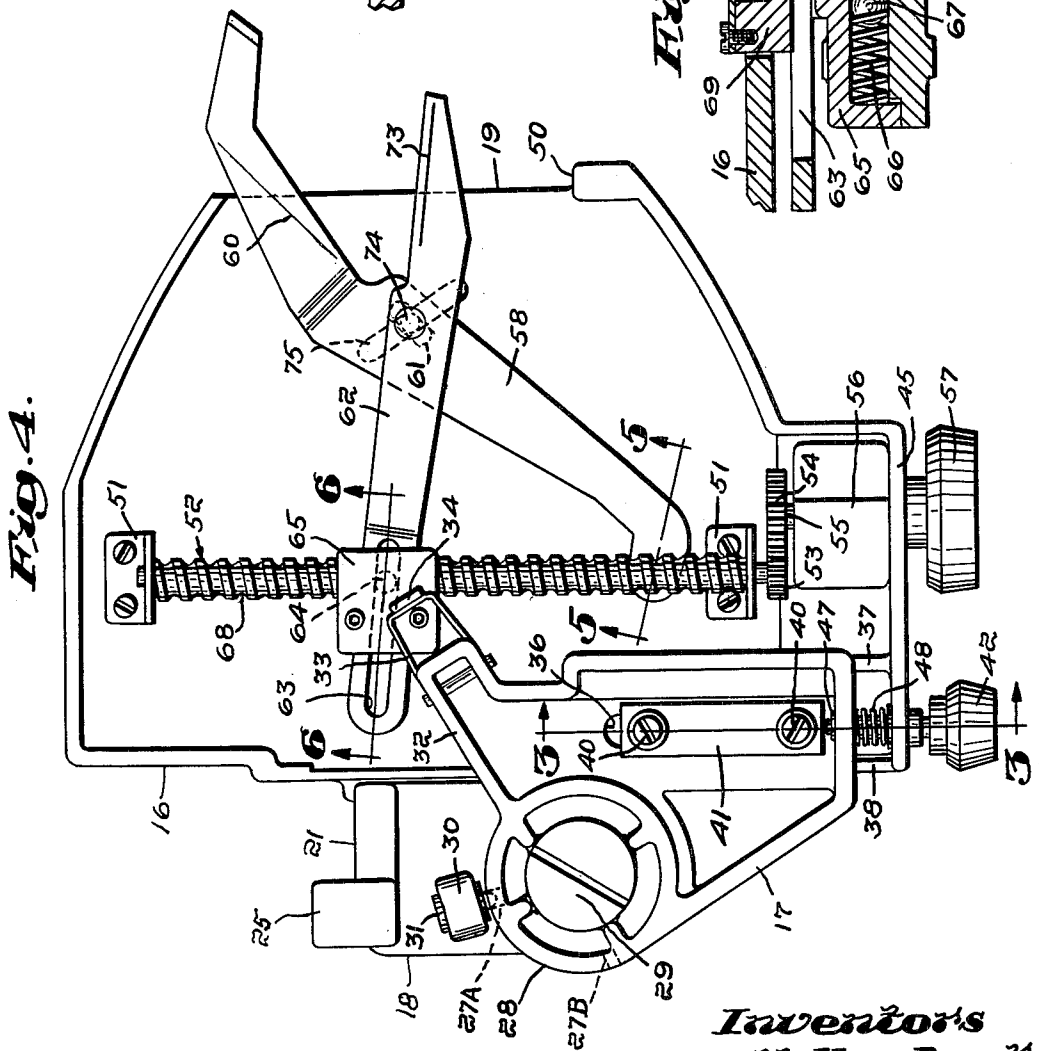


Fig. 4.



Inventors
Kenneth Van Dyck,
Henry S. Jones,
by Abbott Spear,
Attorney

Nov. 23, 1965 K. VAN DYCK ETAL 3,218,719

PERCENTAGE READER FOR CAPILLARY TUBES AND THE LIKE

Filed Sept. 30, 1963 4 Sheets-Sheet 4

Fig. 7.

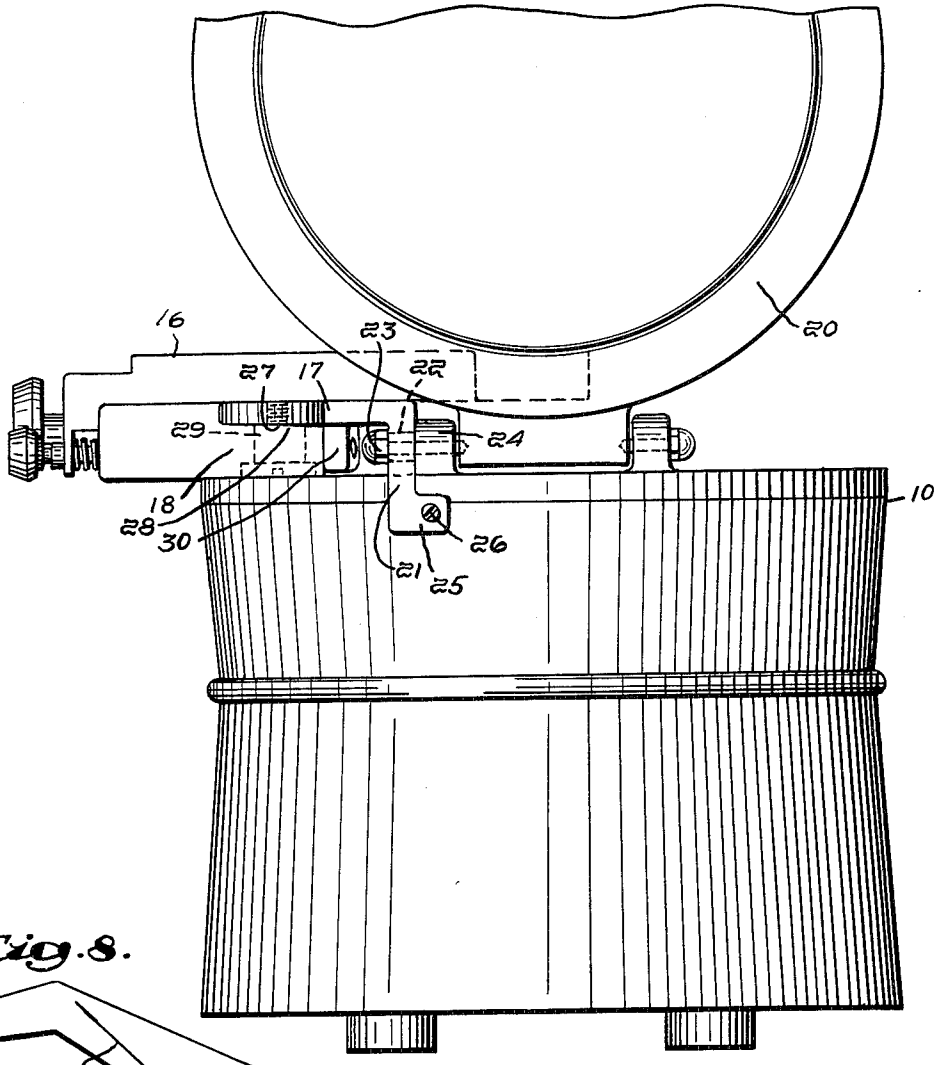
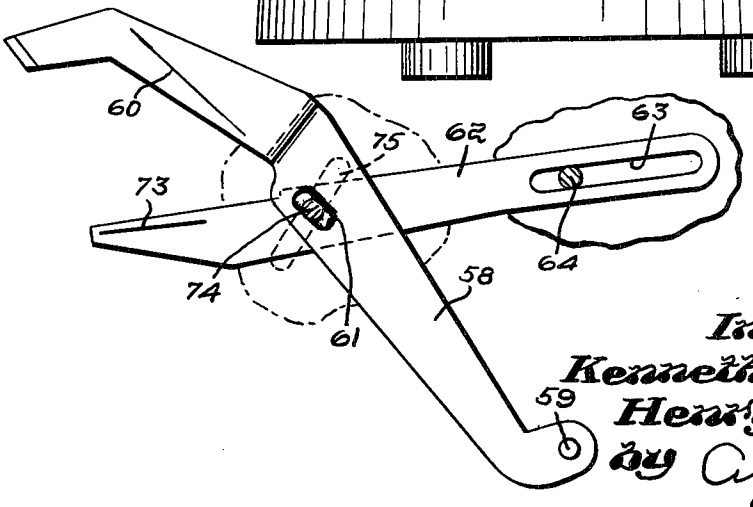


Fig. 8.



Inventors:
Kenneth Van Dyck,
Henry S. Jones,
by Abbott Lyon
Attorney

United States Patent Office 3,218,719 Patented Nov. 23, 1965

3,218,719

PERCENTAGE READER FOR CAPILLARY TUBES AND THE LIKE

Kenneth Van Dyck, Westport, and Henry S. Jones, New Canaan, Conn., assignors, by mesne assignments, to International Equipment Company, Needham Heights, Mass., a corporation of Massachusetts

Filed Sept. 30, 1963, Ser. No. 312,590
14 Claims. (Cl. 33—143)

The present invention relates to readers for use in determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof.

By way of example, blood samples in capillary tubes are radially supported on centrifuge tables. During centrifugation, the cells become packed in the bottom or outer ends of the tubes and the percentage thereof to the total sample can then be determined.

The problems in making such determinations arise from the fact that the tube contents usually vary so that the percentages must be made in terms of columns of different lengths and, if the reading is to be effected while the tubes are on the centrifuge table, the further difficulty exists that, in sealing the bottom ends of the tubes, whether by plugs or by fusion, small but material variations result in the distance between the bottom of the interiors and the bottom of the exteriors of the tubes.

As it is often advantageous to effect tube readings while the tubes are still in position on the centrifuge table and preferably, but not necessarily, while the table or the tube supporting part thereof is still attached to the centrifuge, the general objective of the invention is to provide a reader for use in making percentage determinations easily and accurately, whether either or both of the above referred-to conditions exist.

In accordance with the invention, a reader has a housing having a straight line pathway that is parallel to a tube when the reader is positioned for use. A first arm is pivotally connected to the housing with its pivot axis in alinement with the pathway and with its other end having a reading marker to be set at the upper end of the entire body of the specimen. A second arm has a slot in its rear end through which a pivot extends, the pivot being a part of a guide movable along the pathway and, at its other end, the second arm has a reading member to be set at the upper end of the separated portion. The arms are connected to the housing by means providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of the guide along the pathway and the swinging of the second arm relative to the last named pivot, the distances between the marker are proportional in any position of the first arm thus enabling columns of different lengths to be easily and accurately read.

The housing has a support to which it is adjustably connected for movement relative thereto in a direction parallel to the pathway. The housing has a marker that is to be disposed as a zero marker at the outer or bottom end of the separated portion of the specimen and this is done, when necessary, by means of the adjustable connection ensuring accurate reading even with tubes differing substantially in the difference between the bottom of their interiors and the bottom of their exteriors. It is preferred that the connection include a screw feed.

In practice, the pathway is in the form of a shaft to which the guide is so connected that it moves along the shaft as the shaft is rotated. A counter is actuated as the shaft is turned and this registers in terms of a predetermined unit of travel of the guide which also extends slidably through a housing slot and is provided with a

pointer traversing a scale readable in terms of the same unit. The unit is represented in terms of percentages and while it is, of course, not necessary that both reading means be employed, their conjoint use is advantageous.

In the accompanying drawings, there is shown an illustrative embodiment of the invention from which these and other of its objectives, novel features, and advantages will be readily apparent.

In the drawings:

FIGURE 1 is a top elevational view of a reader attached to a centrifuge and positioned for use,

FIGURE 2 is a like view on an enlarged scale illustrating its use with a capillary tube,

FIGURE 3 is a section taken approximately along the indicated lines 3—3 of FIGURE 4,

FIGURE 4 is a bottom plan view of the reader housing and its supporting bracket,

FIGURE 5 is a section taken approximately along the indicated lines 5—5 of FIGURE 4,

FIGURE 6 is a section taken approximately along the indicated lines 6—6 of FIGURE 4,

FIGURE 7 is a rear view of the reader, and

FIGURE 8 is a plan view of the arms.

The centrifuge **10** is shown as having its rotatable table **11** provided with a series of radial grooves **12** to receive generally indicated capillary tubes such as the tube **13**. The outer end of each tube **13** seats against an annular cushion **14** backed by the upstanding outer wall **15** of the table **11**.

One important blood test is to determine the cell percentage of blood specimens. This is effected by placing each specimen in a tube and subjecting the specimens to centrifugation to separate the cells, the resulting mass at the bottom of the outer end of the tube being indicated at C with the remainder of the specimen being indicated at R. See FIGURE 2.

It is, of course, often advantageous to determine the percentages without removing the tubes **13** from the centrifuge table **11**. The embodiment of the invention shown in the drawings is attachable to the centrifuge **10** to enable that procedure to be followed without removing the table from the centrifuge, the reader comprising a housing **16**, a bracket **17** in support thereof and pivotably connected to the attaching bracket **18** to enable the housing **16** to be swung, see FIGURE 1, into a position of use with its straight edge **19** parallel to and closely adjacent a subjacent capillary tube **13**. After that tube has been "read," the table **11** is stepped to bring the other tubes **13** successively into reading position. The housing **16** is then swung into its inoperative position in which the table **11** may be removed and replaced or the tubes **13** may be removed and replaced by other specimens containing tubes and the centrifuge again operated.

The attaching bracket **18**, see FIGURE 7, is shown as having a leg **21** provided with a vertical slot **22** for the screw **23** by which the bracket **18** may be secured to one of the ears **24** for the centrifuge cover **20** in a vertically adjustable position to enable the reader to be so mounted that the housing **16** and the pivoting bracket **17** may swing freely into and out of its position of use as closely as possible to the table **11**. The leg **21** also has an offset end **25** through which a screw **26** extends for engagement with the centrifuge wall thereby to provide adjustable means for ensuring that the plane in which the housing **16** swings is parallel to the plane of the table **11**.

The pivoting bracket **17** and the attaching bracket **18** have mutually engageable, arcuate bearing portions **27** and **28**, respectively, interconnected by a pivot **29**. See FIGURE 4. The attaching bracket **18** is also provided with a depending lug **30** supporting a detent **31** which rides on the arcuate surface of the bearing portion **27**

which has spaced pockets 27A and 27B, the detent 31 entering the pocket 27A when the reader is in its position of use and entering the pocket 27B when it has been swung into its other extreme position.

It will be appreciated that a centrifuge table turns very readily and it is necessary, for accurate reading, that each capillary tube 13 be parallel to the straight edge 19. For that reason, the pivoting bracket 17, see FIGURE 2, has a fixed arm 32 which, when the reader is positioned for use, is disposed radially with respect to the table 11. The arm 32 carries a U-shaped spring 33 to which is attached a friction element 34 for braking engagement with the periphery of the table 11, the braking engagement being such as to permit the table 11 to be turned from one position to another but securely held in any selected position.

The pivoting bracket 17 has a slideway 35 and a central, longitudinal slot 36, see FIGURES 3 and 4, and the rear part of the housing 16 has a rib 37, parallel to the back housing wall 38 engaging and guided by the slideway 35, and intermediate bosses 39. The housing 16 is slidably clamped to the bracket 17, as by screws 40, passing through a plate 41 and threaded into the bosses 39.

Sliding movement of the housing 16 is effected by turning the knob 42 in the appropriate direction, the knob 42 being fast on a screw 43 threaded through a bushing 44 fixed in the end wall 45 of the housing 16 and anchored in the proximate end wall 46 of the pivoting bracket 17 by a keeper 47. A compression spring 48 between the walls 46 and 45 is held in place by the screw 43. Adjustments of the housing 16 relative to the pivoting bracket 17 are necessary to "zero" the marker 50 which is in the form of a shoulder at the outer end of the straight edge 19, over the outer or bottom edge of the separated cells C in a capillary tube 13. This adjustment is necessary in that, as has been stated, capillary tubes differ as to their end closures with the result that there are small but important differences in the distances between the bottom of the interiors of the capillary tubes and the outer ends thereof.

Within the housing 16, there are brackets 51 supporting a shaft 52 parallel to the straight edge 19. At one end of the shaft 52 there is a pinion 53 in mesh with a gear 54 on the output shaft 55 of a conventional rotation counter 56, such as are manufactured by Veeder-Root Incorporated, of Hartford, Connecticut, supported by the housing end wall 45 and having a knob 57 by which it is manually turned.

A first arm 58, preferably entirely of a clear plastic, has a pivot 59 connecting it to the housing 16 adjacent one end of the shaft 52 and in alignment therewith. At its other end, the arm 58 has a reading marker 60 in the form of a colored line and the arm 58 also has an intermediate slot 61 whose center line is in alignment with the axis of the pivot 59 and the reading marker 60.

A second arm 62, also preferably entirely of a clear plastic, has an elongated slot 63 in its rear end through which there extends a pivot 64 on a guide 65 mounted on the threaded shaft 52 to travel therealong as the shaft is turned, the guide 65 having a spring 66 pressing a laterally confined ball 67 into a spiral channel 68 defined by the threaded shaft 52. A follower 69 is carried by the pivot 64 and is slidably entrant of a housing slot 70 parallel to the straight edge 19. The follower 69 includes a pointer 71 traversing the percentage scale 72. At the other end of the second arm 62, there is a reading marker 73, also shown as a colored line, which is in alinement with the center line of the slot 63.

A pivot 74, whose axis is in alinement with the reading marker 73, extends through the arm 62, the slot 61 of the arm 58 and through a slot 75 in the housing 16 which is disposed at an angle of 45° to the straight edge 18, the pivot 74 being slidably retained in the slot 75 as by a nut 76.

From the foregoing, it will be appreciated that when the reader is positioned for use with the straight edge 19 parallel and close to a capillary tube 13, it is necessary to check the zero setting. If the marker 50 is not at the bottom or outer end of the separated portion C, the knob 42 is turned until such registry is established. The first arm 58 is then manually set so that its reading marker 60 is at the upper or inner end of the column of liquid in the subjacent tube 13. The knob 57 is then turned until the reading marker 73 is at the junction between the portions C and R and the percentage is then determined from the position of the pointer 71 relative to the scale 72 or by the counter 56 which gives the same reading but as a direct numerical value.

It will be appreciated that when the arm 58 is swung from one extreme position to the other, the distance of the pivot 74 from the shaft 52 varies at a constant rate and without causing movement of the second arm 62 along the shaft 51. As a consequence, the leverage varies so that when the second arm 62 is moved by turning the shaft 52, a predetermined movement of the guide 65 results in a different movement of the second arm marker relative to the first arm marker but the differences are always proportional. The counter 56 and the scale 72 may, accordingly, be in terms of predetermined movement of the guide 65 and accurately indicated percentages.

We claim:

1. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway parallel to a tube when the reader is positioned for use, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

2. In a capillary reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing, a shaft in said housing parallel to a tube when the reader is positioned for use, exposed means to rotate said shaft, a first arm pivotally connected to said housing with its pivot axis in alinement with said shaft and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide engaging said shaft to be moved along it as said shaft is turned, said guide having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said shaft and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

3. In a capillary reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing, a shaft in said housing parallel to a capillary tube when the reader is positioned for use, means to rotate said shaft, said means including a counter, a first arm pivotally connected to said housing with its pivot axis in alinement with

said shaft and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said shaft and having a pivot slidable in said second arm slot, said counter visibly registering the rotation of said shaft in terms of a predetermined unit of travel of said guide, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said shaft and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

4. In a capillary reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway parallel to a tube when the reader is positioned for use, said housing having a slot parallel thereto, and a percentage scale disposed adjacent thereto, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot and a follower extending through and slidable in the housing slot, said follower including a pointer traversing said scale, said scale indicating units each representing a predetermined unit of travel of said guide, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

5. In a capillary reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing, a shaft in said housing parallel to a tube when the reader is positioned for use, means to rotate said shaft and including a counter, said housing having a slot parallel to said shaft, and a percentage scale disposed adjacent thereto, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide engaging said shaft to be moved along it as said shaft is turned and having a pivot slidable in said second arm slot and a follower extending through and slidable in said housing slot, said follower including a pointer traversing said scale, said scale and said counter indicating units each representing a predetermined unit of travel of said guide, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said shaft and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

6. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway parallel to a capillary tube when the reader is positioned for use and a marker disposable at the bottom of the separated portion of the tube with reference to which the reader is then positioned for use, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between markers are proportional in any position of said first arm.

7. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway parallel to a capillary tube when the reader is positioned for use, a straight edge and a marker at the outer end thereof, in the position of use, the straight edge being parallel to and closely adjacent the tube and the marker being at the bottom of the separated portion, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

8. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a support, a housing having a straight line pathway parallel to a capillary tube when the reader is positioned for use and an edge marker and an adjustable connection between said housing and said support operable to move said housing relative to said support parallel to said pathway to bring said marker into registry with the bottom of the separated portion, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

9. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof while the tube is positioned radially on the rotatable table of a centrifuge, a support attachable to the centrifuge, a housing having a straight line pathway, said support including pivotally interconnected portions to enable the housing to be swung from a position remote with respect to the centrifuge table into an overlying position in which the pathway is parallel to a tube positioned thereon, said housing including an edge marker to overlie the bottom of the separated portion, a first arm pivotally connected to said

housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

10. The reader of claim **9** in which the portion of the support attachable to the centrifuge has a vertical slot for an attaching screw enabling the height of the housing to be adjusted relative to the centrifuge table and an offset end provided with a screw engaging the side of the centrifuge and adjustable to vary the plane of the housing relative to that of the centrifuge table.

11. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof while the tube is positioned radially on the rotatable table of a centrifuge, a support attachable to the centrifuge, a housing having a straight line pathway, said support including pivotally interconnected portions to enable the housing to be swung from a position remote with respect to the centrifuge table into an overlying position in which the pathway is parallel to a tube positioned thereon, said housing including an edge marker to overlie the bottom of the separated portion, said reader including a brake resiliently engaging said table in said overlying position, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and means connecting said arms to said housing between their ends and providing a pivot for the second arm that so moves, as the first arm is swung, that on a predetermined movement of said guide along said pathway and the swinging of said second arm relative to said pivot, the distances between the markers are proportional in any position of said first arm.

12. The reader of claim **11** in which the reader includes an underlying arm that is radial with respect to the table in the overlying reader position and a U-shaped spring whose ends are secured to the arm and including a table engaging brake element.

13. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway parallel to a capillary tube when the reader is positioned for use, and a slot disposed at an angle of approximately 45° relative to said pathway, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, said first arm having an intermediate slot whose center line is in alinement with the axis of its pivotal connection with the housing, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and a pivot interconnecting said second arm to said housing through said first arm slot and slidable in said 45° slot, the center line of the second arm slot being in alinement with said pivot, the swinging of said first arm between two extreme positions changing the distance between said pathway and said pivot, and the swinging of said second arm relative to said pivot being characterized, on a predetermined movement of said guide along said pathway, by proportional movements of the reading marker of the second arm relative to the reading marker of the first arm in any position of said first arm.

14. In a reader for determining, after centrifugation in a tube, the percentage of a separated portion of a specimen to the entire body thereof, a housing having a straight line pathway and a straight edge including a marker at the outer end thereof, the straight edge being parallel to a capillary tube when the reader is positioned for use and the marker being then at the bottom of the separated portion, and a slot disposed at an angle of approximately 45° relative to said pathway, a first arm pivotally connected to said housing with its pivot axis in alinement with said pathway and with its other end having an exposed reading marker to be set at the upper level of the entire body of the specimen, said first arm having an intermediate slot whose center line is in alinement with the axis of its pivotal connection with the housing, a second arm having a slot in its rear end, a guide movable along said pathway and having a pivot slidable in said second arm slot, said second arm having an exposed reading marker at its other end to be set at the upper level of the separated portion, and a pivot interconnecting said second arm to said housing through said first arm slot and slidable in said 45° slot, the center line of the second arm slot being in alinement with said pivot, the swinging of said first arm between two extreme positions changing the distance between said pathway and said pivot at a constant rate, and the swinging of said second arm relative to said pivot being characterized, on a predetermined movement of said guide along said pathway, by proportional movements of the reading marker of the second arm relative to the reading marker of the first arm in any position of said first arm.

No references cited.

ISAAC LISANN, *Primary Examiner.*