

UNCLASSIFIED

AD 272 150

*Reproduced
by the*

ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA



UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

CATALOGED BY ASTIA
AS AD NO.

272150

272 150

XEROX

62-2-3

DEVELOPMENT OF ULTRA-THIN FILM
PRESERVATIVE COMPOUNDS

Prepared under Navy, Bureau of Naval Weapons
Contract N0w 61-0855

Quarterly Report No. 2

1 October 1961 through 31 January 1962

Released to ASTIA by the
Bureau of
without restriction.

NAVAL WEAPONS



DEVELOPMENT OF ULTRA-THIN FILM
PRESERVATIVE COMPOUNDS

Prepared under Navy, Bureau of Naval Weapons

Contract NOW 61-0855

Quarterly Report No. 2

1 October 1961 through 31 January 1962

FOSTER D. SNELL, INC.
29 West 15 Street
New York 11, NY

ABSTRACT

Construction of the controlled cyclic condensation humidity cabinet was completed. Some delay was encountered by the necessity of design changes and repair of leaks to the refrigeration systems.

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction. Operative Principles of Equipment.....	1
II. Component Parts of Controlled Cyclic Condensation Humidity Cabinet.....	3
III. Changes in Construction of Controlled Cyclic Condensation Humidity Cabinet.....	7
IV. Summary.....	9
V. Future Work	9

PLATES

Plate #1	Controlled Cyclic Condensation Humidity Cabinet. (Top View of Moisture Chamber)
Plate #2	Controlled Cyclic Condensation Humidity Cabinet. (Side view of Moisture Chamber)
Plate #3	Sketch of Air Humidifying System
Plate #4	Sketch of Compressor
Plate #5	Sketch (Top View) of Test Panel Mounting
Plate #6	Sketch of Humidity Cabinet
Plate #7	Sketch of Specimen Trays and Air Distribution Manifold in Cabinet

I. INTRODUCTION. OPERATIVE PRINCIPLES OF EQUIPMENT

In this controlled cyclic condensation humidity cabinet, corrosion test specimens are exposed to alternating conditions of condensation and evaporation of moisture from the test surfaces. Raising the mean temperature and, to some extent, increasing the frequency of this artificial diurnal cycle is intended to produce accelerated corrosion processes which correspond closely to corrosion processes actually encountered by metal parts in storage.

To accomplish the cycle of condensation-evaporation, air containing a fixed percentage of water is continuously supplied to a compartment in which the test panels are exposed. Since the percentage of moisture in the air is constant, variations in temperature result in variations of relative humidity. In order to effect condensation of water on the test specimens, it is not necessary to lower the temperature of the air in the entire cabinet; it is only necessary to lower the temperature of that part of the environment in closest proximity to the test surface. This localized cooling is accomplished by mounting specimens over a water jacket containing refrigeration tubing. By periodic on-off operation of the refrigeration system, a repeatable pattern of condensation and evaporation of moisture is obtained.

For our equipment, moisture content and air temperature are controlled by the following operation: Air from the compressed air line is passed through a sintered bronze filter to remove oil and water. The pressure is

next reduced from 100 psi. to 10 psi. and the air is led through a larger Fiberglas filter to remove all traces of water, oil, and dirt that may have escaped the first filtering. From the second filter, the air is bubbled through a heated distilled water bath in order to dissolve the proper amount of water vapor required by the test conditions. The amount of moisture dissolved in the air is fixed by controlling the rate of air flow, water level, and water temperature in the moisturizing chamber. Air, now containing a proper percentage of water vapor, is then passed through a long coil suspended in a heated oil bath. This is merely to preheat the air somewhat so that it will be easier to maintain the air temperature at the proper level in the humidity cabinet. Air is distributed in the cabinet above and below the specimen holders through perforated copper tubing and is heated by thermostatically controlled heaters. The condensation-evaporation cycle obtained on the test panels is determined by the on-off operation cycle of the compressor, which is controlled by a programming clock.

II. COMPONENT PARTS OF CONTROLLED CYCLIC CONDENSATION HUMIDITY CABINET

In this section are listed the essential parts that are necessary
in the construction and operation of the controlled cyclic condensation
humidity cabinet.

<u>Code</u>	<u>Part</u>	<u>Description</u>	<u>Purpose</u>
A	Needle valve	--	Shut-off valve for compressed air-line
B	Filter, sintered bronze	--	Remove water and oil from air
C	Pressure regulator	--	Reduce air-line pressure to suitable level
D	Filter, Fiberglas	Sealed 5-gallon drum filled with Fiberglas	Remove any oil, water, or dirt from air not removed by "B"
E	Flowrater	Flowmeter tube and valve	Control rate of air-flow through moisture chamber
F	Moisture chamber	5-gallon sealed drum with heated distilled water bath	To saturate air with water vapor
G	Heat exchanger	Copper coil in 5-gallon heated oil bath	Preheat and "dry" water vapor-saturated air
H	Air distribution manifold	Perforated copper tubing shaped in conjoined square and circle	To distribute air in humidity cabinet
I	Cabinet	Cubic, copper-sheeted box with 4 windowed doors and see-through Plexiglas cover	Contain test specimens, test atmospheres, and auxiliary equipment necessary for maintaining desired conditions.

<u>Code</u>	<u>Part</u>	<u>Description</u>	<u>Purpose</u>
J	Compressor	1/2 h. p. hermetically sealed refrigeration compressor	To enable cooling of specimens
K	Programmer	24-hour electric clock with on-off plugs	To control on-off operation of compressor
L	Moisture filter	Silica gel cartridge	To remove any vapor from refrigerant to prevent valve freeze-ups, etc.
M	Needle valves (2)	--	To isolate refrigeration manifold and return line from compressor
N	Expansion valve	--	Allow expansion of liquid refrigerant to gas
O	Manifold	1/2" copper tubing joined through T-valves	For distribution of coolant to water-jacket trays
P	Bleeder	Needle valve at end of manifold	To bleed manifold of excess refrigerant, oil; to draw vacuum, etc.
Q	Specimen trays	Stainless steel water jackets with 3/8" copper coil, with cut-out holes for mounting specimens.	To mount test specimens
R	Return line	Same as manifold	To return refrigerant gas for recirculation

AUXILIARY PARTS

D ₁	Relief tube	3/8" open-ended, vertical, S-shaped copper tube filled with 10" column of mercury	Prevent air pressure buildup in system
----------------	-------------	---	--

<u>Code</u>	<u>Part</u>	<u>Description</u>	<u>Purpose</u>
E ₁	Flowmeter	--	See "E"
E ₂	Needle valve	--	See "E"
F ₁	Water tank	5-gallon distilled water bottle with necessary tubing	To supply water to moisture chamber
F ₂	Float valve	Small valve with float-actuated handle connected to F ₁ with 3/8" copper tubing	To control water level in moisture chamber
F ₃	Distributor	3/8" copper tubing with closed end and perforated sides beneath water level, leading from E ₂	To bubble air through moisture chamber
F ₄	Heating system	(a) Immersion heater (b) Relay (c) Thermostat (d) Thermometer (e) Pilot light	To control temperature of water in moisture chamber
G ₁	Copper coil	50-foot coil of 1/2" copper tubing	Conduct air through heat exchanger
G ₂	Heating system	Same as F ₄	Control temperature of heat exchanger
I ₁	Heating	Same as F ₄ and G ₂ except two heaters are used	To heat air in cabinet to desired temperature
I ₂	Doors	20" x 20" hinged, Plexiglas, windowed (18" x 18") catch-locked doors	Observation; access to cabinet
I ₃	Cover	30" x 30" double-layer Plexiglas lid	To enclose test while permitting observation

<u>Code</u>	<u>Part</u>	<u>Description</u>	<u>Purpose</u>
E ₁	Flowmeter	--	See "E"
E ₂	Needle valve	--	See "E"
F ₁	Water tank	5-gallon distilled water bottle with necessary tubing	To supply water to moisture chamber
F ₂	Float valve	Small valve with float-actuated handle connected to F ₁ with 3/8" copper tubing	To control water level in moisture chamber
F ₃	Distributor	3/8" copper tubing with closed end and perforated sides beneath water level, leading from E ₂	To bubble air through moisture chamber
F ₄	Heating system	(a) Immersion heater (b) Relay (c) Thermostat (d) Thermometer (e) Pilot light	To control temperature of water in moisture chamber
G ₁	Copper coil	50-foot coil of 1/2" copper tubing	Conduct air through heat exchanger
G ₂	Heating system	Same as F ₄	Control temperature in heat exchanger
I ₁	Heating	Same as F ₄ and G ₂ except two heaters are used	To heat air in cabinet to desired temperature
I ₂	Doors	20" x 20" hinged, Plexiglas, windowed (18" x 18") catch-locked doors	Observation; access to cabinet
I ₃	Cover	30" x 30" double-layer Plexiglas lid	To enclose test while permitting observation of test

<u>Code</u>	<u>Part</u>	<u>Description</u>	<u>Purpose</u>
J ₁	Pressure gauge	--	For use with compressor
L ₁	Sight glass	--	For use with moisture filter; indicates amount of moisture present and amount of refrigerant in system
Q ₁	Connecting tubing	3/8" flare nut-fitted copper tubing	To connect water jackets with manifold (M) and return line (R)
Q ₂	Rubber gaskets (2 each)	--	To prevent metal to metal contact between specimen and tray.
Q ₃	Hold-down plate	Cut-out aluminum plate fitted over specimen tray	To seal specimens against water in water-jacket

III. CHANGES IN CONSTRUCTION OF CONTROLLED CYCLIC CONDENSATION HUMIDITY CABINET

For purposes of convenience, the component parts of the controlled cyclic condensation humidity cabinet are grouped under one of three classifications. These classifications are:

- (1) Air Distribution and Moisture Control System
- (2) Cabinet
- (3) Refrigeration and Specimen Holder Systems

Included in the Air Distribution and Moisture Control System are the following component parts: (These parts have been lettered in accordance with the sequence of operations.)

- | | |
|----------------------------|-------------------------------|
| A - Needle valve | E - Flowrater |
| B - Sintered bronze filter | F - Moisture chamber |
| C - Pressure regulator | G - Heat exchanger |
| D - Fiberglass filter | H - Air distribution manifold |

The Refrigeration and Specimen Mounting System is composed of the following parts: (These, as with the air distribution and humidity control system, are lettered in accordance with the sequence of operation)

- | | |
|---------------------|---------------------|
| J - Compressor | O - Manifold |
| K - Programmer | P - Bleeder |
| L - Moisture filter | Q - Specimens trays |
| M - Needle valves | R - Return line |
| N - Expansion valve | |

The cabinet (I) houses the air distribution manifold (H) of the Air Distribution & Humidity Control System and the expansion valve (N), manifold (O), bleeder (P), specimen trays (Q), and return line (R) of the Refrigeration

and Specimen Mounting System.

In general, the systems and component parts of our Controlled Cyclic Condensation Humidity Cabinet correspond rather closely in function and construction with those in the equipment constructed by Minuti at Naval Air Material Center Laboratories, Philadelphia, Pennsylvania.

In the Air Distribution and Humidity Control System, the upper section of the air distribution manifold (H) has been enlarged in order to accommodate the different design of the specimen trays (Q). The cabinet is constructed as the original cabinet. However, in the Refrigeration & Specimen-Mounting System, several changes have been made. The specimen trays (Q) have been redesigned to accommodate ten 2" x 4" test specimens each, whereas the original specimen trays could accommodate only one 6" x 6" test specimen. In the original equipment, nine specimen trays (6" x 6" specimens in rows of 3 each) were contained in the cabinet, while in our equipment, there are 5 specimen trays (ten 2" x 4" specimens) inside the cabinet. These new trays are supported by two aluminum bars anchored to the side walls of the cabinet. The manifold and return line construction was necessarily modified to conform to the new specimen tray arrangement. T-valves are used to connect specimen tray refrigeration coils with the manifold and return lines because they offer a greater variety of control of the refrigeration cycle than was possible in the previous arrangement. The bleeder valve (P) and needle valves (M) were included in the system so that the specimen trays could be more easily isolated from the compressor when repairs are necessary, or samples are changed.

The plates included in this report illustrate some of the changes discussed above.

IV. SUMMARY

The completion of the controlled cyclic condensation humidity cabinet was delayed because of some necessary design changes and repairs to the refrigeration system. The changes effected are of a minor character and will not affect the basic operation of the cabinet. Primarily, the changes enable greater numbers of samples to be tested during any time period.

V. FUTURE WORK

With completion of the Controlled Cyclic Condensation Humidity Cabinet, testing of materials can now proceed.

Respectfully submitted,

FOSTER D. SNELL, INC.

William Miglas

William Miglas
Research Chemist

Bernard Berkeley

Bernard Berkeley, Director
Product Development Dept.

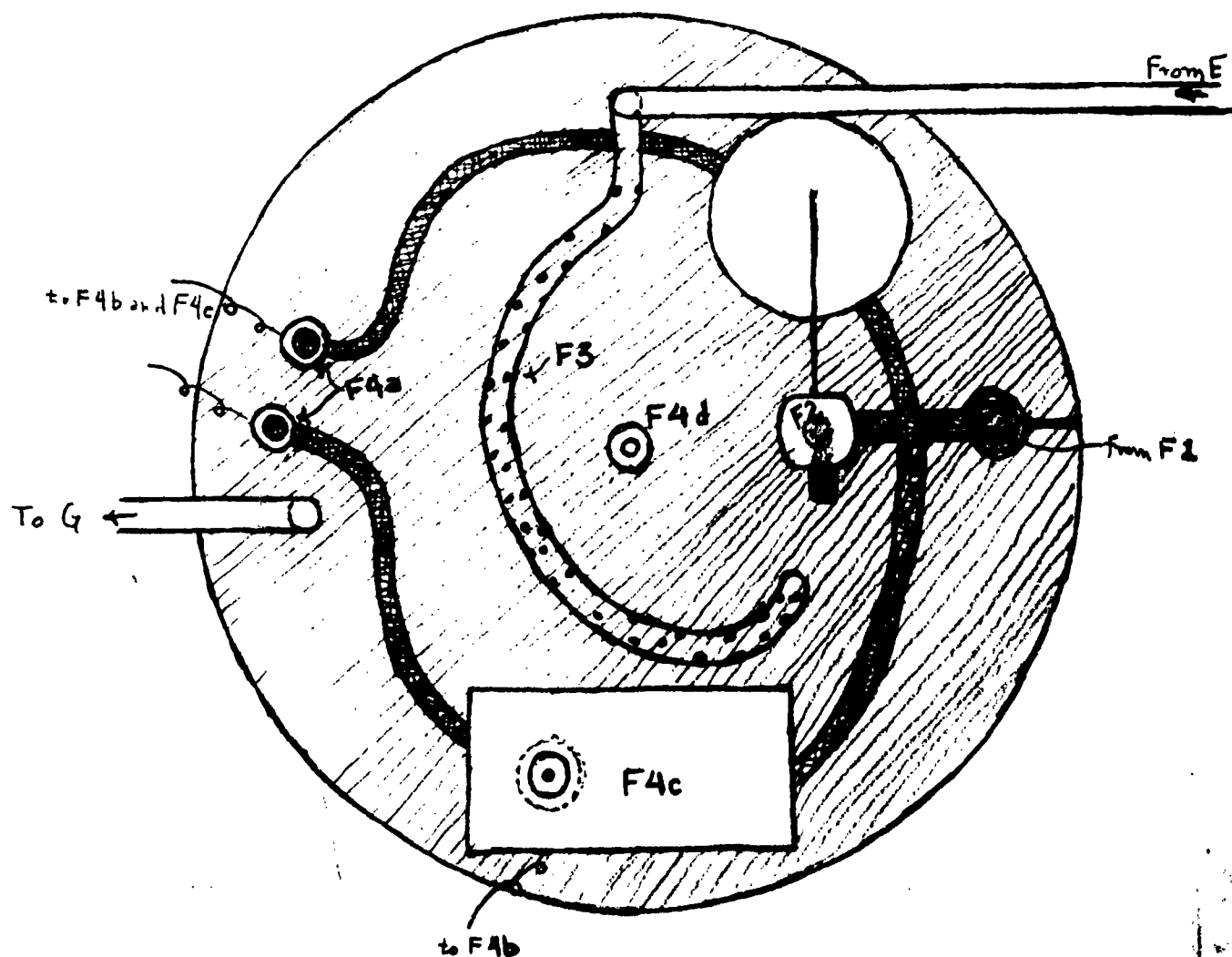
WM:BB:RF/oz. 16
Attached: 7 plates

CONTROLLED CYCLIC CONDENSATION HUMIDITY CABINET

Top View of Moisture Chamber (F)

Scale: 1/2" = 1"

F1	Water feed tank (not shown)	F4c	Thermostat
F2	Float valve	F4d	Thermometer
F3	Air Distributor	F4e	Pilot light (not shown)
F4a	Immersion heater	E	Flowrater (not shown)
F4b	Relay (not shown)	G	Heat exchanger (not shown)



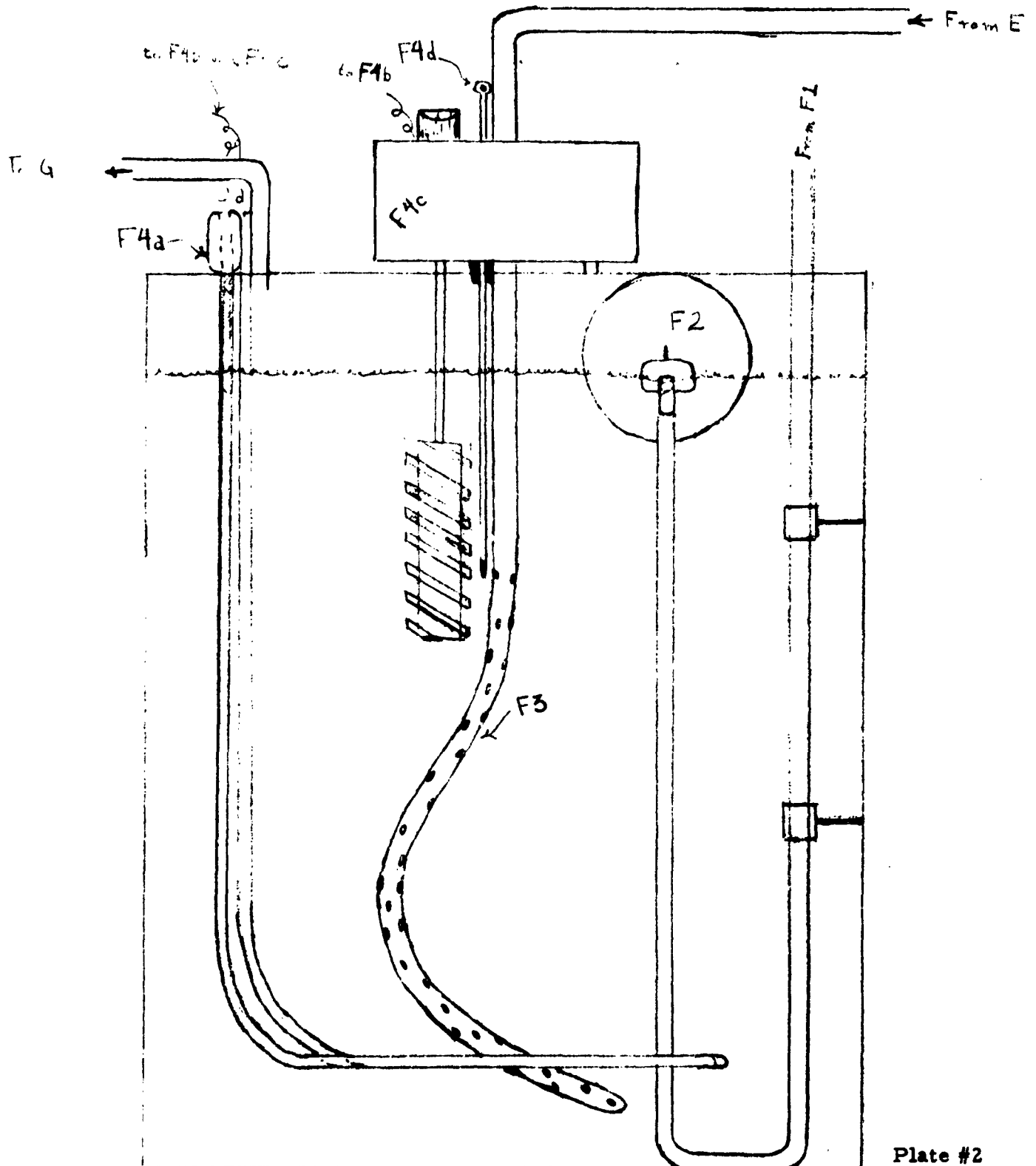
CONTROLLED CYCLIC CONDENSATION HUMIDITY CABINET

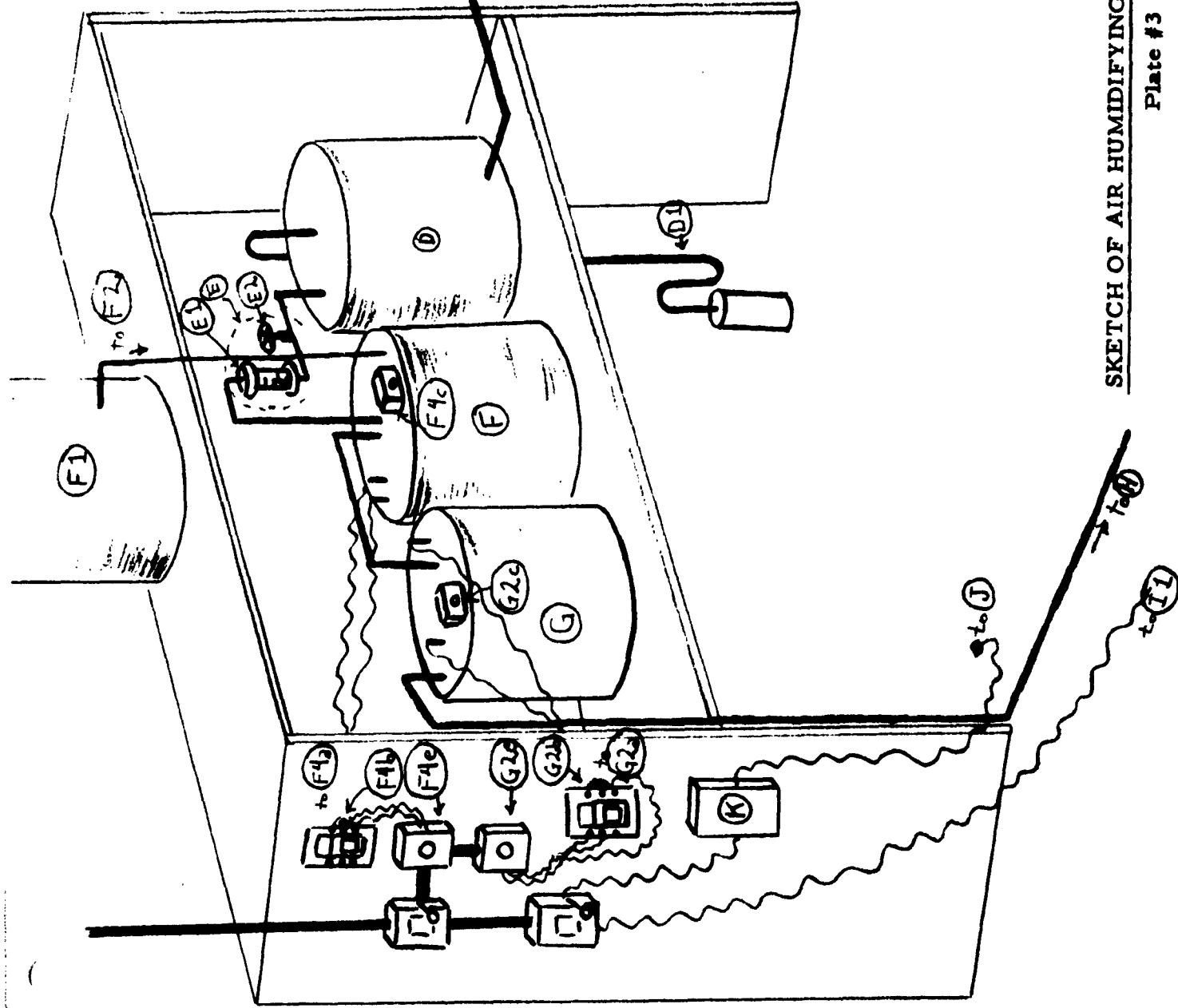
Side view of Moisture Chamber (F)

Scale: 1/2" = 1"

- F-1 Water feed tank (not shown)
- F-2 Float valve
- F-3 Air distributor
- F-4a Immersion heater
- F-4b Relay (not shown)

- F-4c Thermostat
- F-4d Thermometer
- F-4e Pilot light (not shown)
- E Flowrater (not shown)
- G Heat exchanger (not shown)





C Pressure regulator
(not shown)
D Filter, Fiberglass
D1 Relief tube
E Flowrater
E1 Flowmeter
E2 Needle valve
F Moisture chamber
F1 Water tank
F2 Float valve
(not shown)

F4a Immersion heater
(not shown)
F4b Relay
F4c Thermostat
F4e Pilot light
G Heat exchanger
G2a Immersion heater
(not shown)
G2b Relay
G2c Thermostat
G2e Pilot light
H Air distribution
I-1 Cabinet heating system
(not shown)
J Compressor
(not shown)
K Programmer

SKETCH OF AIR HUMIDIFYING SYSTEM (Not to Scale)

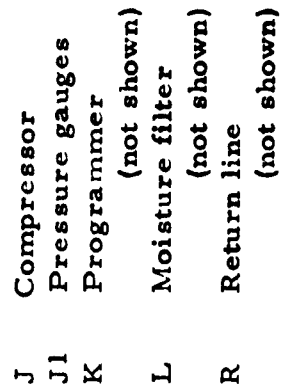
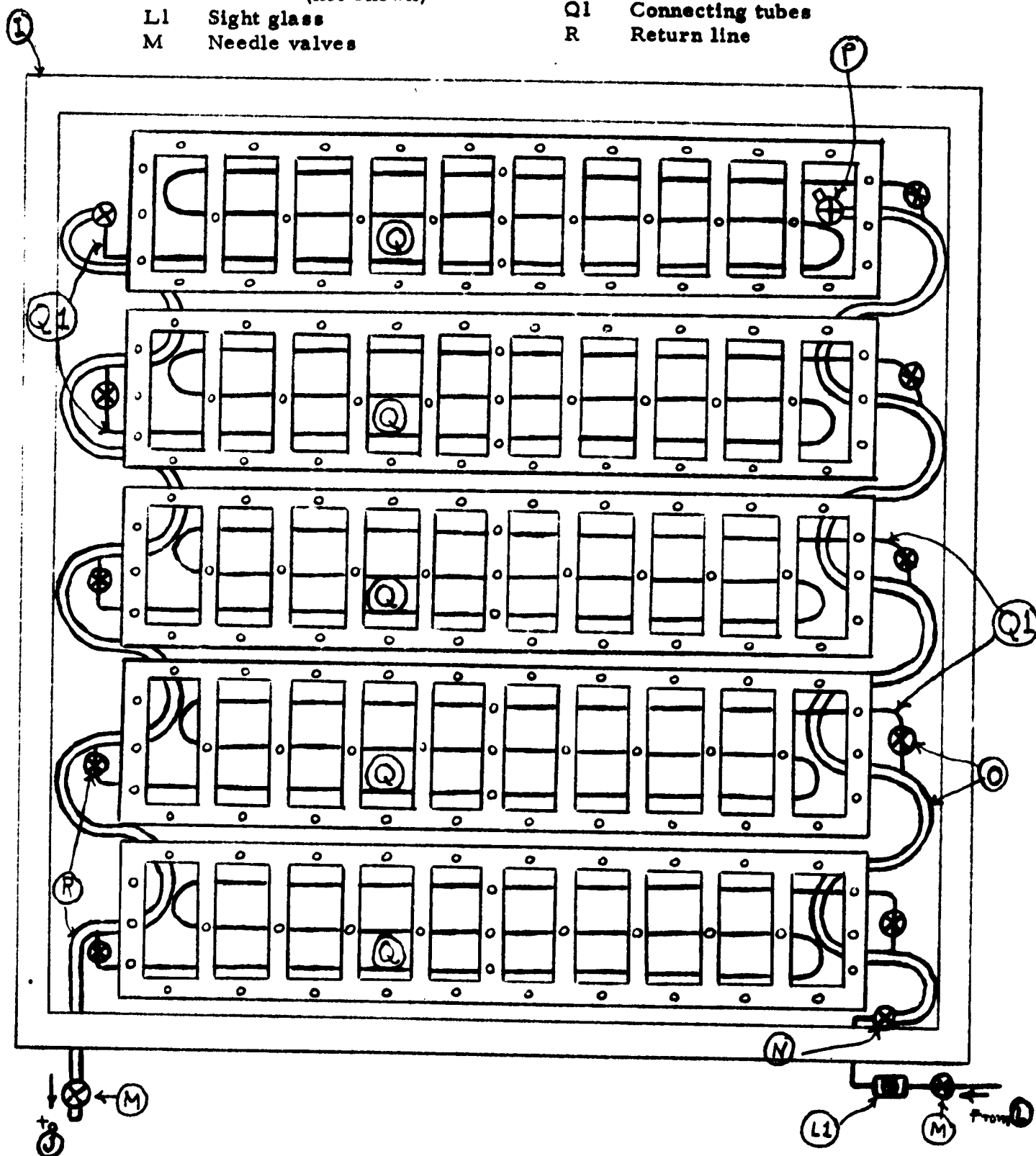


Plate #4

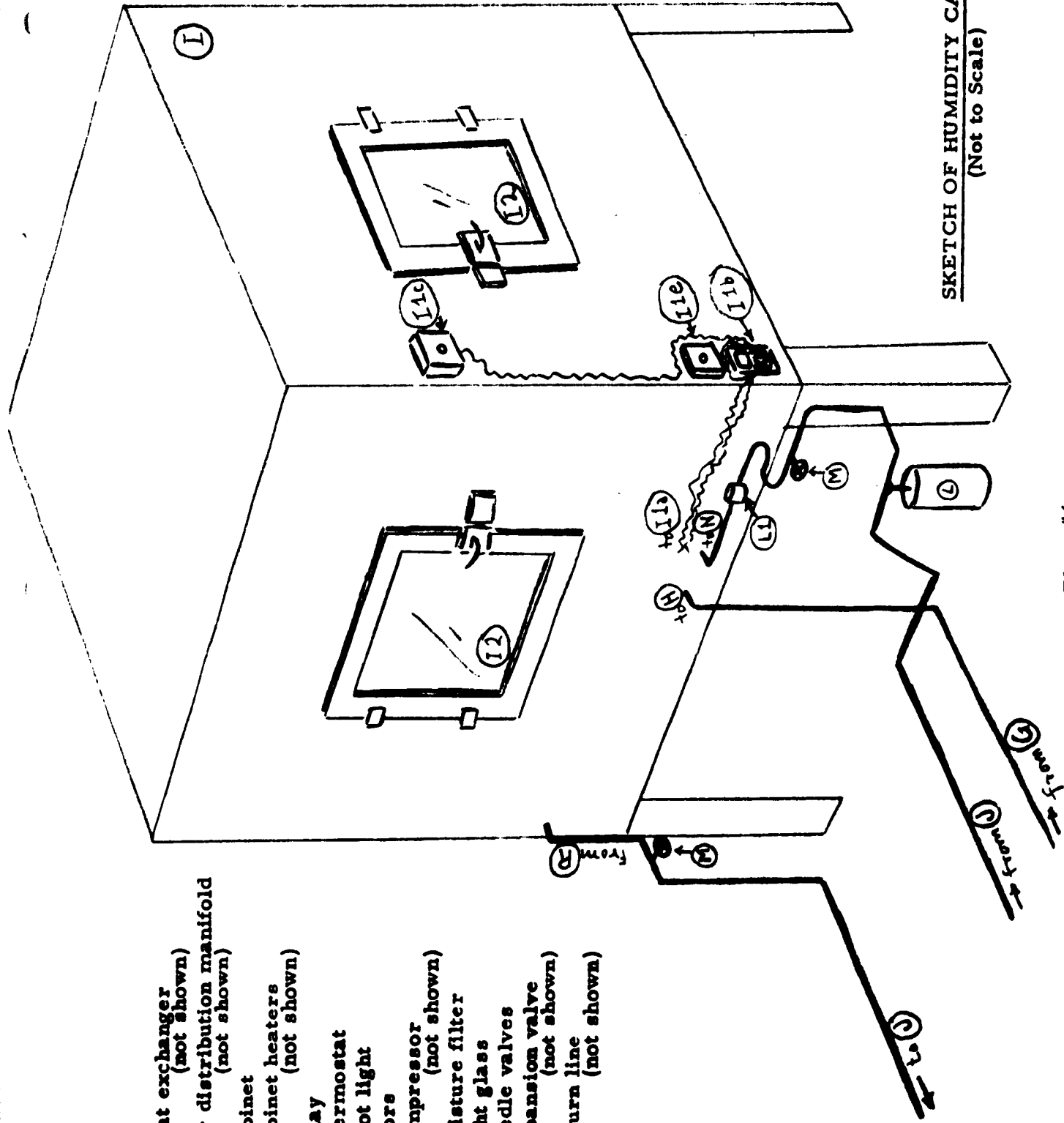
I Humidity cabinet
 J Compressor
 (not shown)
 L Moisture filler
 (not shown)
 Ll Sight glass
 M Needle valves

N Expansion valve
 O Manifold and T-valves
 P Bleeder
 Q Specimen trays
 Q1 Connecting tubes
 R Return line



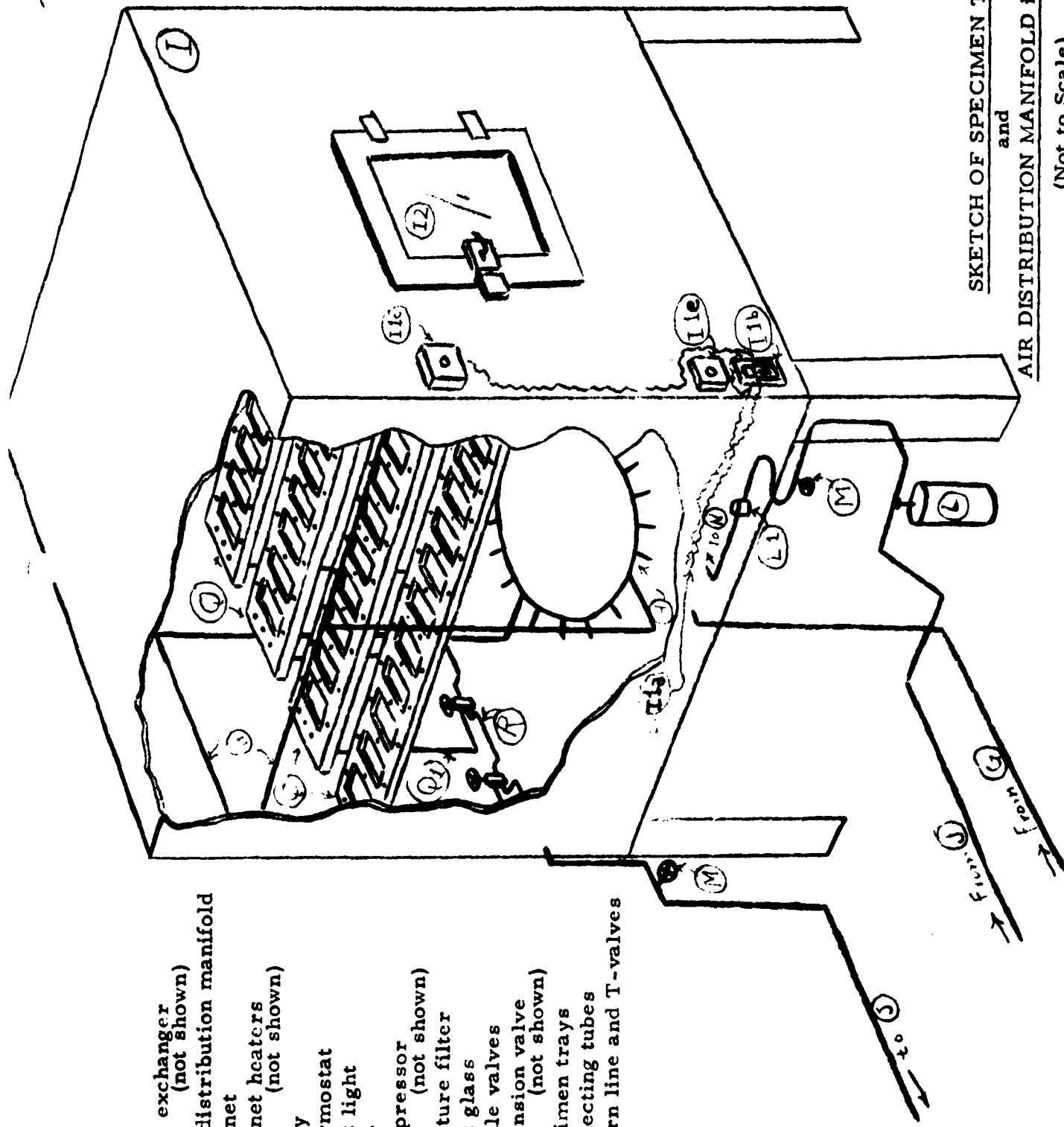
SKETCH (Top View) OF TEST PANEL MOUNTING (Not to Scale)

- G Heat exchanger
(not shown)
- H Air distribution manifold
(not shown)
- I Cabinet
- I-la Cabinet heaters
(not shown)
- I-lb Relay
- I-lc Thermostat
- I-le Pilot light
- I-2 Doors
- J Compressor
(not shown)
- L Moisture filter
- L1 Sight glass
- M Needle valves
- N Expansion valve
(not shown)
- R Return line
(not shown)



SKETCH OF HUMIDITY CABINET
(Not to Scale)

- G Heat exchanger
(not shown)
- H Air distribution manifold
(not shown)
- I Cabinet
- I-la Cabinet heaters
(not shown)
- I-lb Relay
- I-lc Thermostat
- I-le Pilot light
- I-2 Door
- J Compressor
(not shown)
- L Moisture filter
- L1 Sight glass
- M Needle valves
- N Expansion valve
(not shown)
- Q Specimen trays
- Q1 Connecting tubes
- R Return line and T-valves



SKETCH OF SPECIMEN TRAYS
and
AIR DISTRIBUTION MANIFOLD in CABINET

(Not to Scale)