A MULTICOLLECTOR: A FRACTION COLLECTOR FOR THE SIMULTANEOUS COLLECTION OF FRACTIONS FROM A NUMBER OF CHROMATOGRAPHIC COLUMNS

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(Received September 7th, 1959)

In a longitudinal study of steroid metabolism in schizophrenic patients we were faced with the problem of having to run large numbers of column chromatographic assays per day. It was not economically feasible for us to buy the number of individual commercial units necessary to cover our need, nor did we have the space to accommodate them. We decided therefore to build a special unit for multiple simultaneous collections. To suit its purpose the collector had to be simple of design for ease in construction, give trouble-free service with little maintenance, and be far less expensive than commercial units that would give the same capacity.

Fig. 1 shows the collector we built to solve our problem. The principle of construction is simple. Test-tube carriers mounted on wheels ride on rails mounted on a slight slope. A latch activated by a recycling timer allows the carriers to slide down the slope for a distance equal to the distance between the test tubes. The time interval is set by adjusting one of the two recycling timers.

DETAILS OF CONSTRUCTION

The support stand for the rails (Fig. 1)

This stand can be built, as in our earlier models, with a plywood top on a 2 in. × 4 in. lumber frame as support for the rails.

However, a more flexible system is obtained if slotted steel angle framing (Equipto Angle, Aurora, Ill.) is used. This material is inexpensive, easily cut and can be bolted together to suit individual needs.

A sloping frame support for the rails is made by bolting two angles in a parallel position to crossbars cut from the same material. The rails (1/4 in. angle aluminum) are screwed directly to the angles in the frame with uniform spacing maintained for the entire distance.

The bottom part of the rails are curved upwards to a horizontal position at the end so that the cars will not slam against the stop located near the end of the rails.

This sloping frame is supported by 4 vertical pieces of angle iron and these are connected at the bottom to a horizontally placed bottom frame similar to the

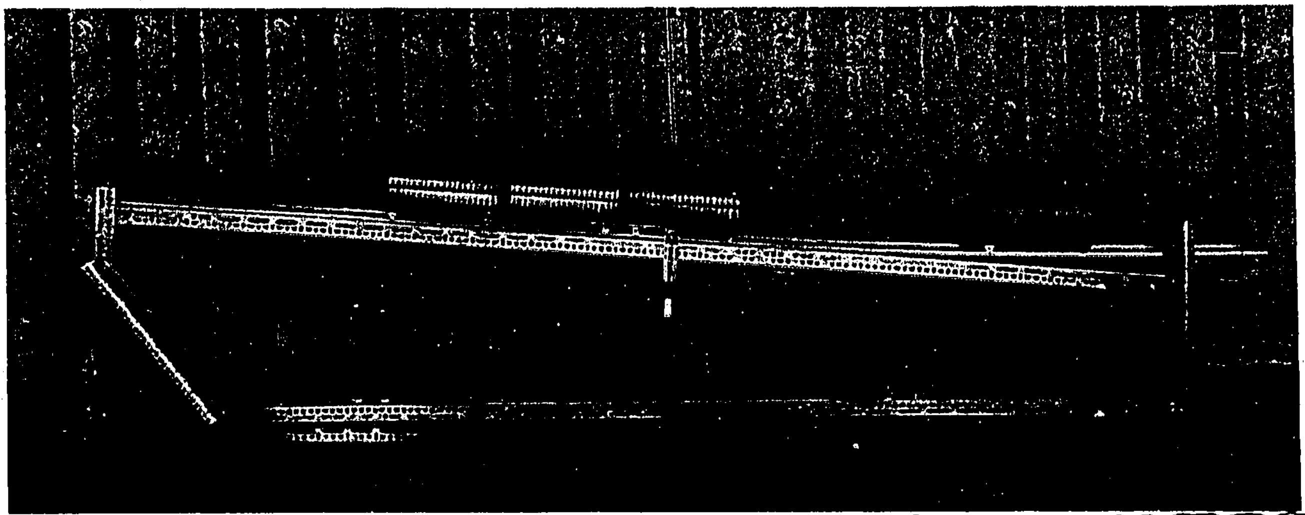

Fig. 1. A multicollector for the simultaneous collection of fractions from six chromatographic columns.

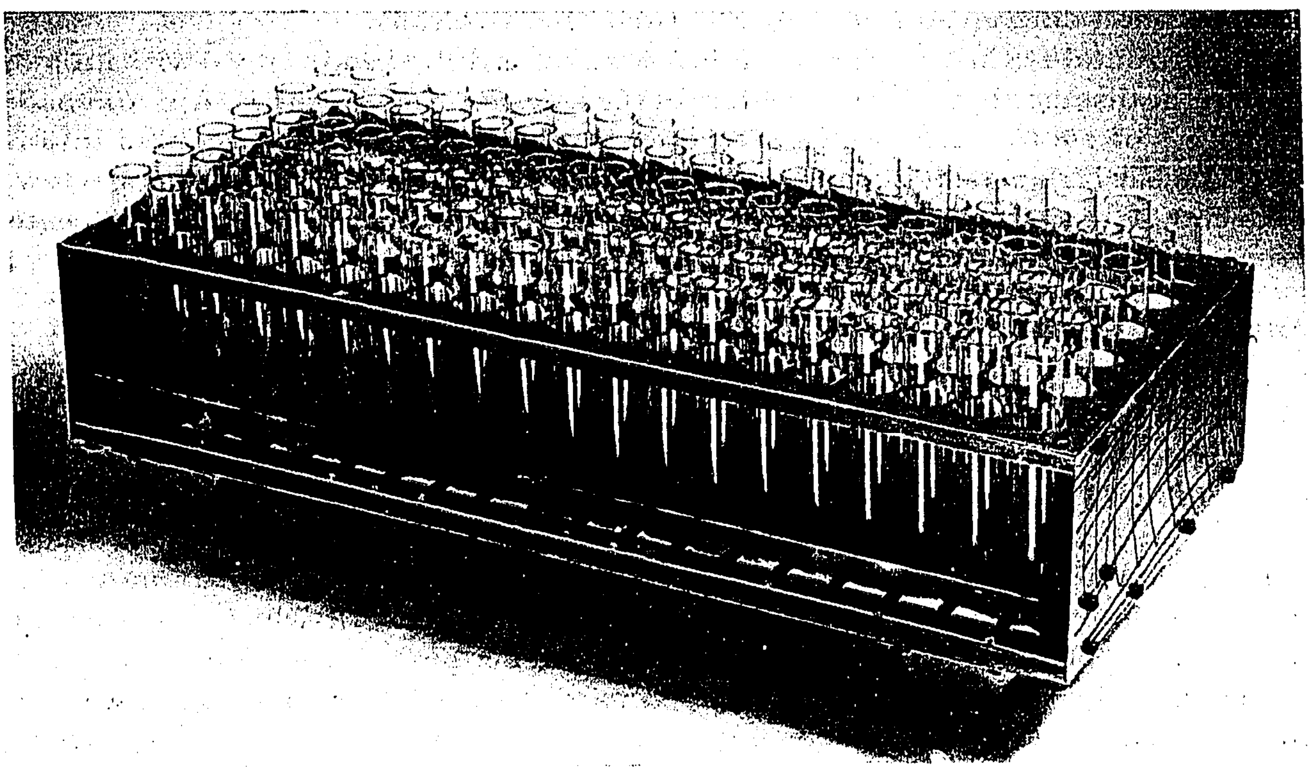

Fig. 2. A test-tube carrier with 6 rows of test tubes and 20 tubes per row.

sloping frame. The bottom frame is placed on floor or table top. A couple of crossbars give stability to the lower frame but are unnecessary if two or three of these units are combined.

The test tube carriers (Fig. 2)

These are rectangular aluminum plate boxes with open sides and are mounted on wheels. Small stainless steel pins positioned on a rectangular bar on the side engage the solenoid activated latch on the fraction collector.

The tube carriers are made from 1/62 in. aluminum plate screwed to a frame of 1/4 in × 1/4 in. aluminum bar. Our standard model has three horizontal rectangular aluminum plates and two vertical rectangular plates. Six rows of 20 holes per row are drilled in two of the horizontal plates. The third plate serves as a bottom. The bottom plate and one of the drilled plates have been screwed to opposite surfaces of a rectangular frame made of 1/4 in. × 1/4 in. aluminum bar and the other drilled plate has been screwed to the top surface of a similar rectangular frame. They have then been assembled to make an open box with the two smaller rectangular plates as end plates.

The wheels for the carriers were turned on a lathe from aluminum rod. The wheels on the side of the carrier where the pins are located are grooved slightly wider than the thickness of the rail to insure that the carrier is kept at constant distance from the latch. The wheels on the other side are rather wide ungrooved cylinders to allow for small differences in distance between the two rails.

A horizontal 1/8 in. by 1/2 in. stainless steel bar is drilled and tapped with intervals equal to the distance between the centers of the holes for the test tubes. Approximately 1-in. pieces of 1/8 in. stainless steel rod are threaded at one end and screwed into the holes. The bar is then bent at right angles at the ends and, with a few washers, screwed to the end plate and positioned in such a way that the pins are in line with the centers of the test tube openings.

The release/engage mechanism (Fig. 3)

This device serves to position a new row of test tubes under the chromatographic columns when activated by the timer.

It is comprised of a top portion, a connecting rod with an adjustable spring, a solenoid and an aluminum mounting plate.

The top portion consists of a frame with a U-shaped upper portion and a straight lower portion and is milled from a single piece of steel. The lower part moves in a channel made by cutting an oversized groove in a brass block which is closed by a piece of brass plate fastened across the groove. This part is connected downwards to the connecting rod. The upper U-shaped part of the steel frame has screwed to it two L-shaped pieces of spring steel, one with the opening in the L turned downwards, the other with the opening upwards.

The connecting rod is a piece of 1/8 in. steel rod connected upward to the head portion, and downward to the solenoid. It has an adjustable spring held between two washers. One washer is held in a fixed position by an L-shaped piece of aluminum

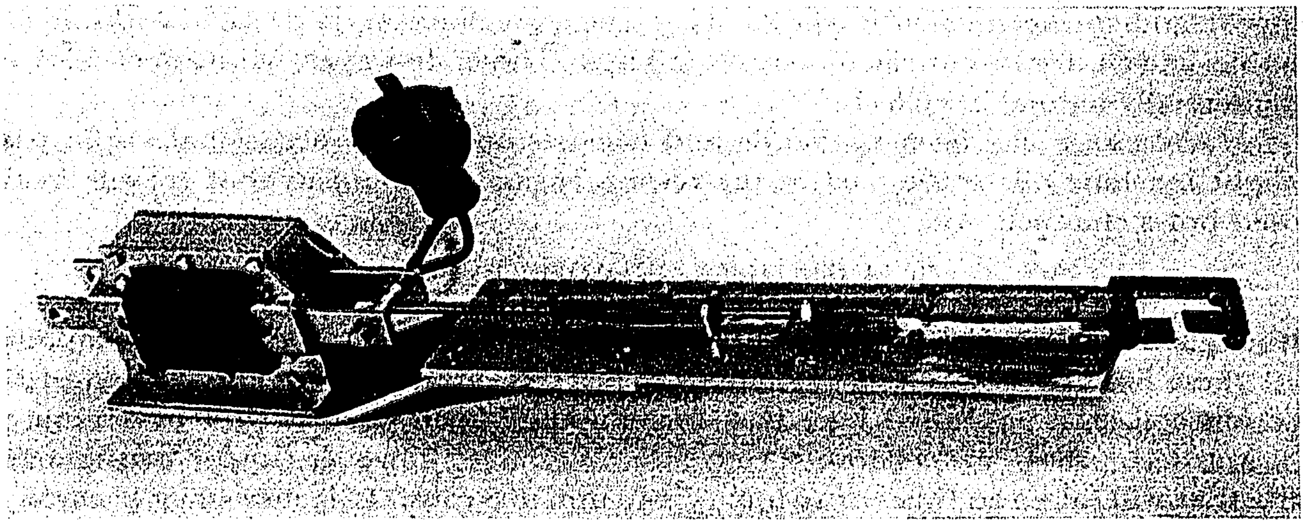

Fig. 3. The release/engage mechanism.

plate screwed to the mounting plate, the other washer can be moved upwards or downwards by moving a small cotter pin for which small holes have been drilled in the connecting rod.

The solenoid (2000 Size C-1, Dormeyer Industries, Chicago 41) is of the push-pull type, mounted in the push position.

The whole assembly is aligned and screwed on an 1/8 in. thick aluminum plate that has to be bent at the lower end to align the solenoid. The total mechanism is then screwed to the fraction-collector frame.

The timer is used to activate the release/engage mechanism after a set interval. We have chosen, from several commercially available units, a tandem automatic recycling timer (Industrial Timer Corporation, Newark, New Jersey) which employs two interchangeable timers. One, a 0–6 sec timer, is used to activate the solenoid and is set for approximately 3/5 of a second. The other timer is used for timing the interval between activations. In the model used, interchangeable plug-in timers covering a wide range are available so that one can choose a timer suited for any specific purpose. A timer with a 60 min maximum interval between activations of the second timer and the solenoid in the release/engage mechanism will probably cover most applications.

In use the solenoid is connected with the line voltage over the normally open contacts of timer 2. Timer 2 is activated together with the solenoid for 3/5 of a second after expiration of the interval set on timer 1 and timer 1 will start recycling immediately. This cycle continues until the unit is disconnected from the line voltage.

The firm estimates, on the basis of the performance of similar units in industrial applications, that the average trouble-free life of the timer in its present application should be 4 to 5 years.

PERFORMANCE

Several collectors of this type have been in almost continuous use in our laboratories over the last year and have, after initial adjustments of the proper slope of the rail support and spring tension in the release/engage mechanism, performed without any trouble except for a couple of power failures. These, however, will affect also all commercially available collectors.

Maintenance has been negligible and consists only of an occasional application of light machine oil to the part of the release/engage mechanism that travels in the closed brass channel.

LIMITATIONS AND ADVANTAGES

Although the collector has in its present version some limitations, it is our opinion that these limitations are relative only. Capacity is one problem. The version of the fraction collector presented here has, for example, been used with a maximum of 6 × 100 test tubes, size 13 mm × 100 mm. We have, however, under construction units that will take 120 tubes of 16 mm × 150 mm in 8 rows. It is necessary because of the increased load to use a heavier solenoid and corresponding spring, and also to use heavier spring steel. It will be possible to run, because of the higher electrical rating of the solenoid, only 2 units from the same timer.

The length of the units will present a problem in some laboratories. The length of a 120 tube 13 mm diameter collector is 12½ feet. However, three such units can be placed alongside of each other on a tabletop or on a corresponding area on the floor, and give a capacity of 18 columns. The smallest commercially available unit has a width of 15 inches and 18 such units would take up 50% more space.

We have at present one unit on the floor under two laboratory tables that are placed about 3 feet from each other. The space between the tables is then used for the setting up of the chromatographic columns and the area on the tabletops is available for other work. These narrow types of collector can also be set up in (well ventilated) hallways where one often finds otherwise wasted space. Another factor to consider is that these units can be partially disassembled in about 10 min by unbolting the vertical supports from the horizontal and sloping part of the collector and the components can then be stored on a shelf.

The most important advantage of this collector design is that it allows many columns to be run at the same time. This will be of greatest value in cases of serial analyses where long runs are necessary to get good analytical results and where the number of columns that can be run will be the limiting factor in the analysis. In many other cases considerable time per analysis will be saved since the analyses can be set up on an "assembly" line basis with a corresponding cut in time spent per analysis.

The collector is particularly useful when used in connection with the technique described elsewhere in this issue[1] for simultaneous gradient elution chromatography on a number of columns.

It is furthermore very flexible in design. Length and width can be adapted to the problem at hand and the test tube carriers can be built to take test tubes of many different sizes, and if needed, flasks or beakers.

The test tube carriers can be put directly in a large vacuum oven for evaporation of organic solvents. The carriers in the present version have permanently attached wheels. It would be simple to make the test tube rack detachable from the wheel portion so that different type tube racks could be put on the same wheel base.

The device is inexpensive. The total cost in materials and labor for a duplex unit that can handle 12 chromatographic columns is somewhat less than the cost of one of lowest priced commercial fraction collectors that can be used for one column only.

ACKNOWLEDGEMENTS

The author expresses his appreciation to his colleague, JOHN BLAIR, for much valuable advice and to L. G. COLLYER, who did the mechanical construction involved. This piece of work was supported in part by a grant (M 1953) from the National Institute of Mental Health of the Public Health Service of the Department of Health, Education and Welfare.

SUMMARY

A fraction collector for the simultaneous collection of fractions from a number of chromatographic columns is described. The collector is simple in design, easy to construct and is inexpensive to build. Limitations and advantages of the apparatus are discussed.

REFERENCE

[1] P. VESTERGAARD, *J. Chromatog.*, 3 (1960) 560.