Monsanto

PLAINTIFF'S EXHIBIT

MON-2550

NAME & LOCATION: F. H. Dupre

DATE: February 14, 1977

SUBJECT: Respirator Testing & Training Facility

REFERENCE: Memo J. E. Fox to J. A. Glass 1/27/77

TO: J. E. Clark - TC

cc: W. H. Collier
J. C. Edwards
J. E. Fox - TC
J. A. Glass - TC
J. S. Hagood
F. C. Himes
R. B. Kennard
R. G. McNeely
J. C. Usrey

Thank you for routing your copy of the referenced memo, along with all attachments, concerning the Dow Respirator Testing & Training Program, to John Hagood. You ask if there is any interest in pursuing a similar program jointly.

At this point in time I do not intend to pursue the development of similar facilities, jointly with Texas City or otherwise. You or the copyees of this memo may wish to disagree with my judgement; I certainly welcome your comments.

There are several reasons for the above conclusion. In general the Dow situation is vastly different from that of Chocolate Bayou. Consider the following:

- Dow has frequent spills of a highly corrosive material, namely chlorine. Spills of this type are rare at Chocolate Bayou.
- Dow makes wide use of "mouthpiece" respirators. Use of this type (non-approved by Bureau of Mines, etc.) was discontinued at Chocolate Bayou in 1976.
- Dow does not require or use nose clamps with the mouthpiece respirators due to poor employee acceptance of nose clamps. This creates the need to train people to breath through their mouth while at the same time not breathing through their nose. Almost all of the Dow training to date has been directed at this need. As stated above mouthpiece respirators are not permitted at Chocolate Bayou.
- Dow uses canister masks for escape and other purposes. Canisters are no longer used at Chocolate Bayou for escape purposes (discontinued in 1976). Self contained, constant flow, air supplied Lear-Siegler masks with total head coverage are now used.

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- The Dow tests are conducted with demand type regulators. By definition a slight vacuum must exist in the mask or mouthpiece before additional air is supplied. In 1976 Chocolate Bayou completed conversion of all air supplied respiratory equipment to the pressure demand type to eliminate this problem. In addition only full face pieces are acceptable.

At present, there is little use of half face masks with cartridges at Chocolate Bayou and none with canisters. The use of cartridges has pretty well been limited to dusts and fumes. This is the use area where I believe training, similar to Dow's would improve performance. I think a more conventional approach to this training will meet our needs.

Due to the limited present need for training via the use of alien atmospheres, I want to investigate the feasibility of using a less sophisticated set up. My version includes a plastic bag over the trainees head instead of a test room, the use of pre-blended gas (500ppm freon 12 in air) for the supply and a halide flame detector in place of the electronic detector. If this arrangement is feasible and is warranted, I can be in business for four or five hundred dollars.

I'll keep Arnold informed of any future developments at the Bayou. Please keep us informed of any action you take.

F. H. Dupre

FHD/dg
Enclosures

Monsanto

FROM : J. E. Fox

DATE : January 27, 1977

SUBJECT : Visit To Dow's Respirator Test Facility

REFERENCE :

TO : J.A. Glass

cc: J.E. Clark
A.J. Stroud
T. Ozarchuk

A trip was made to Freeport by A. J. Stroud and J. E. Fox to tour one of the respirator test facilities used by Dow Chemical Company. Our contact was Roger Daniel, Manager of Industrial Hygiene. We spent several hours looking over the equipment and building with Larry Packard, Chlorine Area Training Supervisor and Homer Brady, a former chlorine foreman and now operator of the test chamber.

They appear to have an excellent respiratory protective equipment training program and have spent a large amount of time, effort and money setting up the many test facilities. Outlined below are a number of items that were noted during our discussion. Attached are two write-ups and a piping diagram of their system.

1. They have seven respirator training units in use. Most are portable buildings on a trailer frame but they are not moved from place-to-place very often. They feel that it is easier to send the people to the units' location.

2. Three of the units have "trainers" assigned full time.

3. Very important to have well trained instructor, knowledgeable in the test program and respirator fitting.

4. They have tested and trained over 4,000 people, mostly with the "mouth-bit" respirator. They are now starting a training program on other types of masks. They retrain on a yearly schedule. Contract and construction personnel working in the chlorine areas are also trained.

5. About one-third of the people going through the test chamber need help or additional training. If they cannot pass the test within 4 to 6 minutes in the chamber, they fail and are required to return until they pass. A few have had to come back 3 or 4 times. They don't have this much of a problem with full or half face masks unless goggles are required with the half face mask.

6. Two air supplies are required. Dry air for instrument purging and humidified air for breathing.

7. They continually monitor the air supply for oxygen content.

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8. Freon 12 is piped to the trailer for use in the test chamber.

9. A large cylinder of calibration gas (500 ppm Freon 12 in air) is piped to the detector. The detector is calibrated several times per day.

10. A constant voltage transformer is used on the halide detector.

11. Normal test time, in the chamber, is 4 to 5 minutes.

12. The Freon 12 level in the exhaled air must drop below 10 ppm for a "passing" test.

13. A two compartment sink for cleaning masks is installed in the trailer.

14. Special air intake and exhaust fittings are available to fit each type of mask.

15. They like the A-0 R5000 & R6000 over the Comfo when cover goggles will also be required. They get a good fit on over 75% with A-0 and only 60% with Comfo.

16. Breathing air is supplied to the test masks through a demand regulator. Pressure mode is much better than demand mode. They also record pressure inside the face piece.

17. The halide meters are sometimes a maintenance problem so they keep a spare on hand in the trailer.

18. They have found that it takes 3 different types or styles of cover goggles to fit most subjects properly in a half face mask.

19. A 30 pound Freon 12 tank lasts approximately 2-3 months.

20. An air conditioner, set on make-up, is mounted in the control area. A separate air conditioner is used in the test chamber and is on total recirculation.

21. Voice communication is maintained between the control room and test chamber.

22. A recorder provides a written record of each test which is placed in the individual's file. I believe they also keep a card file of the total program for OSHA records. Included with this memorandum is a copy of my test cards. Note that I could not pass the test while wearing eye glasses. Also note the instant response of the halide detector when I pushed one finger under the side of the mask. It then took readjustment of the mask to lower the level down below 10 ppm.

23. The test facility we examined cost $10,000.00

John E. Fox

Attach 7C to 1cx memo 7C to Tagood -

CONSTRUCTION OF A RESPIRATOR TEST FACILITY

SUMMARY: A respirator test facility has been constructed in an 8' x 16' portable building. A section 5' x 8' was enclosed at one end to provide the test chamber. Freon 12 is introduced into the chamber to a level of 500 ppm in the atmosphere. Exhaled gases are collected from a man's respirator and sampled with a halide detection meter. Any leakage of the Freon-contaminated air into the man's pulmonary system is detected by the meter. Auxiliary equipment includes a circulating fan, an exhaust fan, a sink, storage cabinet, and minimal furniture.

RESULTS: The results to date have been highly significant. Ninety people have received screening tests. These are largely people from Chlorine 3. Operators, cell repair personnel, craftsmen, and supervisors have been tested. Approximately 45% have been unable to use a mouth-bit respirator properly when first tested. It would appear that a number of these men would receive an inhalation if they were exposed to a major chlorine release.

The facility is now being used not only to screen the personnel at Chlorine 3, but also to train them in the proper use of the mouth-bit respirator. The man is placed in the chamber with his test respirator and encouraged to watch the halide detection meter through a glass window. The man will modify his breathing pattern and muscular control until he "self-trains" himself to bring the meter down to zero.

CONSTRUCTION: The basic facility is a 16' x 8' portable building mounted on a lightweight trailer. A partition divides the unit into two sections. A circulating fan and an exhaust fan have been added to the chamber. The circulating fan has the function of maintaining a uniform concentration in the test chamber, and the exhaust fan is used to clean it out. A double sink and some kitchen cabinets were installed in one corner for washing gas masks; a small desk and chair are directly opposite the sink. Breathing air and Freon 12 were piped into the wall of the test chamber, and sample connections for the room and the respiratory device were brought out through the wall. Sample connections were piped up so that the halide meter could monitor either the room or the exhaled gases from the respirator. (See Plate No. 3) Purchase specifications for the building, the fans, and the kitchen equipment are shown in the appendix.

EQUIPMENT: Purchase specifications for the halide meter are shown in the appendix.

It was soon determined that Freon 12 would rapidly saturate the activated charcoal in a cartridge. The Safeline cartridges were useless for test purposes. As a substitute, a polyurethane plug was machined. (Plate No. 4) A demand regulator and breathing air supply were attached to the plug. (Plate No. 5) This is screwed into a man's respirator to take the place of the cartridge.

To collect the exhaled gases, several flexible adapters were fabricated by the Materials and Methods group. These were molded from RTV silastic. (Plate No. 6) The respirator, as prepared for testing, includes the polyurethane plug, demand regulator, flexible adapter, and a length of lightweight polyethylene hose. (Plate No. 7)

Flexible adapters were also prepared for full-face masks. (Plate No. 8) For those respirators and masks whose exhalation valves are not readily accessible, a sample connection is brought out of the side of the face piece. (Plate No. 9)

Although it is not shown in the photos, a humidifier has been added to the breathing air system.

Also not shown is an L&N INFOTRAC recorder; this is being substituted for strip chart recorder. The INFOTRAC will provide an individual chart of a man's test results on a 5" x 8" card suitable for filing.

OPERATION: The chamber is first charged to a level of 500 ppm of Freon. This is 1/2 of the Threshold Limit Value for Freon 12. The man's respirator is prepared as in Plate 7. The man is seated in the chamber and breathes through his respirator. When his pattern has been established, he is asked to make up some simple pipe fittings in order to distract his attention from the respirator. This constitutes the screening test. For those who fail, the halide detection meter is turned so that the scale is visible to the man. He is then encouraged to change his breathing manner in order to bring the reading down to zero. This method has had some very encouraging successes.

The fit of full-face masks can be tested in a similar manner, but this project has not been started at the time of this writing.

L. H. Packard, Jr.

hrl
7/16/75

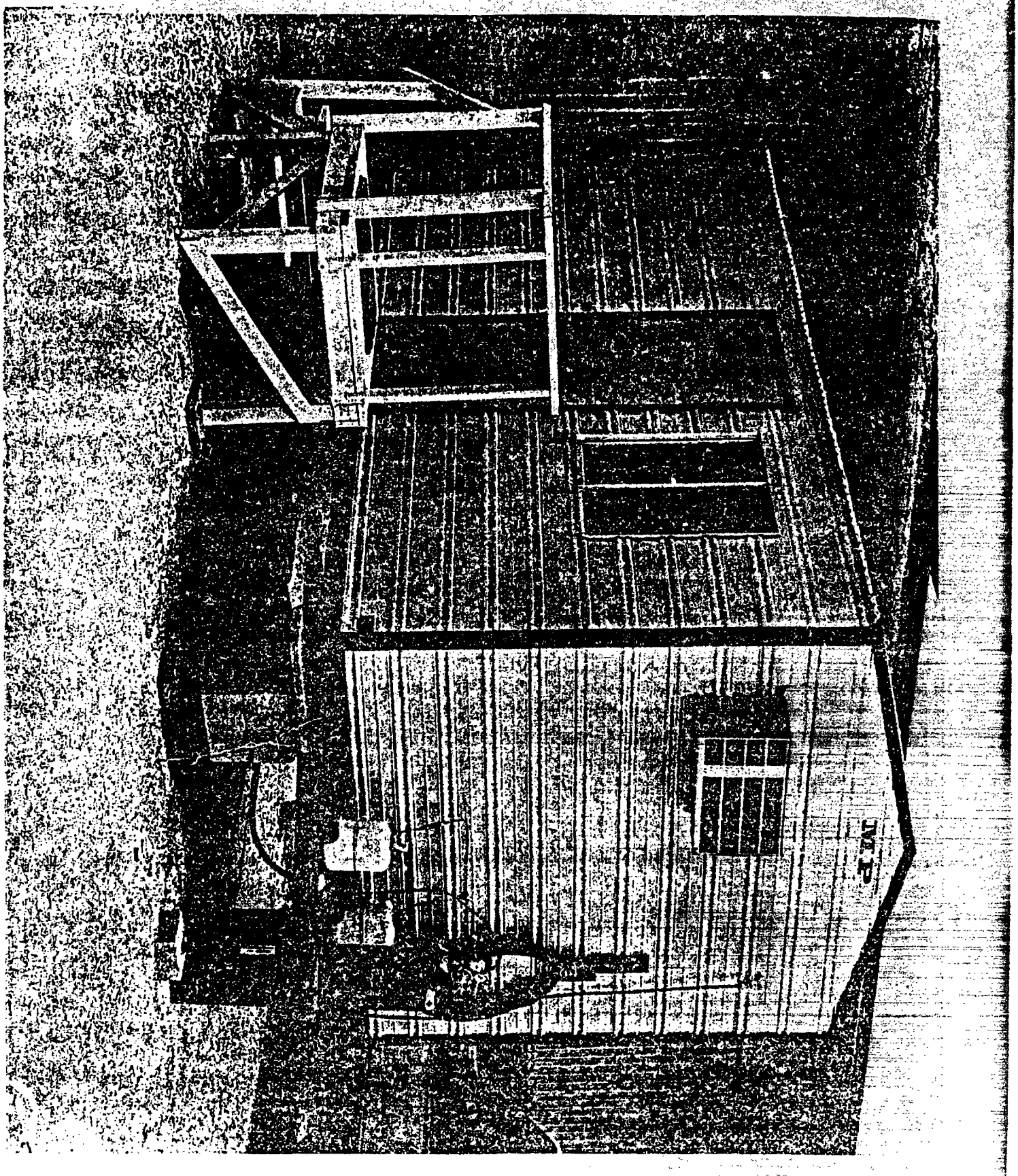

PLATE NO. 1
VIEW OF TEST FACILITY

C 003372

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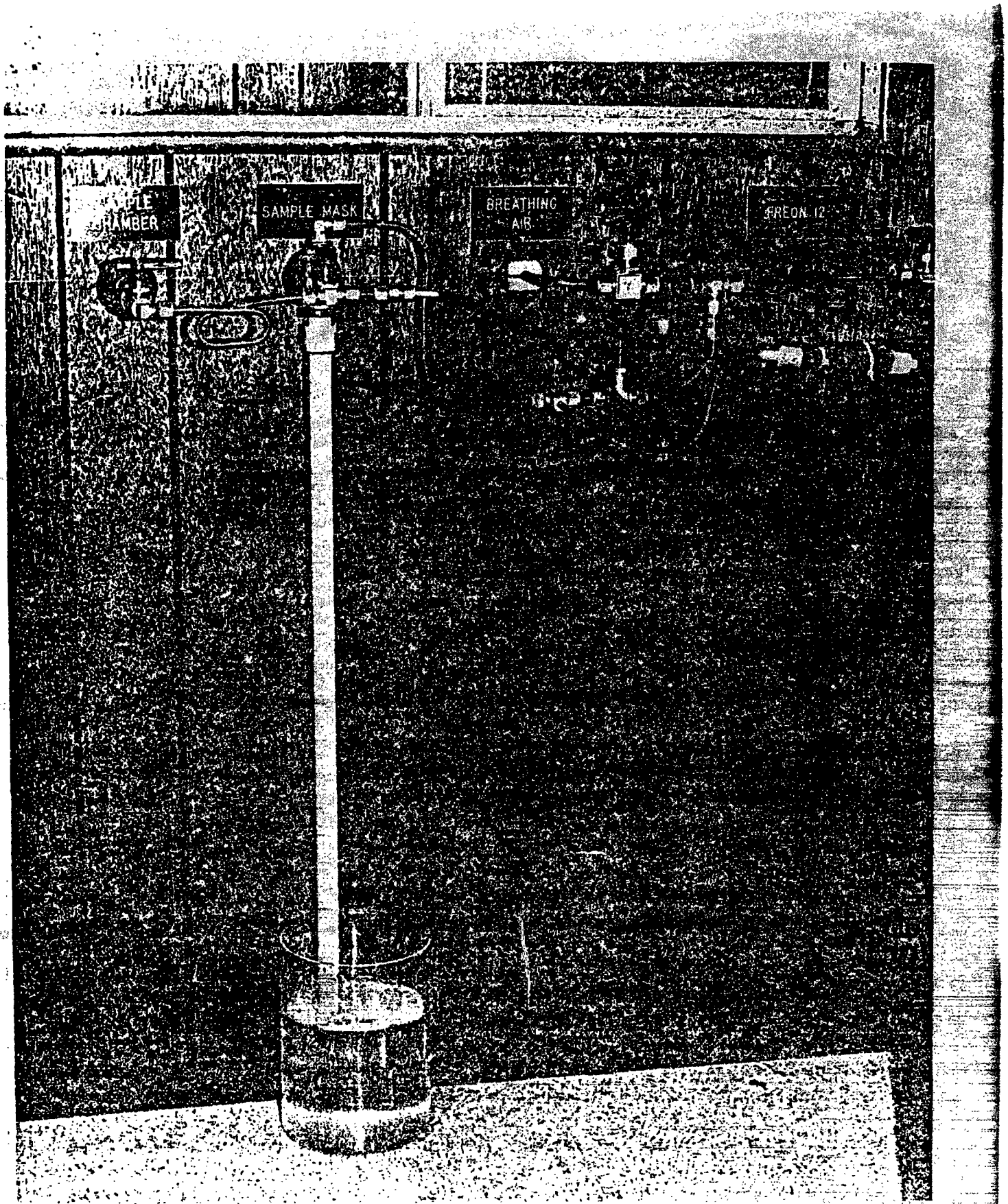
RESPIRATOR TEST FACILITY

PLATE No. 2

LAM023034

C 003373

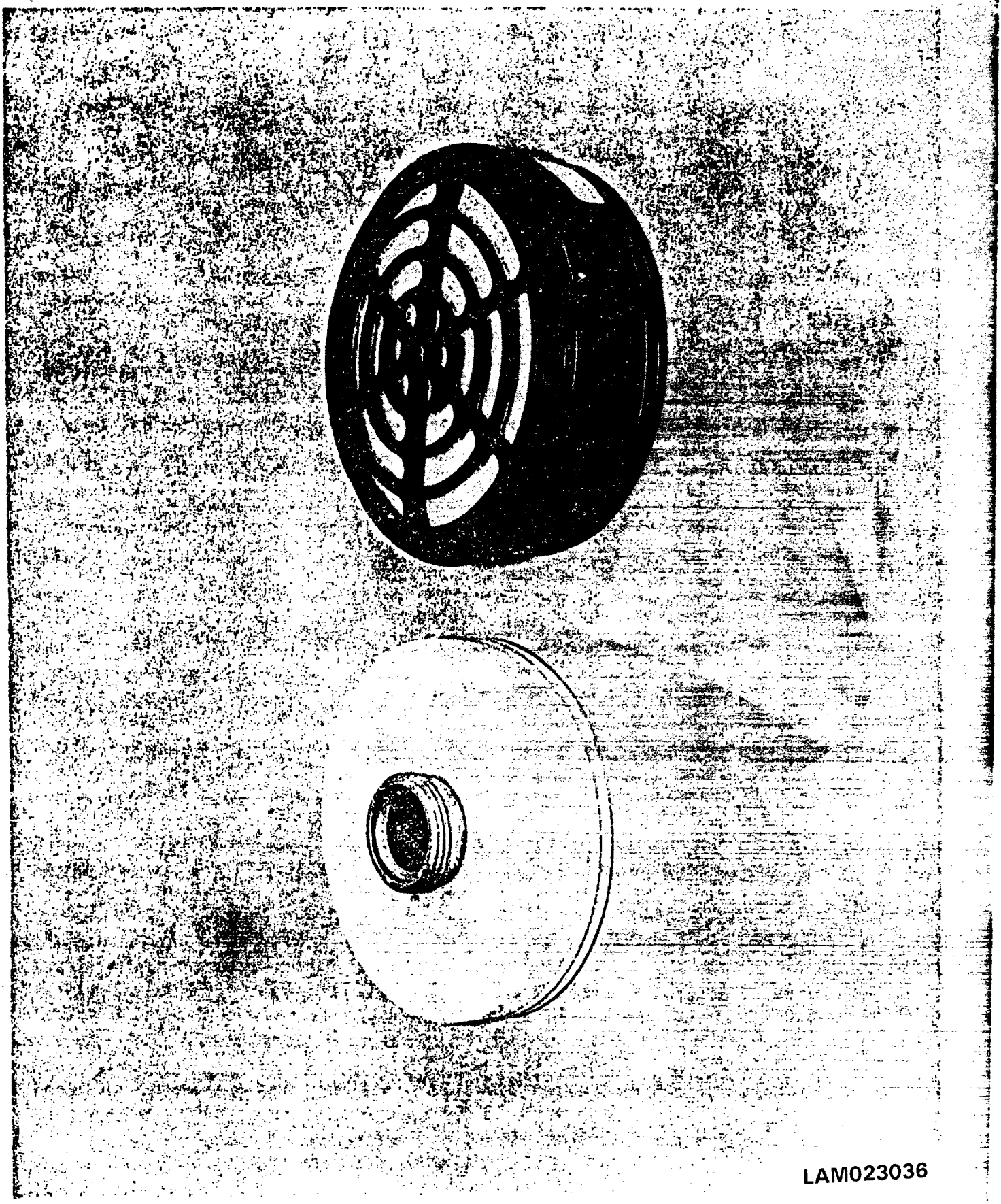


CHANGE

C 003374

PLATE NO. 3
PIPING AT WALL OF TEST CHAMBER

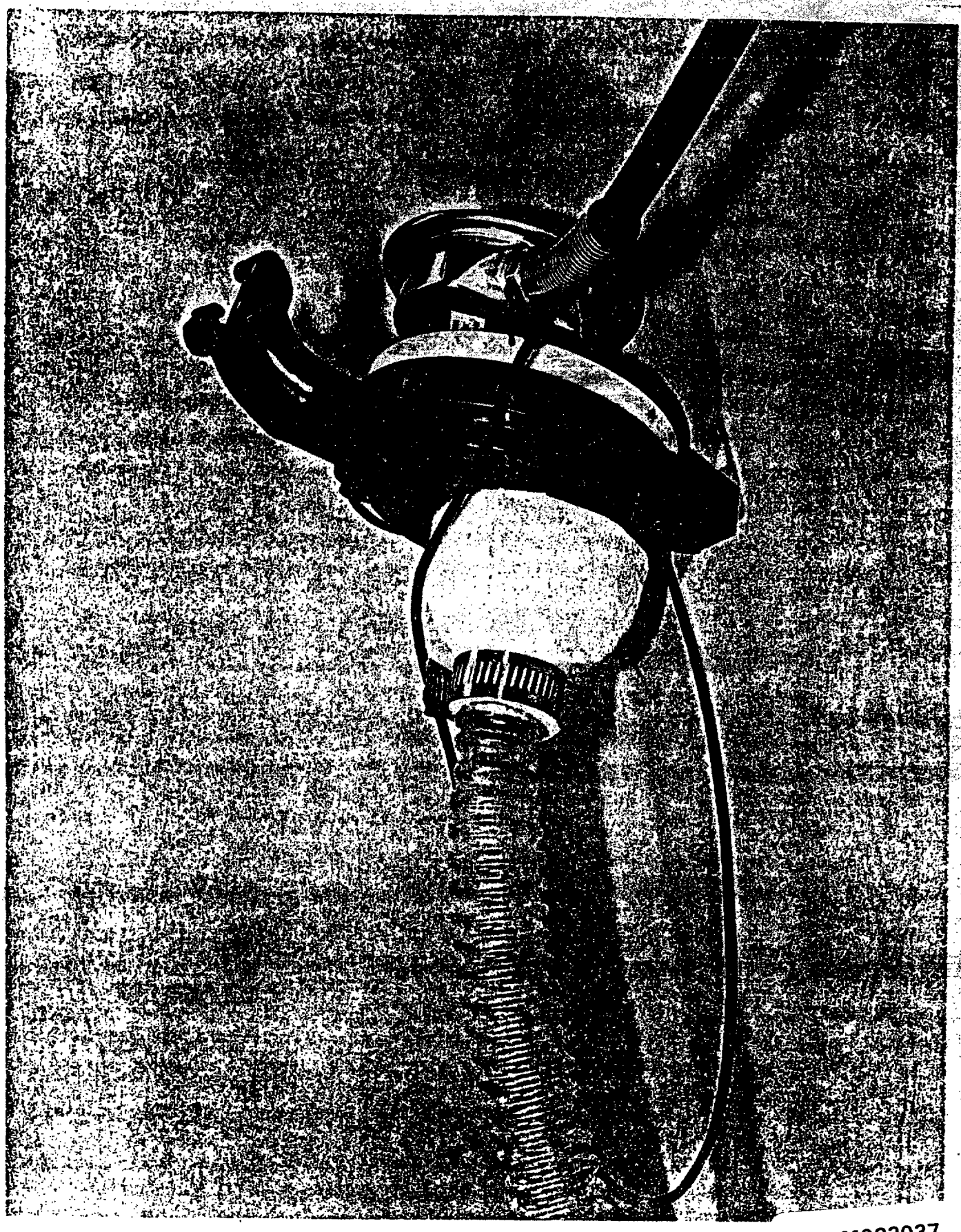
LAM023035



LAM023036

PLATE NO. 4
POLYURETHANE CARTRIDGE PLUG

C 003375



LAM023037

PLATE NO. 7
RESPIRATOR TEST ASSEMBLY

C 003376

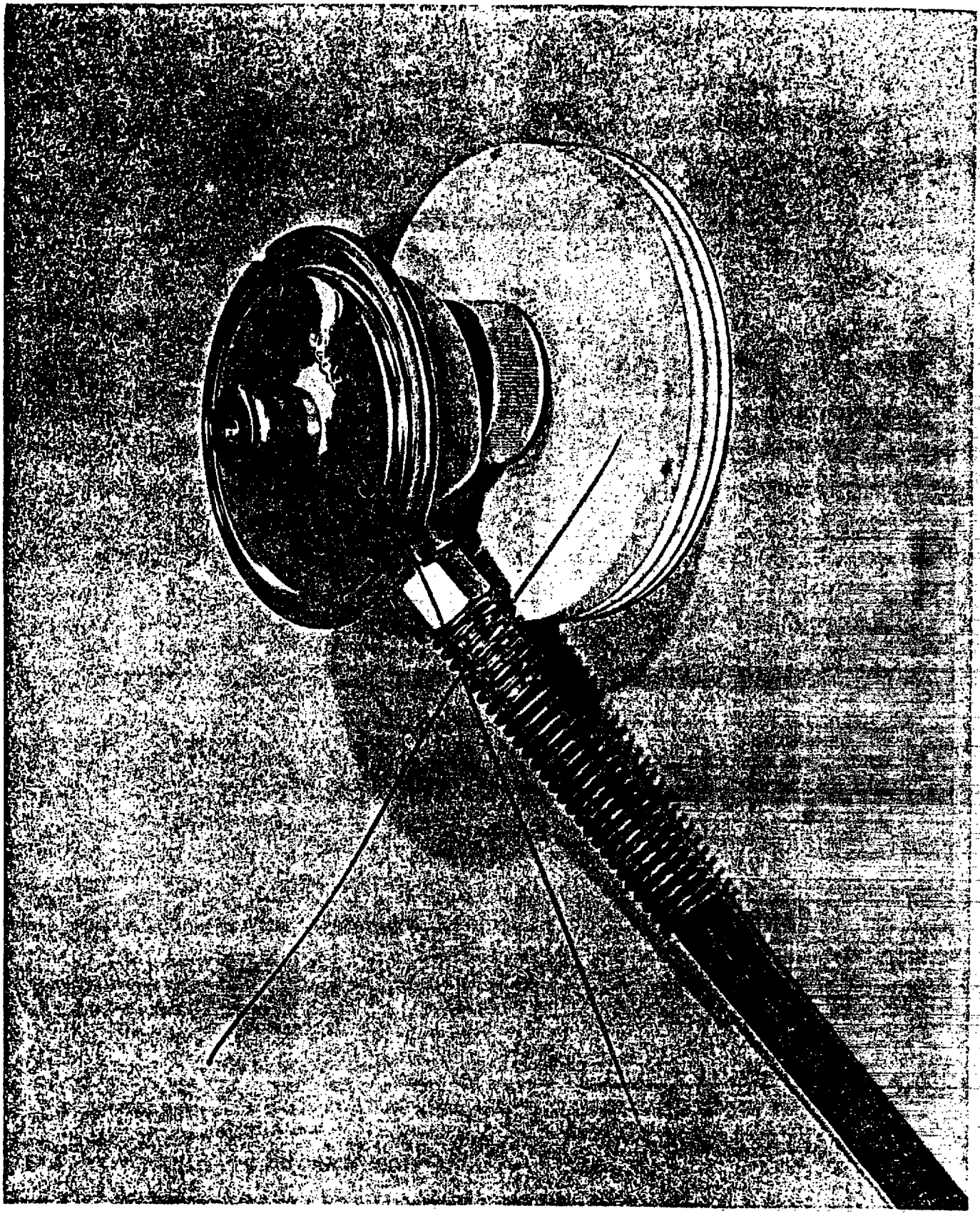
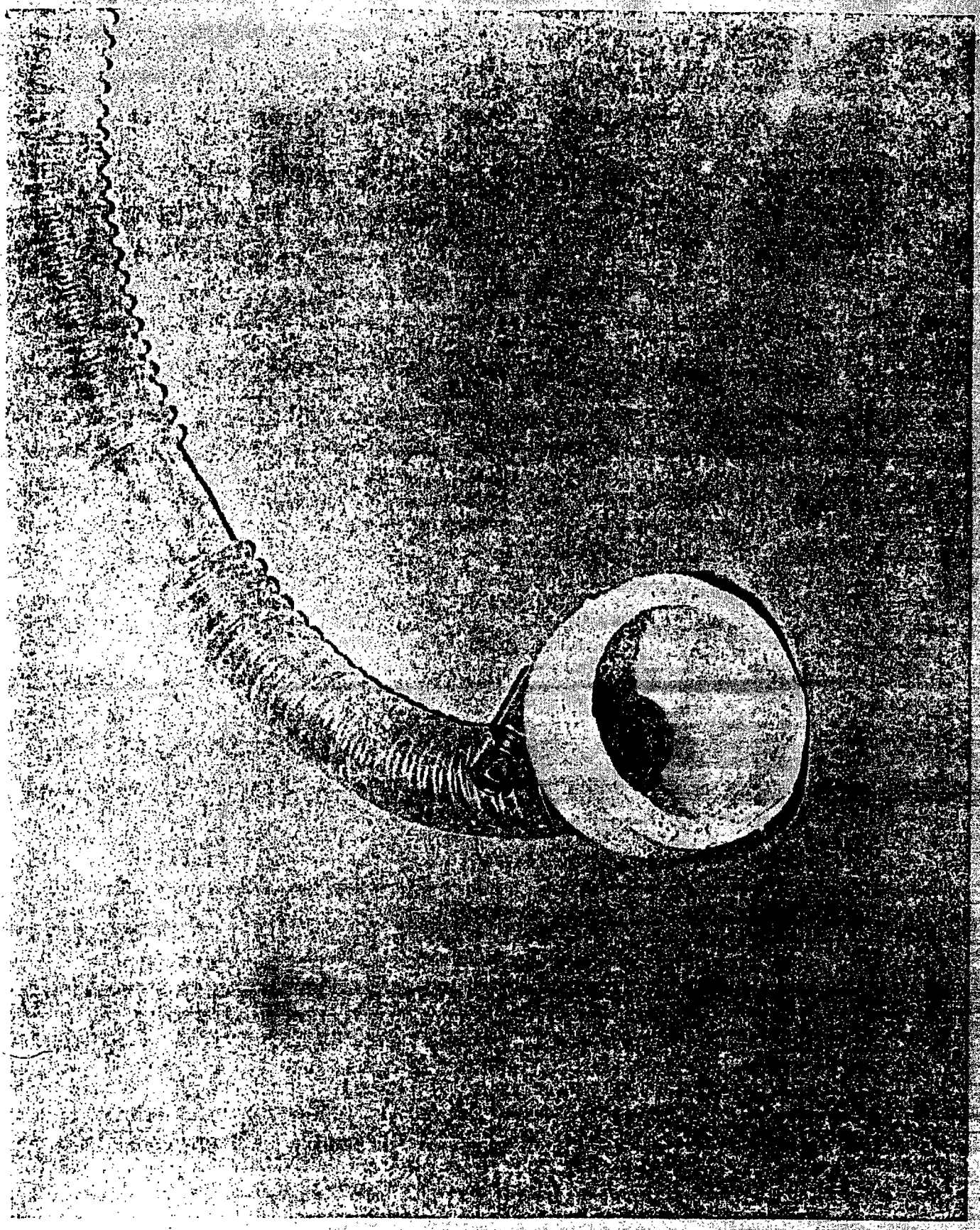


PLATE NO. 5
BREATHING AIR REGULATOR AND PLUG

LAM023038

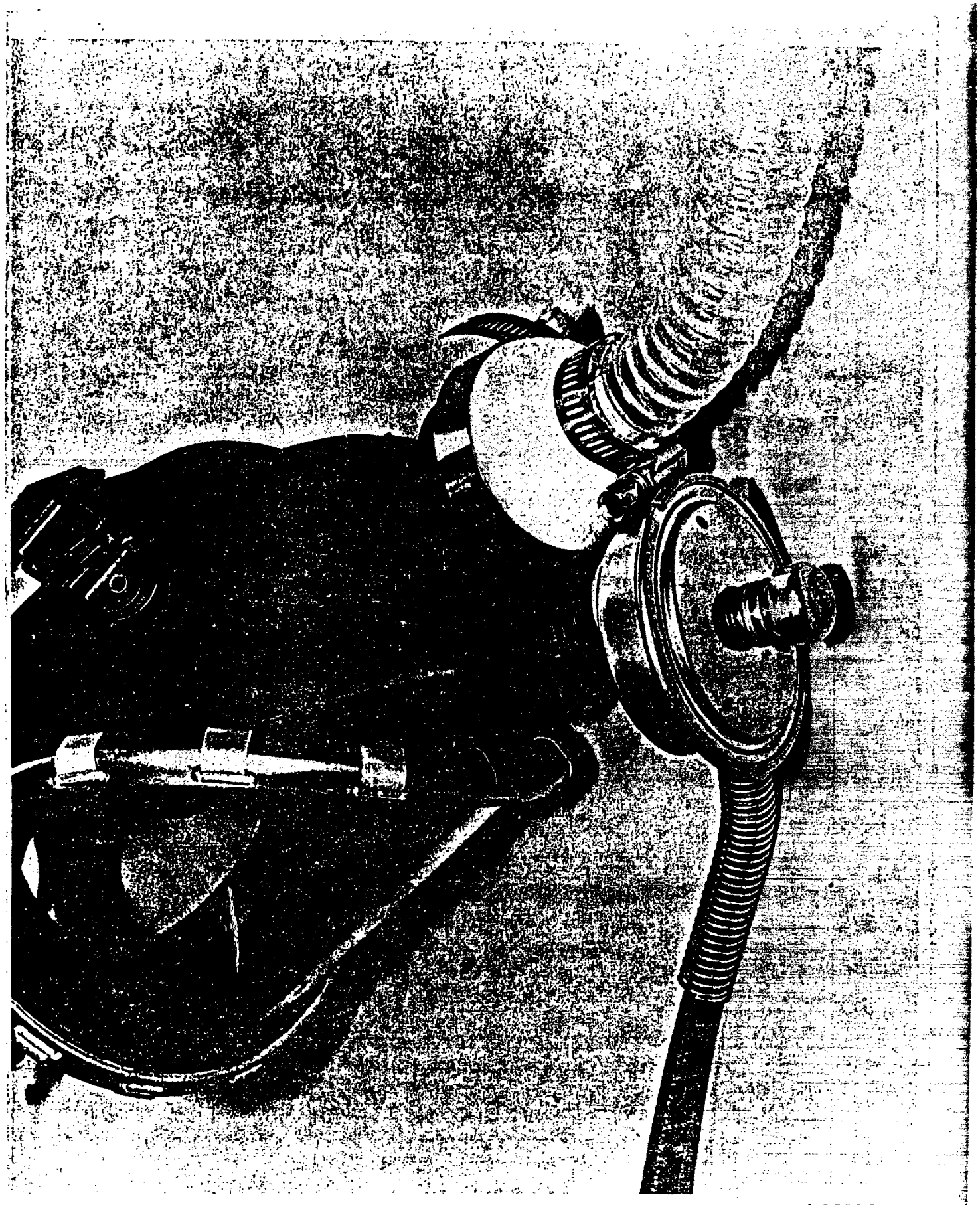
C 003377



C 003378

PLATE NO. 6
SILASTIC SAMPLE CUP WITH HOSE

LAM023039



LAM023040

PLATE NO. 8
BREATHING AIR MASK WITH SAMPLE CUP

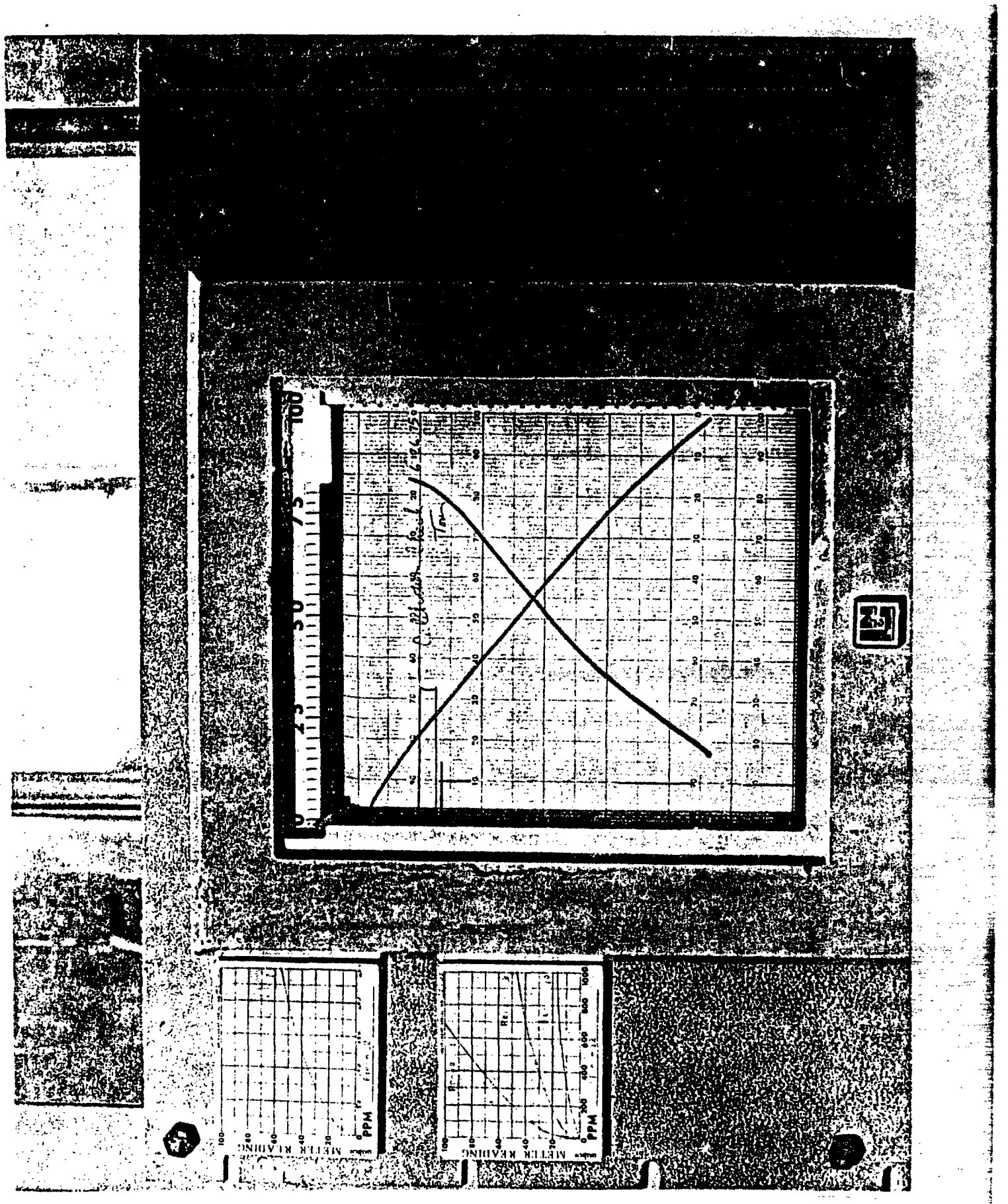
C 003379



LAM023041

PLATE NO. 9
BREATHING AIR MASK WITH SAMPLE CONNECTION

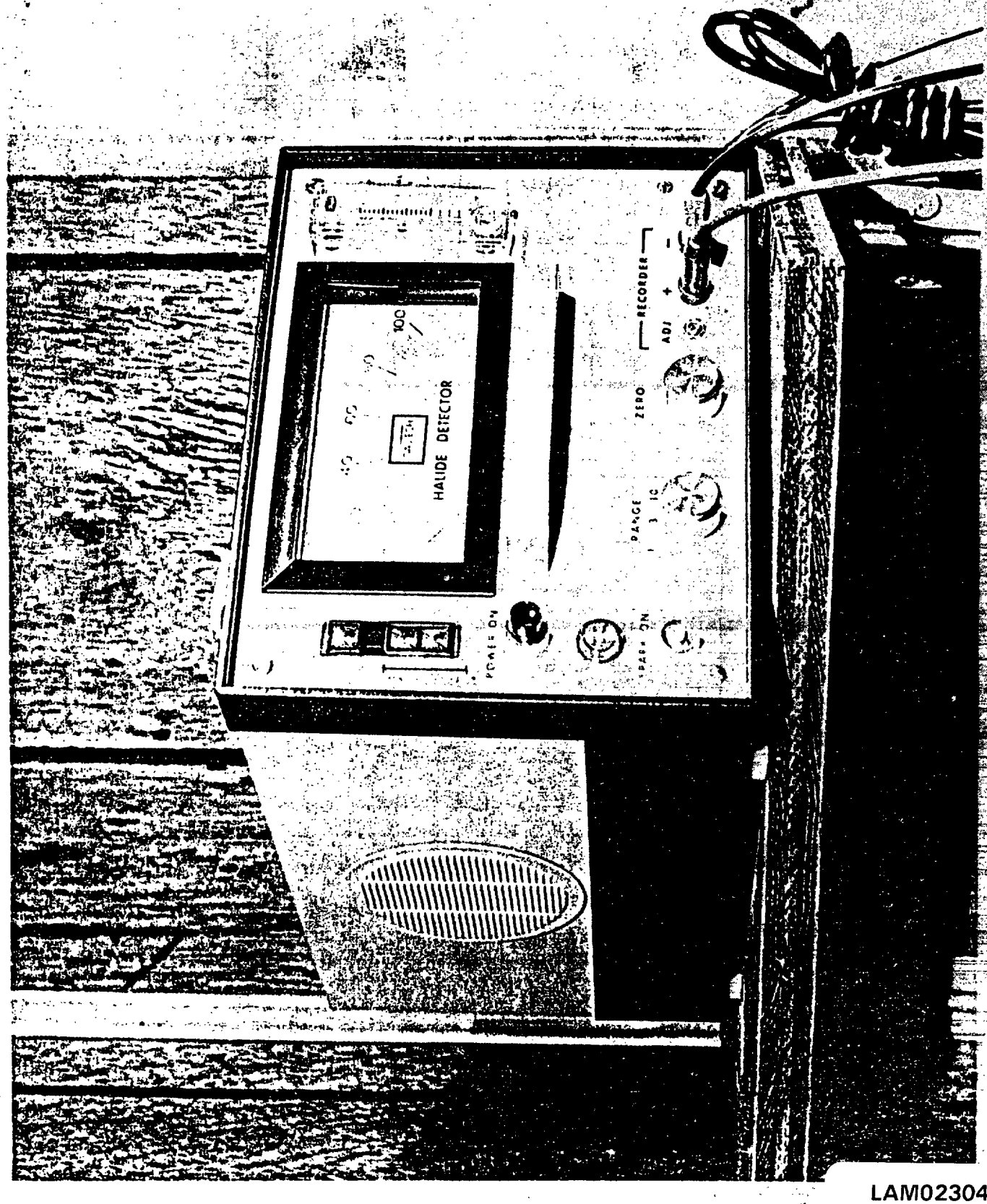
C 003380



LAM023042

PLATE NO. 10
L&N STRIP CHART RECORDER

C 003381



LAM023043

PLATE NO. 11
HALIDE DETECTOR

C 003382

APPENDIX

LAM023044

C 003383

DOW

DOW CHEMICAL U.S.A.

PURCHASE ORDER NO. 48621-P73-F5001

DELIVER TO: (PERSON AND BLDG.)

COYNER B-624
TEXAS DIVISION FREEPORT, TEXAS 77541

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

PAGE 1

M.P. MOVABLE PRODUCTS
P.O. BOX 18196
HOUSTON, TEXAS 77023

DATE	BUYER
03-10-75	P73/COYNER-ML

SUPT OR PROCESS REF	REGN/PROJ ENGR BLDG PHONE	CONTRACT P.O. REPLACES
L.H. PACKARD	COYNER B-624 1211	

OR PHONE	ACCOUNT	SUFFIX	IDENTITY	REGN OR B/M NO	DATE	COMMODITY CODE	MATL NEEDED
	48621		-70	161442		OFFICE, PORTABLE	3-24-75

HIP VIA	TERMS	F.O.B.	TO BE SHIPPED
VENDOR TRUCK PREPAID	NET 30	FREEPORT, TEXAS	3-24-75

ATE RECEIVED	ITEM	QUANTITY	DESCRIPTION	UNIT	PRICE
			DO NOT DUPLICATE. CONFIRMING PHONED ORDER OF 3-7-75 . OUR MR. COYNER TO YOUR MR. JIM GAMBLE		
	1	1	PORTABLE OFFICE 8' X 16' ON TRAILER, TRAILER TO HAVE 13" WHEELS, HITCH AND JACK. OFFICE TO BE PANELED IN LIGHT BROWN, INSULATED, WIRED FOR 220, 12000 BTU AIR COND. WITH HEATER, INSTALLED IN FRONT END, HARD BOARD FLOORS, ONE LIGHT IN SMALL ROOM, ONE 4 FT. FOUR TUBE FLUORESCENT LAMP IN OFFICE, THREE ELECTRICAL OUTLETS, ALUMINUM SIDING, TWO OUT SIDE WINDOWS.AT BACK END OF OFFICE A PARTITIONED WALL, FIVE FEET FROM REAR WALL WITH ONE SLIDING WINDOW AND ONE DOOR.	LOT	2,181.00
			ALL FUTURE REFERENCE, CORRESPONDENCE AND TRANSMITTALS OF DATA (EXCEPT INVOICES) PERTAINING TO THIS ORDER SHALL BE ADDRESSED TO THE ATTENTION OF: R.P. COYNER BUILDING: B-624		
			BUYER CERTIFIES THAT PURCHASE IS EXEMPT FROM PAYMENT OF ALL TEXAS TAXES UNDER CHAPTER 20, TITLE 122A, DIRECT PAYMENT AUTHORIZATION 3-00001-7597-3. THE UNDERSIGNED AGREES TO ACCRUE AND PAY TAXES IMPOSED.		
				TOTAL	2,181.00

C 003384

LAM023045

3—BUYER

DOW CHEMICAL U.S.A.

PURCHASE ORDER NO. 48621-P73-F6001

DELIVER TO: (PERSON AND BLDG.)

PACKARD B-24/1
TEXAS DIVISION FREEPORT, TEXAS 77541

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

GAS TECH INC.
2560 WYENDOTTE
'OUNTAIN VIEW. CALIF.
4043

DATE	BUYER
03-11-75	P73/COYNER-DC

SUPT OR PROCESS REP	REQN/PROJ ENGR BLDG PHONE	CONTRACT P.O. REPLACES
	COYNER B-624 1211	

OR PHONE	ACCOUNT	SUFFIX	IDENTITY	REQN OR S/M NO DATE	COMMODITY CODE	MATL NEEDED
415-967-6794	48621		-70181479		INST.	4-4-75

SHIP VIA	TERMS	F.O.B.	TO BE SHIPPED
AIR FREIGHT PREPAID	NET 30	MOUTAIN VIEW. CALIF.	4-4-75

ATE RECEIVED	ITEM	QUANTITY	DESCRIPTION	UNIT	PRICE
			DO NOT DUPLICATE. CONFIRMING PHONED ORDER OF 3-10-75 . OUR MR. COYNER TO YOUR MR. JOHNSTON		
	1	1	HALID METER FOR FREON 12	EACH	1.060.00
	2	1	:LY	EACH	9.75
	3	1	CALIBRATING KIT	EACH	16.20
			ALL FUTURE REFERENCE. CORRESPONDENCE AND TRANSMITTALS OF DATA (EXCEPT INVOICES) PERTAINING TO THIS ORDER SHALL BE ADDRESSED TO THE ATTENTION OF: MR. COYNER BUILDING: B-624		
			BUYER CERTIFIES THAT PURCHASE IS EXEMPT FROM PAYMENT OF ALL TEXAS TAXES UNDER CHAPTER 20, TITLE 122A. DIRECT PAYMENT AUTHORIZATION 3-00001-7597-3. THE UNDERSIGNED AGREES TO ACCRUE AND PAY TAXES IMPOSED.		
				TOTAL	1.085.95

C 003385

LAM023046

3—BUYER

DOW CHEMICAL U.S.A.

PURCHASE ORDER NO. 48621-P73-F5002

DELIVER TO: (PERSON AND BLDG.)
PACKARD B-2401
TEXAS DIVISION FREEPORT, TEXAS 77541
AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

T.W. SMITH CO.
P.O. BOX 36826
HOUSTON, TEXAS 77036

DATE	BUYER
03-14-75	P73/COYNER-MM

SUPT OR PROCESS REP	REQN/PROJ ENGR BLDG PHONE	CONTRACT P.O. REPLACES
	COYNER B-624 1211	

OR PHONE	ACCOUNT	SUFFIX	IDENTITY	REQN OR P/M NO	DATE	COMMODITY CODE	MATL NEEDED
666-3246	48621		-70			FANS	3-17-75

SHIP VIA	TERMS	F.O.B.	TO BE SHIPPED
MOTOR FREIGHT PREPAID	NET 30	HOUSTON, TEXAS	3-17-75

DATE RECEIVED	ITEM	QUANTITY	DESCRIPTION	UNIT	PRICE
			DO NOT DUPLICATE. CONFIRMING PHONED ORDER OF 3-13-75 . OUR MR COYNER TO YOUR MR. LIPSCOMB		
	1	2	BRDAN MODEL 301 LO SONE CEILING EXHAUSTER, 260 CFM @ 0" STATIC PRESSURE	EACH	56.00
			ALL FUTURE REFERENCE, CORRESPONDENCE AND TRANSMITTALS OF DATA (EXCEPT INVOICES) PERTAINING TO THIS ORDER SHALL BE ADDRESSED TO THE ATTENTION OF: MR. COYNER BUILDING:		
			BUYER CERTIFIES THAT PURCHASE IS EXEMPT FROM PAYMENT OF ALL TEXAS TAXES UNDER CHAPTER 20, TITLE 122A, DIRECT PAYMENT AUTHORIZATION 3-00001-7597-3. THE UNDERSIGNED AGREES TO ACCRUE AND PAY TAXES IMPOSED.		

TOTAL 112.00

C 003386

LAM023047

3—BUYER

FILL IN SHADED AREA ONLY, AS DATA APPLIES TO YOUR REQUEST.

DOW CHEMICAL U.S.A.

TEXAS DIVISION • P. O. DRAWER 'K' • FREEPORT, TEXAS 77541
AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

G PURCHASE REQUISITION
No. DATE

SUGGESTED VENDOR OR VENDORS AND ADDRESS
Sears
Brazosport Village

A PURCHASE ORDER
B-72819-P-73

APPROVED BY MAJOR MGR DATE

* USE OF THE FOLLOWING TERMS WILL HELP PURCHASING MEET YOUR REQUIREMENTS:
1. SCHEDULED DATE, WHEN KNOWN, AS EXAMPLE: 6-24-73.
2. ROUTINE – MEANS NORMAL TIME TO OBTAIN; NO SPECIAL EFFORT REQUIRED.
3. EMERGENCY – MEANS SPARE NO EFFORT TO OBTAIN EARLIEST DELIVERY INCLUDING BUT NOT LIMITED TO HIGHER PRICE, PREMIUM FREIGHT, SUBSTITUTION, PHONE HANDLING, CUTTING ACROSS STANDARD PRACTICE, ETC. SUCH REQUIREMENTS WILL NORMALLY COME TO THE BUYER BY SPECIAL MESSENGER AND BE PRECEDED BY A PHONE CALL EXPLAINING THE CIRCUMSTANCES.
4. SEE COMMENTS – MEANS REFER TO BACK OF REQUISITION FOR DETAILED EXPLANATION OF CIRCUMSTANCES BEARING ON MATERIAL INVOLVED.

B VENDOR CODE | C ACCOUNT 5090 | D SUFFIX 415 | E IDENTITY 1 | F BUYER P-73-Coyner
H APPROVED BY SUPERINTENDENT | I CONTRACT P.O. REPLACES

J SHIP TO DOW CHEMICAL U.S.A. TEXAS DIVISION
PLANT Freeport, Texas

K NOTIFY (PERSON & BUILDING) 297-7263
L REQUISITIONED BY (PERSON BLDG. PHONE) Coyner B-624 1211
M AUTH NO

SHIP VIA
1. MTR FRT 4. PARCEL POST
2. AIR FRT (5) VENDOR TRK
3. DOW TRK 6. HOT SHOT
Q (1) PREPAID 2. COLLECT 3. SEE BELOW
R S

N DELIVER TO (PERSON & BLDG.) Coyner B-624-A
O COMMODITY CODE Cabinet
P NEEDED 6-2-75
T TERMS Net 30
U F.O.B. Lake Jackson
V TO BE SHIPPED 6-2-75

QUANTITY	DESCRIPTION	UNIT	PRICE
	301- 5-29-75- Coyner - Morrison		
1	#65-A1319N3 66in wide Sink Base P935	ea	179.50
1	#65-A6978N Nickle Chrome sink P930	ea	81.95
1	#65 A7932NH (27) Countertops P931	ea	39.00
	602 R. P. Coyner		
	508		
	2303		

TOTAL

LAM023048

C 003387

871 REV 9 72

BISHC

DOW CHEMICAL U.S.A.

PURCHASE ORDER NO. 48621-P73-F5003

DELIVER TO: (PERSON AND BLDG.)
PACKARD B-624
TEXAS DIVISION FREEPORT, TEXAS 77541
AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

LAKE JACKSON PAINT &
~~LOOR~~ CO
32 PLANTATION DR
LAKE JACKSON TEX 77566

DATE	BUYER
06-05-75	P73/COYNER-MB

SUPT OR PROCESS REP	REGN/PROJ ENGR BLDG PHONE	CONTRACT P.O. REPLACES
	COYNER B-624 1211	

JOB PHONE	ACCOUNT	SUBSIDIARY	IDENTITY	REGN OR B/M NO	DATE	COMMODITY CODE	MATL NEEDED
297-3218	46621		-70			FLOOR COVERING	6-14-75

SHIP VIA	TERMS	F.O.B.	TO BE SHIPPED
VENDOR TRUCK	NET 30	LAKE JACKSON, TEXAS	6-14-75

DATE RECEIVED	ITEM	QUANTITY	DESCRIPTION	UNIT	PRICE
			DO NOT DUPLICATE. CONFIRMING ORDER OF JUNE 1975 BY OUR MR. COYNER TO YOUR MR. POTEET.		
	1	3	WINDOW BLINDS 35-5/8 X 35-1/2 (SEA FOAM COLOR)	EACH	43.22
	2	1	VINYL FLOOR COVERING #86367 (15'5" X 7'7")	LOT	130.00
			NOTE: TO FACILITATE PAYMENT OF YOUR INVOICE OUR ORDER NUMBER SHOULD APPEAR ON THE OUTSIDE OF EACH CONTAINER AND EACH INVOICE SHOULD BE ACCOMPANIED BY A COPY OF THE BILL OF LADING WHERE APPLICABLE.		
			ALL FUTURE REFERENCE, CORRESPONDENCE AND TRANSMITTALS OF DATA (EXCEPT INVOICES) PERTAINING TO THIS ORDER SHALL BE ADDRESSED TO THE ATTENTION OF: R.P. COYNER BUILDING: B-624		
			BUYER CERTIFIES THAT PURCHASE IS EXEMPT FROM PAYMENT OF ALL TEXAS TAXES UNDER CHAPTER 20, TITLE 122A, DIRECT PAYMENT AUTHORIZATION 3-00001-7597-3. THE UNDERSIGNED AGREES TO ACCRUE AND PAY TAXES IMPOSED.		
				TOTAL	259.66

C 003388

LAM023049

3—BUYER

A RESPIRATOR TESTING AND TRAINING FACILITY

SUMMARY: A new facility has been constructed for training employees in the proper use of respiratory, protective equipment. The effectiveness of mouth-bit respirators has been markedly increased by the use of this facility. In this unit, the user is treated as a component of the protective system. Each employee is trained to use his respirator in a challenge atmosphere containing 500 ppm of Refrigerant 12. Nose-breathing or mouth-seal leakage is detected by a halide-detection meter analyzing the exhaled breath. Six hundred, sixty-six persons have been tested in two identical units. Of these, only two have been untrainable. Retention of the learned breathing skill appears to be excellent.

BACKGROUND: Chlorine is produced in several major production units in the Texas Division of Dow Chemical U.S.A. A mouth-bit respirator adopted to a large volume canister was the early method of providing personal protection in chlorine atmospheres. The presently used mouth-bit respirator (Plate 1) was developed as a joint effort between Dow and the manufacturer. It includes a large cartridge (Plate 2), a replaceable mouth-bit (Plate 3), inhalation valves (Plate 4), and an exhalation valve (Plate 5). The cartridge will withstand 5000 parts per million of chlorine in moist breathing air for fifteen minutes at the normal breathing rate. Use of the nose clip was discontinued several years ago because of poor acceptance by the employees. This unit affords the employee the highest level of protection in a mouthpiece respirator. Even so, some employees have continued to receive chlorine inhalations. In an emergency situation, the majority of employees would effectively utilize their respirators for a safe evacuation, while a few would require medical treatment. This became a growing concern of Dow management, and ways were investigated to improve the respirator training program. The first field testing facility was constructed in May 1975 to provide a technique to quantitatively measure the effectiveness of the training program and to provide both the trainer and the trainee a means to verify that the respirator was being used properly.

EQUIPMENT AND CONSTRUCTION: The facilities are housed in 16' x 8' portable buildings (Plate 6). One end of the interior is walled off to provide a chamber, 8' x 5'. A circulation fan for uniform mixing and an exhaust fan for clean-out are installed in the chamber. Two sinks, cabinets, and a desk and chair are the furnishings of the outer room. Breathing air and Refrigerant 12 are piped through the wall of the test chamber. The exhaled breath of the test subject is collected by attaching a silicone-rubber cup and polyethylene hose to the exhalation valve of his respirator (Plate 7). These gases and vapors are continuously analyzed by a halide-detection meter manufactured by the Gas Tech Corporation, Mountain View, California. The presence of halide compounds is indicated by a meter in the face of the instrument (Plate 8). Output of the meter is also recorded by a 0-10 millivolt strip-chart recorder. This recorder furnishes a 5" x 8" card with an individual record of each person's test results (Plate 9).

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Since Refrigerant 12 quickly saturates activated charcoal, a dummy cartridge connected to a demand regulator is utilized. This supplies breathing air in place of purified air from the cartridge (Plate 10). For comfort, the breathing air is humidified prior to use (Plate 11).

Sample connections are provided to allow this meter to check both the halide concentration of the challenge gas in the chamber and the halide concentration in the exhaled breath.

PROCEDURE: A) Testing. The chamber is charged to a level of 500 parts per million of Refrigerant 12. This is one-half of the concentration allowed by the Threshold Limit Value. The respirator is prepared as shown in Plate 12. The subject is then seated in the chamber and the test ensues (Plate 13). When the breathing pattern at rest has been established, the subject is asked to make up some small pipe fittings in order to evaluate his use of the respirator while performing simple tasks. These two portions constitute the screening test. Maximum time in the test chamber is six minutes, and many tests are completed in three minutes. The greatest possible exposure to Refrigerant 12 is therefore:

$$\frac{(6)(500)}{(480)(1000)} \times 100 = 0.625\% \text{ of the TLV}$$

B) Training. The procedure for training is similar to the test procedure, except that the halide meter is placed so that the output dial is visible to the subject through a window. By watching the reading (and through exhortations from the trainer), a process of self-training results. Two to six training sessions are adequate to train even the worst subject. The duration of a training session is eight minutes, and only one session per employee is conducted each day. The maximum exposure is therefore:

$$\frac{(8)(500)}{(480)(1000)} \times 100 = 0.833\% \text{ of the TLV}$$

C) Discussion. A level of 10 ppm in the exhaled breath is easily determined by the halide meter. Zero concentration is not exact because of instability of the analyzer. It floats between 0 and 10 on the output dial; however, an experienced operator can easily detect 0 leakage by the pattern of breathing recorded on the strip-chart recorder. The test can determine 10/500 or 2% leakage, and much greater accuracy is the usual result. The halide meter requires purging after each use in order to clear the effects of moisture in the breath. In addition, it is somewhat susceptible to variations in line voltage. Once again, these conditions are quickly determined and adjusted by an experienced operator.

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In addition to the training that occurs in the chamber, very valuable one-on-one training can be carried out in the facility. The trainer emphasizes respirator care and maintenance and thoroughly discusses inspection procedures. An increased emphasis on respiratory protection is the end result.

RESULTS: A) Testing. Six hundred, sixty-six chlorine plant personnel have been tested for proper respirator use. These comprise four categories: supervisory, cell repair, maintenance workers, and operators. Overall, 71.6% of the tested group was proficient in the use of the mouth-bit respirator without additional training. Significantly, the operators were more capable than the other three groups. Operators who must use their respirators at times in small concentrations of gas were 84.6% proficient in respirator usage. The other three groups were roughly equal. Supervisors of twenty and thirty years experience often were among those requiring additional training. Some hourly employees, with many years of service, also failed the screening test.

The patterns of failure were many and diverse. Some had only slight leakage through the nose, while others breathed gross amounts from the chamber. Mouth leakage became easy to diagnose because of a particular, recurring pattern on the strip chart; however, the number of persons exhibiting this problem was not great.

B) Training. The true worth of the respirator facilities has been realized in their training function. Of the total population who received initial training, only two proved to be untrainable. Initially, the combined system of the employee and his respirator was 71.6% effective. With proper training, the effectiveness of the system has been increased to better than 99.5%. New employees are provided with genuine training that is accurately measured; proper documentation is furnished for personnel records.

Cases of gross inability to use a respirator can be corrected with a maximum of six training sessions of eight minutes duration. This number is infrequently required; the usual number is three sessions.

At the present time, it appears that proper respirator usage is a skill that is well retained after it is once acquired. The first group that received training has been retested after a six-month interval. 18 men have been retested; of these, 16 retained their breathing ability. This is a retention rate of 88.9%.

COMPLEMENTARY ACTIONS: A respirator training and testing program cannot stand alone. It is only one facet of the total respirator program. To this end, the chlorine department has taken several additional actions. Individually issued respirators are inspected by the employee on a

regular schedule. A log is maintained in each plant to record the results of these inspections. Respirator cleanliness is encouraged. Cartridges are changed on a fixed schedule, or they are changed at more frequent intervals after periods of heavy use. As required by OSHA, emergency equipment (such as SCBA's) is inspected and logged monthly.

Over the past five years, cell area ventilation has been consistently improved. Individual exposures have been evaluated in the production areas, and these are all less than the time weighted average of 1 part per million. The requirement to wear SCBA's under conditions of greater exposure has been aggressively followed.

CONCLUSIONS: For the first time, an accurate index of mouth-bit respirator proficiency has been achieved. The facility shows an outstanding training capability, in that better than 99.5% of the personnel make an effective use of the respirator after testing and training. Respirator usage is a highly retained skill. Initial tests show 88.9% retention after a six-month interval.

The trained employees have a greater degree of confidence in their respirators and in their ability to use them properly. Respirator training is a portion of the safety program that is sincerely appreciated by a great majority of the employees. They fully realize that this is safety training that is carried out for their benefit.

Misinformation and improper training are both eliminated by these procedures. The largest single group of employees failing the initial test was made up of those persons who received faulty respirator training from well-meaning supervisors.

A very real benefit is that it is no longer necessary to breathe chlorine-contaminated air in order to gain experience in the use of a respirator.

L. H. Packard, Jr.

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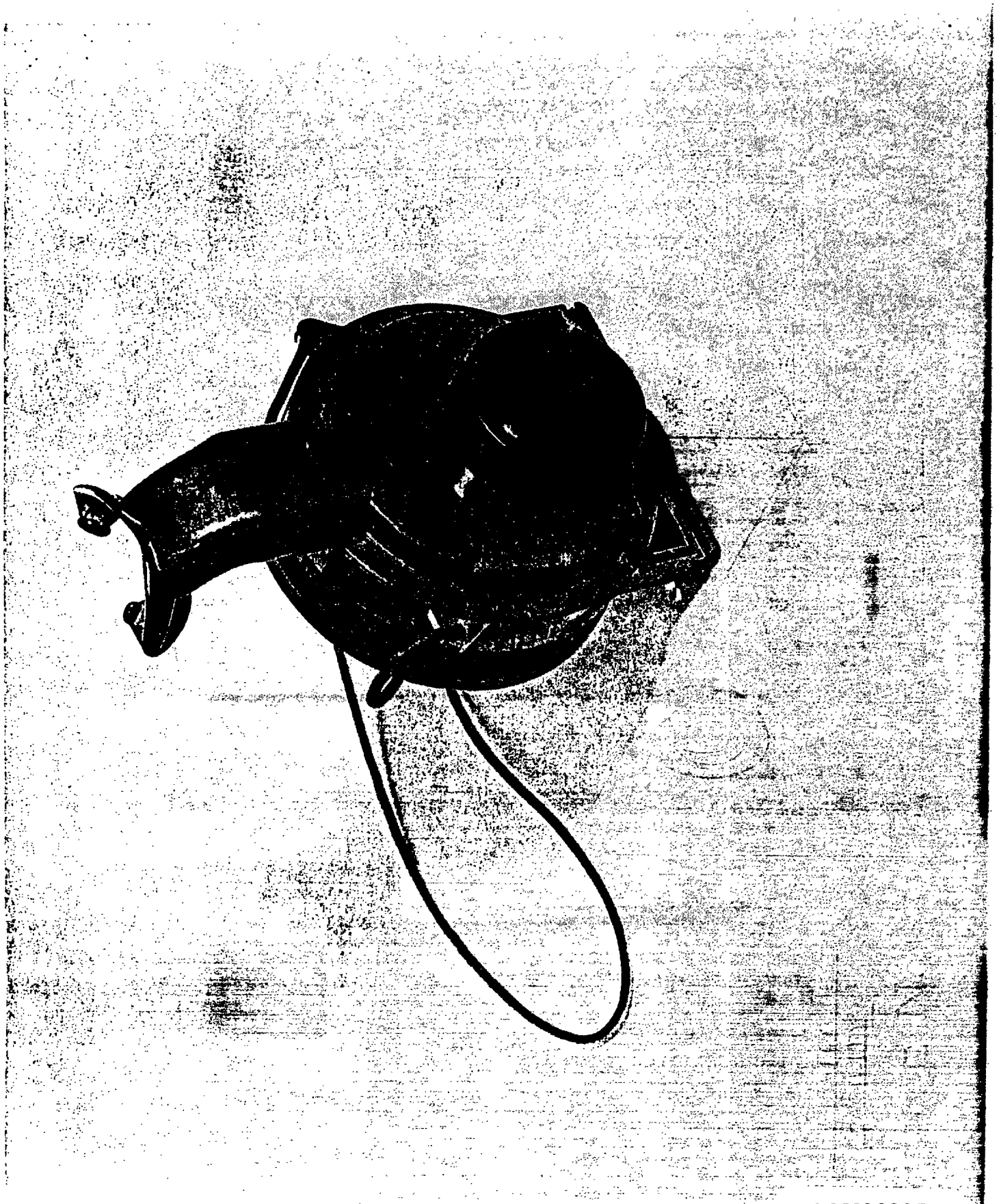

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PLATE NO. 1

A HIGH-CAPACITY MOUTH BIT RESPIRATOR

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PLATE NO. 2

RESPIRATOR CARTRIDGE

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PLATE NO. 3

REPLACABLE MOUTH BIT

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PLATE NO. 4

INHALATION VALVES

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PLATE NO. 5
EXHALATION VALVE

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C 003397

RESPIRATOR TEST FACILITY

PLATE No. 6

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PLATE NO. 7

SILICONE-RUBBER CUP AND PLASTIC NOSE

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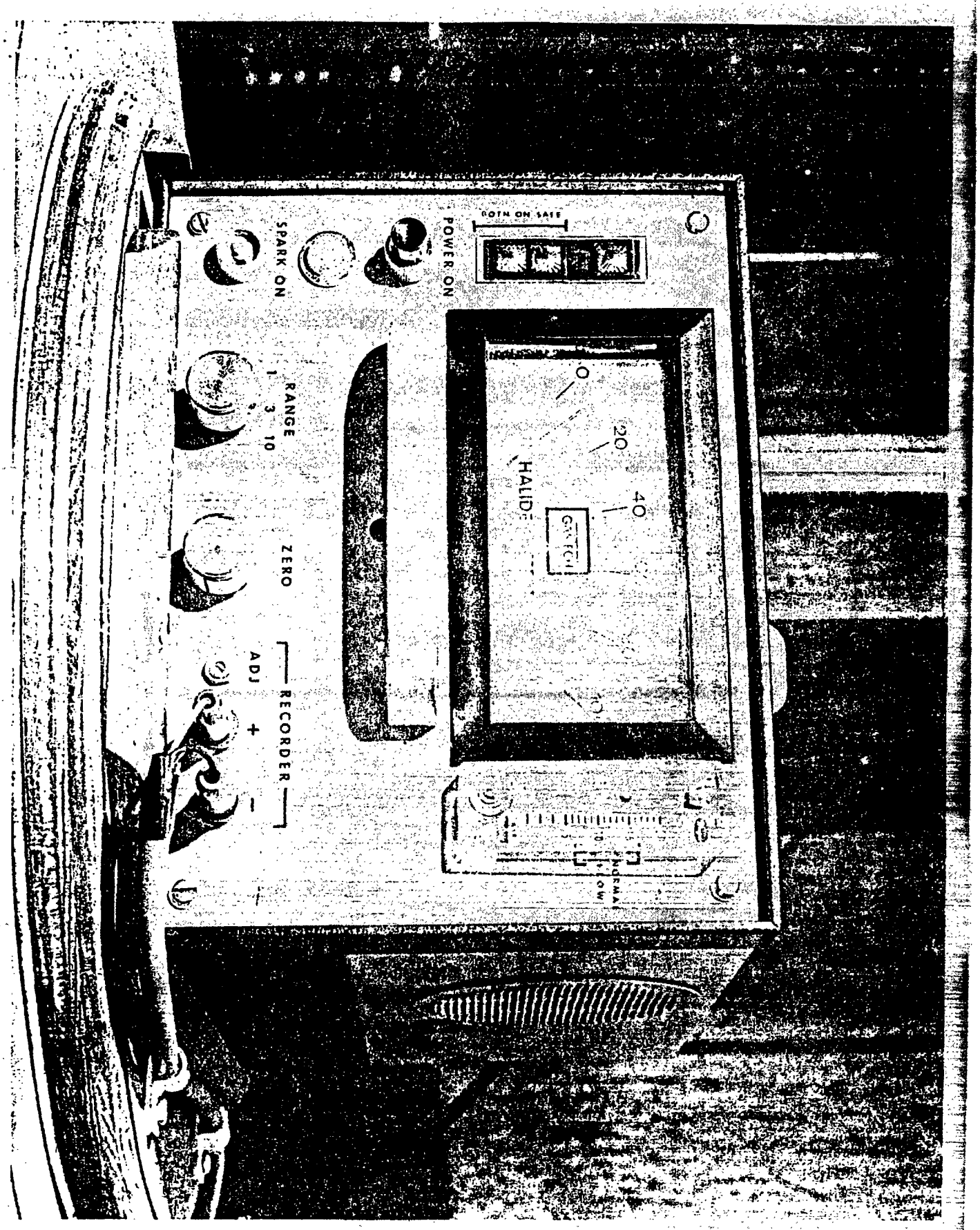

PLATE NO. 8

THE GAS-TECH HALIDE DETECTION METER

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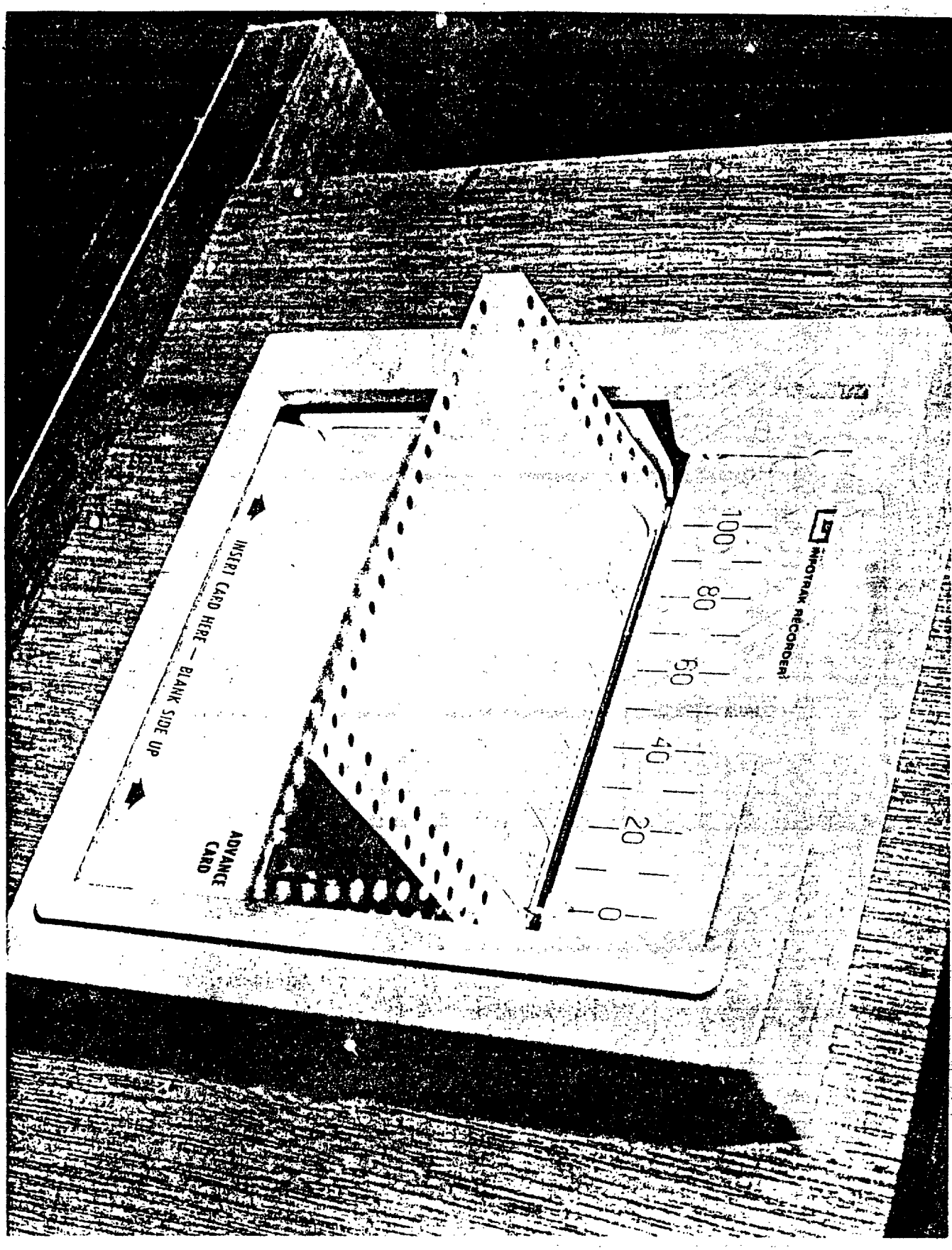

PLATE NO. 9

STRIP CHART RECORDER C 003401

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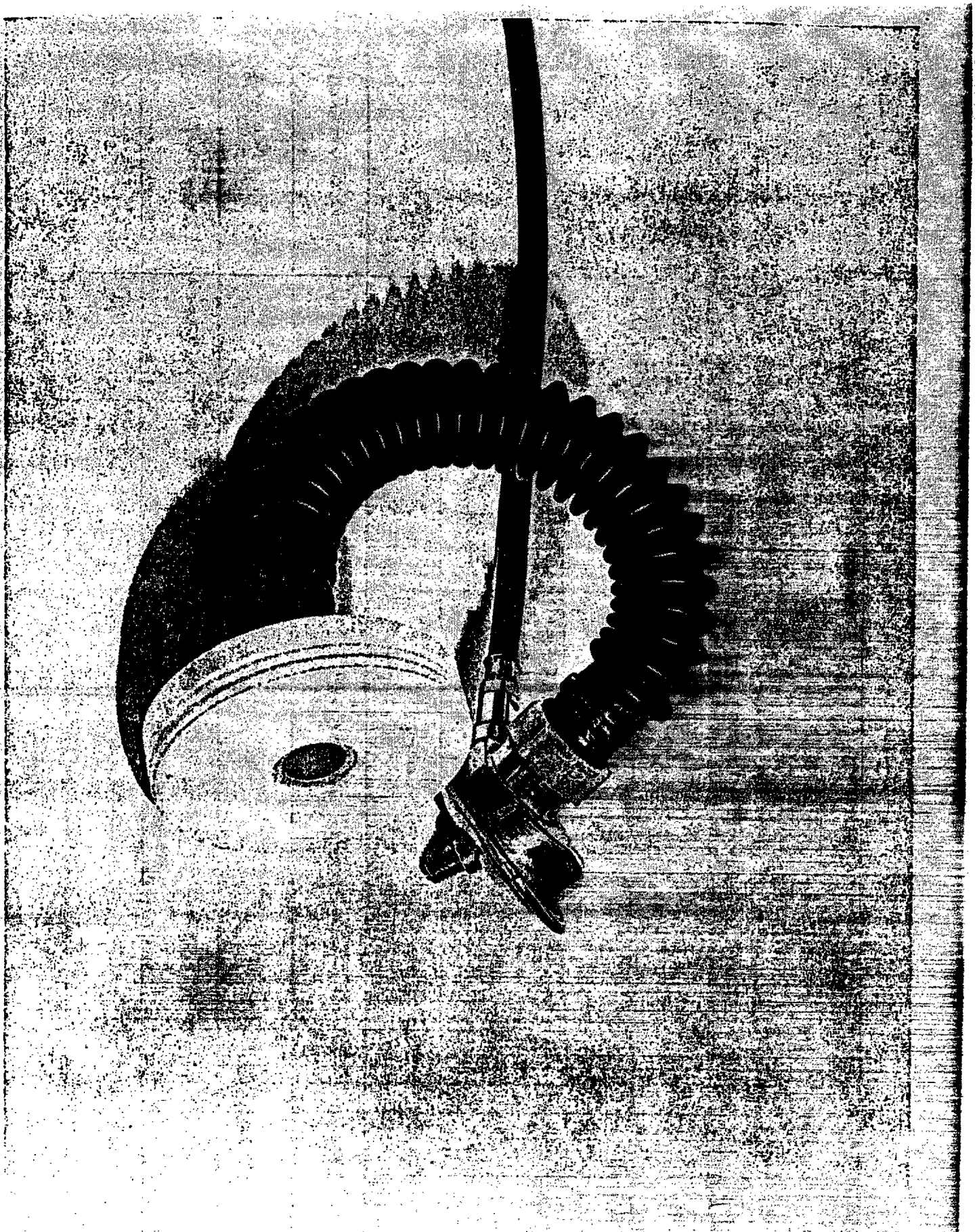

PLATE NO. 10

DUMMY CARTRIDGE AND DEMAND REGULATOR C 003402

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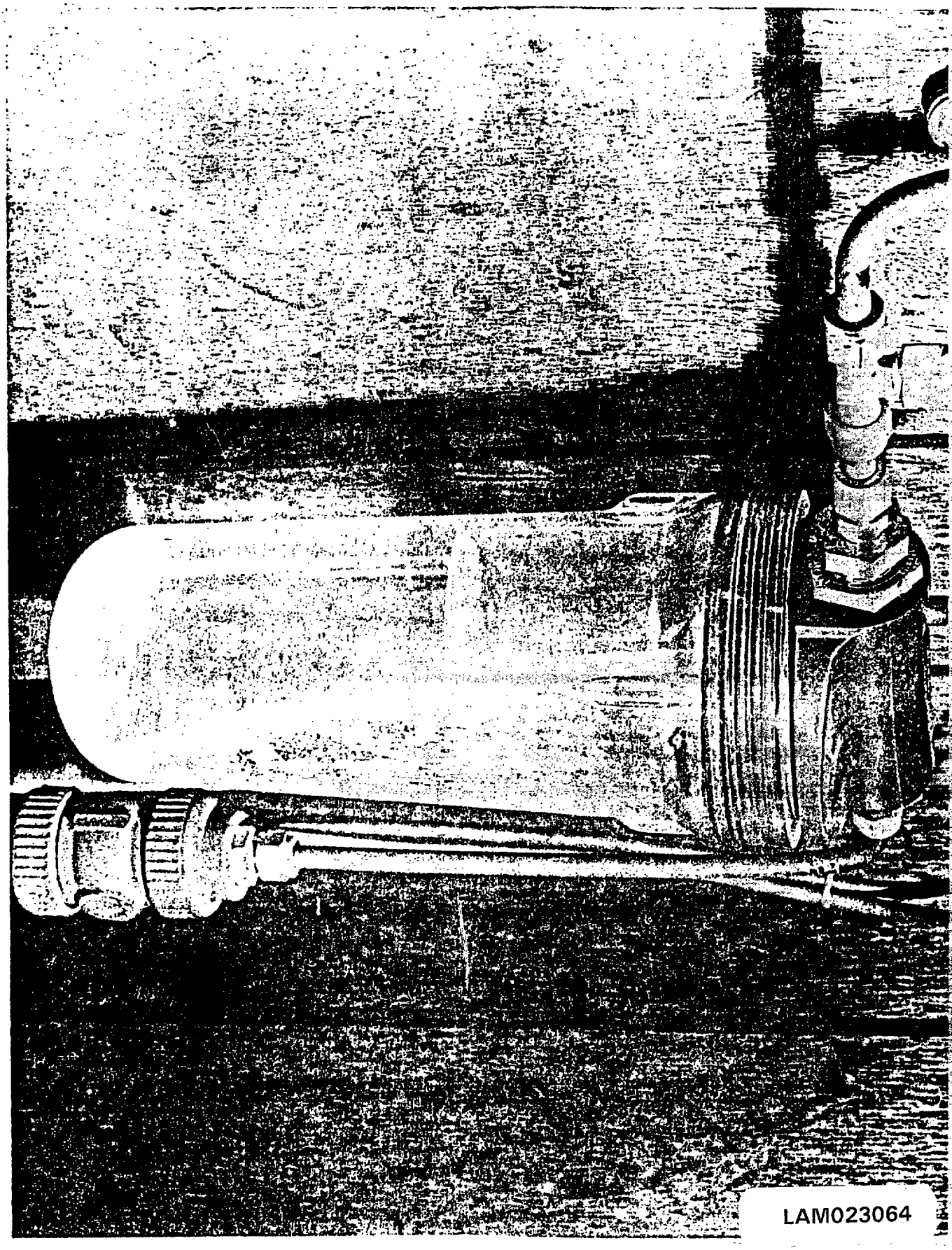

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PLATE NO. 11
HUMIDIFIER

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PLATE NO. 12

RESPIRATOR ASSEMBLED FOR TESTING

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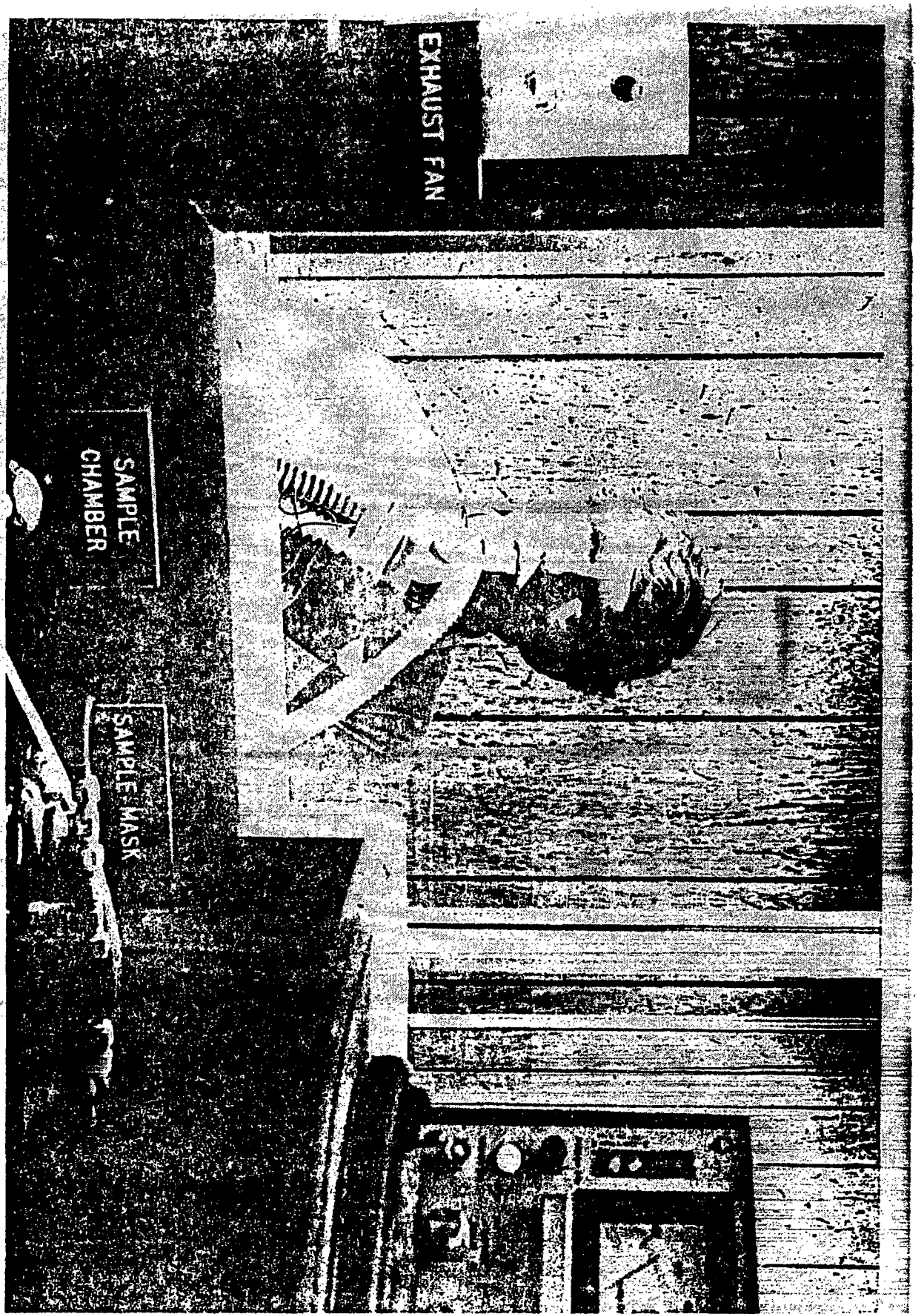

PLATE NO. 13

EMPLOYEE IN TEST PROCEDURE

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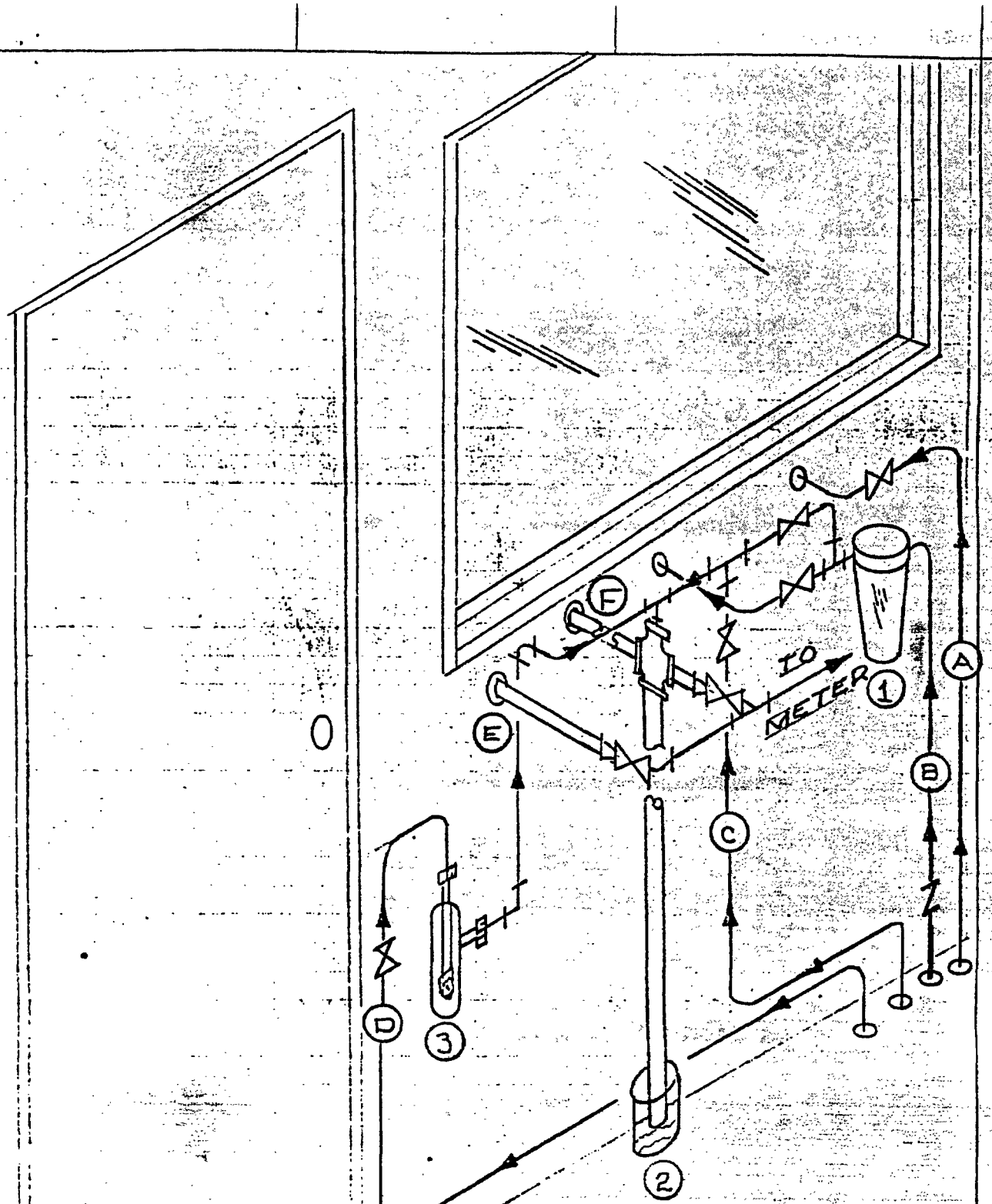

PIPING AT CHAMBER WALL

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LINE DESIGNATION	SERVICE	MATERIAL	PRESSURE	NOTES
A	FREON 12 TO CHAMBER	I	100 PSIG	USE TUBING BENDS (WHERE POSSIBLE)
B	WET BREATHING AIR	I	35 PSIG	AS ABOVE
C	DRY BREATHING AIR	I	10 PSIG	AS ABOVE
D	STANDARD GAS MIXTURE	I	10 PSIG	AS ABOVE
E	CHAMBER SAMPLE	II	ATM.	-
F	MASK SAMPLE	II	ATM.	-

SPECIFICATIONS

I. $\frac{1}{4}$" VINYL-JACKETED COPPER TUBING. $\frac{1}{4}$" BRASS HOKE NEEDLE VALVES WITH SWAGELOCK TUBING FITTINGS.

II $\frac{1}{2}$" PIPE, EITHER GALVANIZED STEEL, ABS OR PVC. $\frac{1}{4}$" WHITEY QUICK OPENING BALL VALVES

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EQUIPMENT

1. CUNO WATER FILTER D-10-1. CONVERT TO HUMIDIFIER BY REMOVING CORE. REPLACE CORE WITH LARGE FRITTED GLASS SPARGER ON INLET AIR. ADD 4" DISTILLED H_2O.

2. GLASS OR PLASTIC WATER SEAL POT. APPROXIMATELY THE SIZE OF A 1000 ML BEAKER. ADD WATER TO PROVIDE A MINIMUM SEAL.

3. APPROX. $1\frac{1}{2}$" DIA. BY 5" HIGH GLASS HUMIDIFIER. INSTALL SMALL FRITTED GLASS DIFFUSER ON INLET AIR. FILL WITH ABOUT 2" OF WATER.

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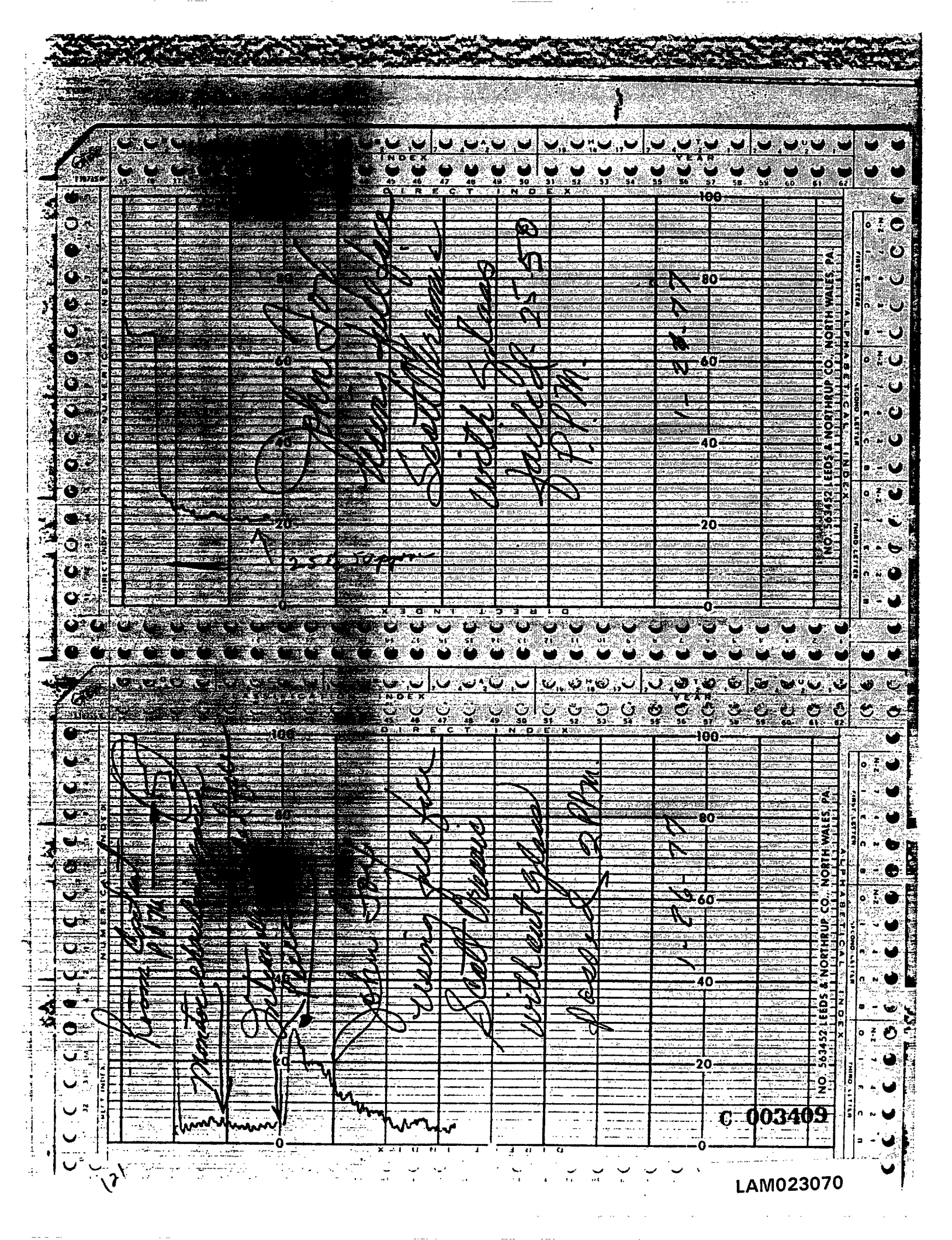
INDEX
YEAR
DIRECT INDEX
100
80
60
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20
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NO. 56342 LEEDS & NORTHRUP CO., NORTH WALES, PA.
ALPHABETICAL INDEX
FIRST LETTER
SECOND LETTER
THIRD LETTER
NUMERICAL INDEX
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