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AEC RESEARCH AND DEVELOPMENT REPORT

AN AUTOMATIC SYSTEM FOR THE PREPARATION OF CULTURE MEDIA

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AN AUTOMATIC SYSTEM FOR THE PREPARATION OF CULTURE MEDIA

by

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ABSTRACT

An automatic system was developed to reduce the manpower and laboratory space required for the preparation and storage of synthetic media for long-term continuous flow studies with mass cultures of algae. This equipment was designed to supply culture media containing radionuclides for tracer studies with algae; however, it can be easily modified to continuously supply a variety of solutions for laboratory investigations. This system is compact, accurate, and requires little maintenance.

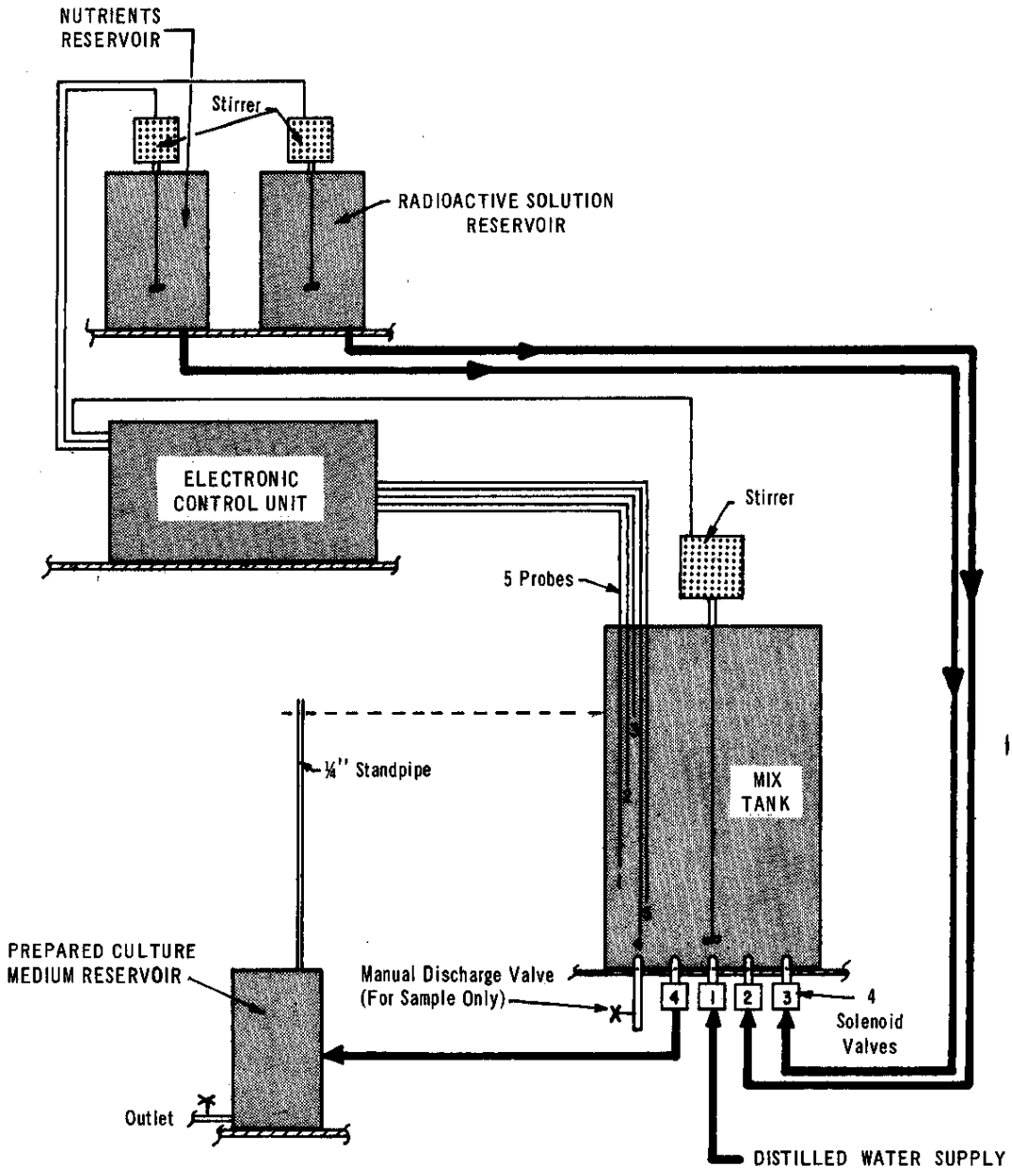


FIG. 1 FLOW DIAGRAM OF AUTOMATIC MEDIUM PREPARATION SYSTEM

EQUIPMENT

The automatic system consists of an electronic control unit, a mix tank, a distilled water supply, and reservoirs for nutrients, radioactive solution, and prepared culture medium (Fig. 1). The control unit (Fig. 2) sequentially programs five functions:

1) Adds distilled water to the mix tank and starts the stirrer in the radioactive solution.

2) Stops radioactive solution stirrer, starts nutrient solution stirrer, and adds radioactive solution to the mix tank.

3) Stops nutrient solution stirrer and adds nutrient solution to the mix tank.

4) Starts automatic timer which operates the mix tank stirrer for five minutes and sets the control unit to Function 5.

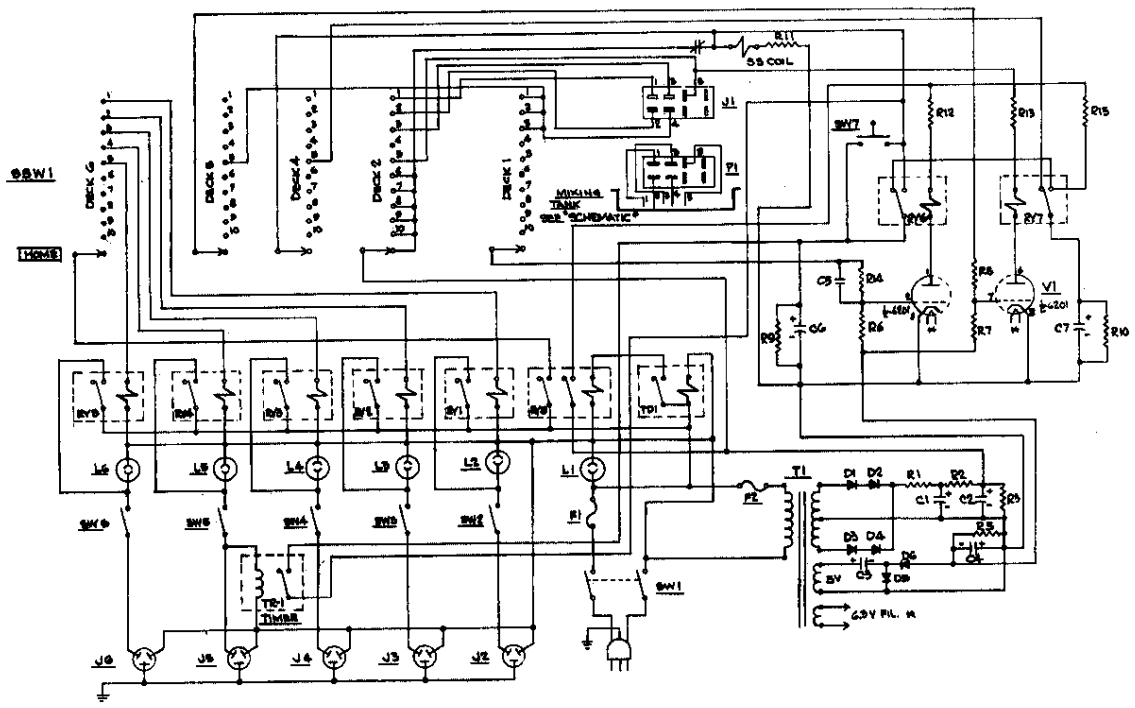
5) Drains prepared medium from the tank and resets the control unit to Function 1.

The stainless steel solenoid valves and stirrers are automatically controlled by stepping switches which are actuated by stainless steel electrodes or probes that detect changes in the liquid level in the mix tank.

OPERATION

The flow of ingredients into the 39-liter stainless steel mix tank and the discharge of prepared medium from the tank are regulated by four, electrically operated solenoid valves (Fig. 1). The solenoid valves and a 1/4-inch-ID stainless steel sample valve are mounted one inch above the base of the tank. The stirrer and five 1/8-inch-OD probes with tapered tips are mounted on a "Plexiglas"* lid on the mix tank. These probes are accurately positioned during calibration to control the volumes of various solutions added and discharged from the tank. Distilled water flows to Valve 1 (1/4-inch ID) under 10-15 psi from a laboratory outlet. Radioactive solution is supplied to Valve 2 (1/8-inch ID) and nutrients are supplied to Valve 3 (1/4-inch ID) by gravity flow from the two 24.7-liter polyethylene reservoirs. Prepared medium flows from the mix tank through Valve 4 (1/4-inch ID) to a 7.6-liter polyethylene, prepared medium reservoir from which the medium is pumped directly to the culture vessels.

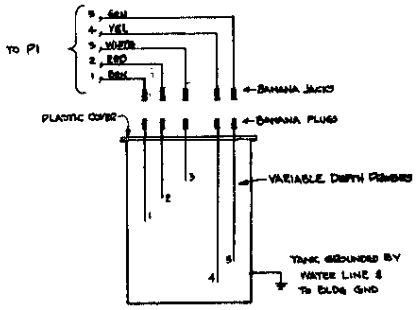
* Trademark of Rohm and Haas Company



PARTS LIST

C1, C2	40 MFD, 450V ELECTROLYTIC CAPACITOR
C3, C4	100 MFD, 25V " " "
C5,	0.2 MFD 200V CAPACITOR
C6, C7	50 MFD 350V ELECTROLYTIC CAPACITOR
D1 - D6	IN-2071 (SOME UNITS USED K200 DIODE RECTIFIER)
F1	SLO-BLO FUSE 3AG, 5A
F2	SLO-BLO FUSE 3AG, 1A
J1	CONNECTOR H.B. JONES *S-308-AB
J2-J6	CONNECTOR HUBBELL *7213
L1-L6	NE-51 BULB
R1	15 OHM, ½ W
R2	1K, 10 W
R3	100K, 2 W
R5, R7	100 K, ½ W
R6, R8	1 MEG, ½ W
R9, R10	68 K, 2 W
R11	150 OHM, 2 W
R12	10 K, 2 W
R13, R15	20 K, 2 W
R14	500 K, ½ W
RY1 - RY5, RY8	DPDT RELAY, POTTER BRUMFIELD *KEP11AG
RY6, RY7	DPDT RELAY, " " *KEP11D
SW1	DPDT TOGGLE SWITCH
SW2 - SW6	SPST " "
SW7	PUSH BUTTON SWITCH GRAYHILL *2201
SSW1	STEPPING SWITCH - AUTOMATIC ELECTRIC TYPE 44
P1	CONNECTOR H.B. JONES * P-308-CCT
T1	TRANSFORMER STANCOR *PM8404
TD1	RELAY 15-95C *SILIC-O-NETIC *8
TR1	TIMER, ADJ 0-95 MIN, HAYDON * DA-21
V1	TUBE, *6201

* Trademark of Heinemann Electric Co., Trenton, N. J.



SCHEMATIC OF MIXING TANK

FIG. 2 CIRCUIT DIAGRAM OF THE AUTOMATIC MEDIUM PREPARATION SYSTEM

The above dimensions are not critical to the operation of the system and may be altered to meet a wide range of volumetric and laboratory space requirements. However, with these dimensions, the system can be charged with sufficient ingredients for the automatic preparation of thirty-two 24.780-liter batches of modified Chu 10 medium. The medium can then be prepared as needed. The only purpose for the 7.6-liter reservoir is to maintain a supply of medium for the cultures during the mixing cycle. The system is designed so that all functions stop during a power failure and are automatically resumed in proper sequence when the power is restored. No toxic materials are in contact with the culture medium, and the system is easily dismantled for cleaning between tests. No maintenance has been required for the three systems which have been in use for a year.

CALIBRATION

The system is quickly calibrated with distilled water by the following procedures:

1. Insert Probe 4 (which completes the circuit for all probes) through the mix-tank lid until the tip of the probe is below all valve openings.

2. Position Probe 5 approximately one inch above the valve openings, and add distilled water to the tank until the tip of Probe 5 is submerged.

3. Switch the control unit on, and manually set it to Function 5. This drains the tank until contact is broken between Probe 5 and the water. (The control unit automatically resets to Function 1.)

4. Switch the control off, and manually add enough distilled water to equal the required volume of Ingredient 1.

5. Insert Probe 1 into the tank until an ohmmeter reading indicates that Probe 1 is in contact with the water.

6. The accuracy of each probe position is determined in proper sequence, as described below for Probe 1.

   a) Manually drain the distilled water from the

tank into a graduated cylinder until contact is broken between Probe 1 and the distilled water.

b) Switch the control unit on, and slowly add the withdrawn distilled water to the mix tank, without causing ripples, until the control unit automatically sets to Function 2.

c) Switch the control unit off, and repeat Steps 5 and 6 until the error, as determined by the volume of distilled water remaining in the cylinder, is within permissible limits.

7. With the control unit off and set to Function 2, manually add enough distilled water to equal the volume of Ingredient 2, and accurately position Probe 2 as outlined in Steps 5 and 6.

8. With the control unit off and set to Function 3, manually add enough distilled water to equal the volume of Ingredient 3, and accurately position Probe 3 as outlined in Steps 5 and 6.

9. Switch the control unit off, and manually drain the distilled water from the mix tank.

10. Manually add the prepared media or solution to the mix tank until the tip of Probe 5 is submerged.

11. Switch the control unit on, and set to Function 5 for automatic operation of the system.