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EVALUATION OF A CHEMICAL SPRINKLER TYPE FIRE EXTINGUISHING SYSTEM FOR VOR TYPE S BUILDINGS

FOR LIMITED DISTRIBUTION

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PURPOSE

The purpose of these tests was to evaluate a sprinkler type extinguishing system for protecting the transmitter and engine rooms of a VOR Type S building against fire

SUMMARY

Fire extinguishment tests were conducted in both the transmitter room and engine room of a VOR Type S building on various arrangements of bucket and spillage fires of combustible liquids. Shur-Spray units were used as a means for automatically discharging extinguishing agent on the fires. An electrical interlocking system was devised and incorporated with a normally closed contact on the Shur-Spray unit. This system disconnected the incoming power line and the battery circuit, stopped the engine, if operating, and closed the louver doors in the engine room when any one of the Shur-Spray units began to discharge. This was necessary in order to prevent high rates of air change within the rooms, which would result in removing the extinguishing vapors and permit fires to continue and spread.

EQUIPMENT

The basic extinguisher used was a Shur-Spray bottle, Fig. 1, built by International Fire Equipment Corporation, Staten Island, New York, which contained one gallon of carbon tetrachloride. The bottle is normally installed in an inverted position The outlet at the bottom is sealed by a spring-loaded valve held closed by a fusible link. Fusing of the link permits the valve to open, allowing the carbon tetrachloride to be discharged by gravity through a spray nozzle.

The extinguishing system was made up of three Shur-Spray units with special, normally closed switch type arms and an electrical interlocking circuit as shown in Fig. 2 The electrical circuit consisted of·

(a) A two-pole relay with 27 v dc low-drain coil, single throw contacts, open when coil was energized and closed when not energized. The contacts on this relay, when open, should have a large gap clearance.
(b) Two solenoid-operated latches, one each for each set of louver doors. The solenoids operated from the 27 v dc

battery supply. They were mounted on one of the louver doors so that the fuse link, previously intended to hold open the louver doors, would slip over the solenoid plunger. See Fig. 3.

(c) A suitable ac line circuit breaker. This breaker was held in the closed position by a latch. The latch was operated by a 27 v dc coil, which, when energized, allowed the breaker to open. A set of contacts were included which closed when this switch was in the full open position.

(d) A suitable circuit breaker for the main battery circuit This breaker was held in the closed position by a latch. The latch was operated by a 27 v dc coil, which, when energized, allowed the breaker to open.

(e) A normally closed test switch

These components were connected along with the normally closed switches on the Shur-Spray arms, as shown in Fig. 2.

The building used was a VOR Type S, complete with two transmitters and an engine generator set properly installed and in operation.

METHOD OF TEST

Bucket fires were produced in a 12 quart bucket partially filled with a mixture of fuel oil and gasoline (except where otherwise noted). Spillage fires were simulated by using shallow pans in order to maintain controlled and reproducible conditions. The fires were ignited manually with a torch Locations of the fire pans for each test are shown in Fig. 5. Shur-Spray units were mounted as high as possible in the gable, Fig. 4, and the plan locations were as shown in Fig. 6.

RESULTS

I. Rapidly Progressing Fires (Fuel Oil and Gasoline).

(a) Two Shur-Spray units
Two shallow fuel pans, 20 by 30 inches
Door closed, fan left on - fire extinguished

(b) Same as (a) except with door open - fire extinguished

(c) Two Shur-Spray units
Two shallow fuel pans, one deep fuel pan, six inches deep, three foot square, and one 12 quart bucket half full of fuel
Door open, fan left on - fire not extinguished

(d) Three Shur-Spray units
Four fire pans as in (c)
Door closed, fan shut off manually when bottles discharged - fire extinguished

(e) Two Shur-Spray units
Four fire pans as in (c)
Door closed, fan shut off when bottles discharged
Fire appeared to be out 6 1/2 minutes later, so door was opened - flash back occurred in the six inch deep pan. Complete extinguishment may have occurred if the door had been closed for a longer period of time.

(f) One Shur-Spray unit, otherwise repeat of test (e)
Four fire pans as in (c)
Door closed, fan shut off manually when bottles discharged - fire extinguished - door opened 11 minutes after ignition

(g) Two Shur-Spray units
Four fire pans as in (c)
Door closed, fan shut off when bottles discharged
The three pan fires were extinguished - bucket fire continued to burn.

Note. This test was a repetition of (e) and (f), except that the outside air temperature was 50 degrees F rather than 85 degrees F as in (e) and (f). The bucket fire probably would have been extinguished if test had been conducted in warmer weather.

II. Slowly Progressing Fires (No. 10 Engine Oil).

(a) Two Shur-Spray units
Two fire pans
Door closed, fan running continuously
Highest temperature in room 7 1/2 minutes after ignition was 150 degrees F
Temperature rose to 300 degrees F nine minutes after ignition At this time, both bottles discharged five seconds apart.
Door was opened 19 minutes after ignition.
Fire was noticed and the door closed 22 minutes after ignition.
The door was again opened and fire was out 36 minutes after ignition. Fire extinguished.

III. Rapidly Progressing Fire, But Small in Size, Therefore, Producing a Small Amount of Heat.

(a) Two Shur-Spray units
One fire pan (12 quart bucket half full of gasoline and fuel oil)
Door closed, fan shut off when bottles discharged
Only one bottle discharged - fire not extinguished

IV. Engine Room

Engine Room fire tests were conducted with the electrical interlock circuit, Fig. 2, in operation except where noted.

(a) One Shur-Spray unit
One shallow fire pan (oil and gasoline)
Fire extinguished

(b) One Shur-Spray unit
Two shallow fire pans (oil and gasoline) under and at both sides of engine
Fire extinguished

(c) One Shur-Spray unit
One deep fire pan (12 quart bucket)
Fire not out but confined to bucket

(d) Repeat IV (c) with same result

(e) One Shur-Spray unit
Two shallow fire pans
Electrical interlock connected to close louver doors only
When bottle discharged, fumes choked and stopped engine. Fire extinguished

(f) One Shur-Spray unit
Two shallow fire pans
Electrical interlock connected to stop engine only
Louver doors held open by fuse links supplied with building.
When bottle discharged, the engine stopped due to electrical interlock. Louver doors remained open - fuse links did not melt. Fire extinguished

Note If strong wind prevailed so as to exhaust fumes from room with louver doors open, the fire may have continued to burn as it did in IV (g).

(g) One Shur-Spray unit
Two shallow fire pans
No electrical interlock used

When bottle discharged, engine continued to operate and louver doors remained open. Fire continued to burn. Fuse links on louver doors did not melt.

DISCUSSION

Fires occurring from spillage of volatile flammable fluids gave off considerable heat and caused the Shur-Spray units to operate in 20 seconds or less.

Bucket fires generally give off a small amount of heat, in some cases, insufficient to cause the Shur-Spray units to operate. Such fires, if confined, are considered too small to cause damage. In several cases, when bucket fires did cause the Shur-Spray units to operate, the bucket fires were not extinguished. In tests conducted on warm days (85 degrees F outside air temperature), bucket fires were extinguished, while in the tests conducted on cool days (50 degrees F outside air temperature), they continued to burn. On the warm days, more of the CTC liquid apparently vaporized, and bucket fires were extinguished.

Small smoldering fires, unless they break out into flame, would probably not give off sufficient heat to cause the extinguishers to operate.

In order to detect and extinguish small or smoldering fires, intricate and costly detecting and extinguishing systems would be necessary.

Ventilation control, such as is afforded by the electrical interlock system, is necessary, especially in the engine room. Without this control, extinguishment is unreliable However, in the event of battery failure prior to detection, a reasonable amount of protection is still available, since the detecting elements (fuse links) are mechanically connected to the extinguisher bottles. This would not be so on more intricate detecting and extinguishing systems.

The system used in these tests requires very little maintenance. The Shur-Spray units can be inspected visually by noting the liquid level in the glass container. The electrical system can be inspected by opening the test switch. After the inspection of the electrical system, the two electrical disconnect switches and the louver doors must be reset manually.

CONCLUSIONS

1. Two extinguisher bottles in transmitter room and one extinguisher bottle in engine room provided adequate fire protection.

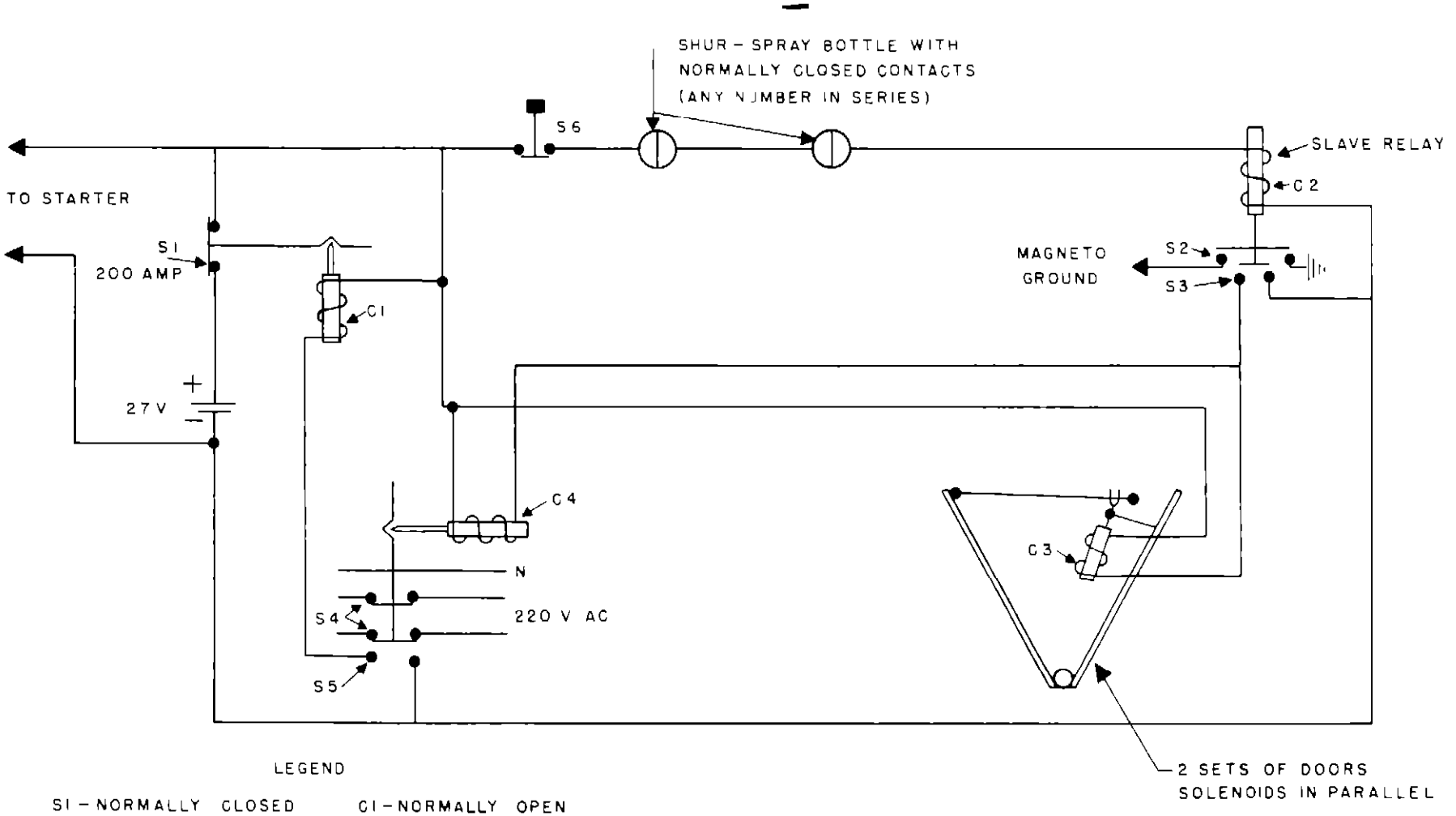
2. The subject extinguishing system incorporating proper ventilation controls extinguished all major fires in both transmitter and engine rooms.

3. The extinguishing system alone is unreliable without proper ventilation control.

4. Small, confined fires (bucket fires) persisted in several instances after the major fire was extinguished; however, the bucket fires were confined within the bucket and were not hazardous to the remainder of the building or equipment.

5. The existing fuse links furnished on the building louver doors proved unreliable.

FIG. 1 EXTINGUISHER UNIT



LEGEND

S1 – NORMALLY	CLOSED		C1 – NORMALLY	OPEN
S2 – "	OPEN		C2 – "	CLOSED
S3 – "	OPEN		C3 – "	OPEN
S4 –	CLOSED		C4 – "	OPEN
S5 – "	OPEN			
S6 –	CLOSED (OPEN TO TEST)			

FIG 2 SCHEMATIC OF ELECTRICAL INTERLOCK CIRCUIT

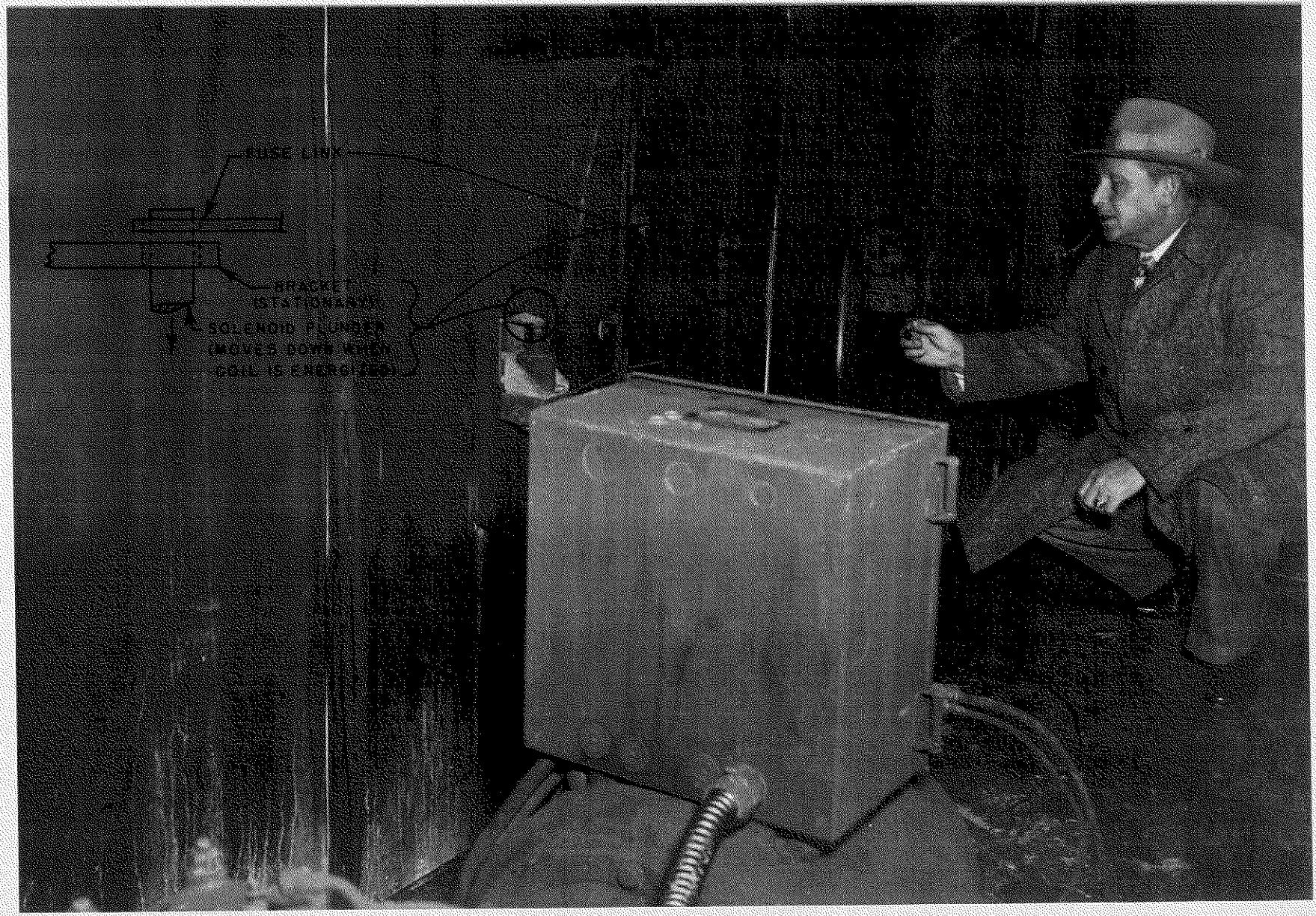


FIG. 3 RELEASE MECHANISM (ELECTRICAL) FOR LOUVER DOORS

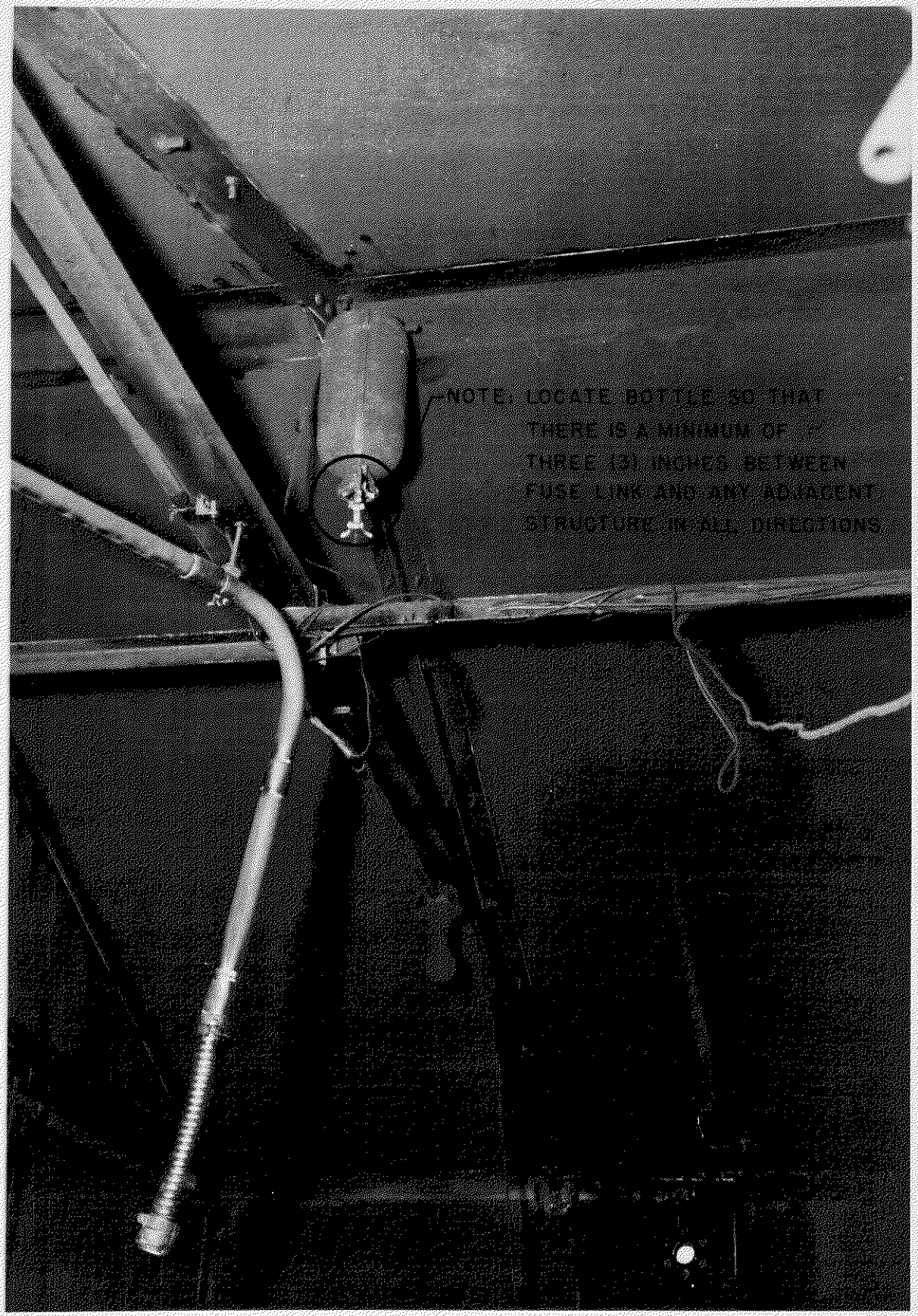
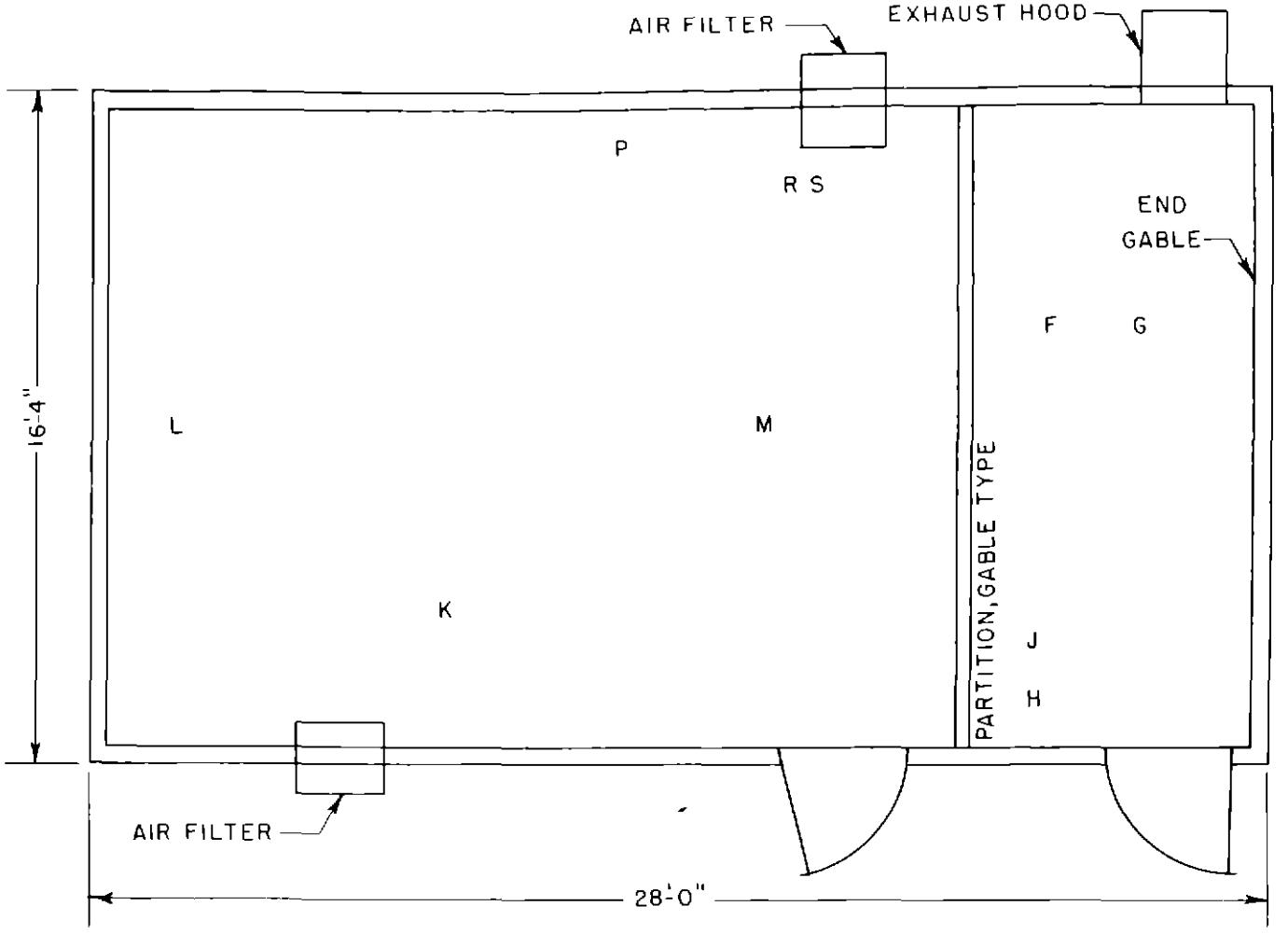


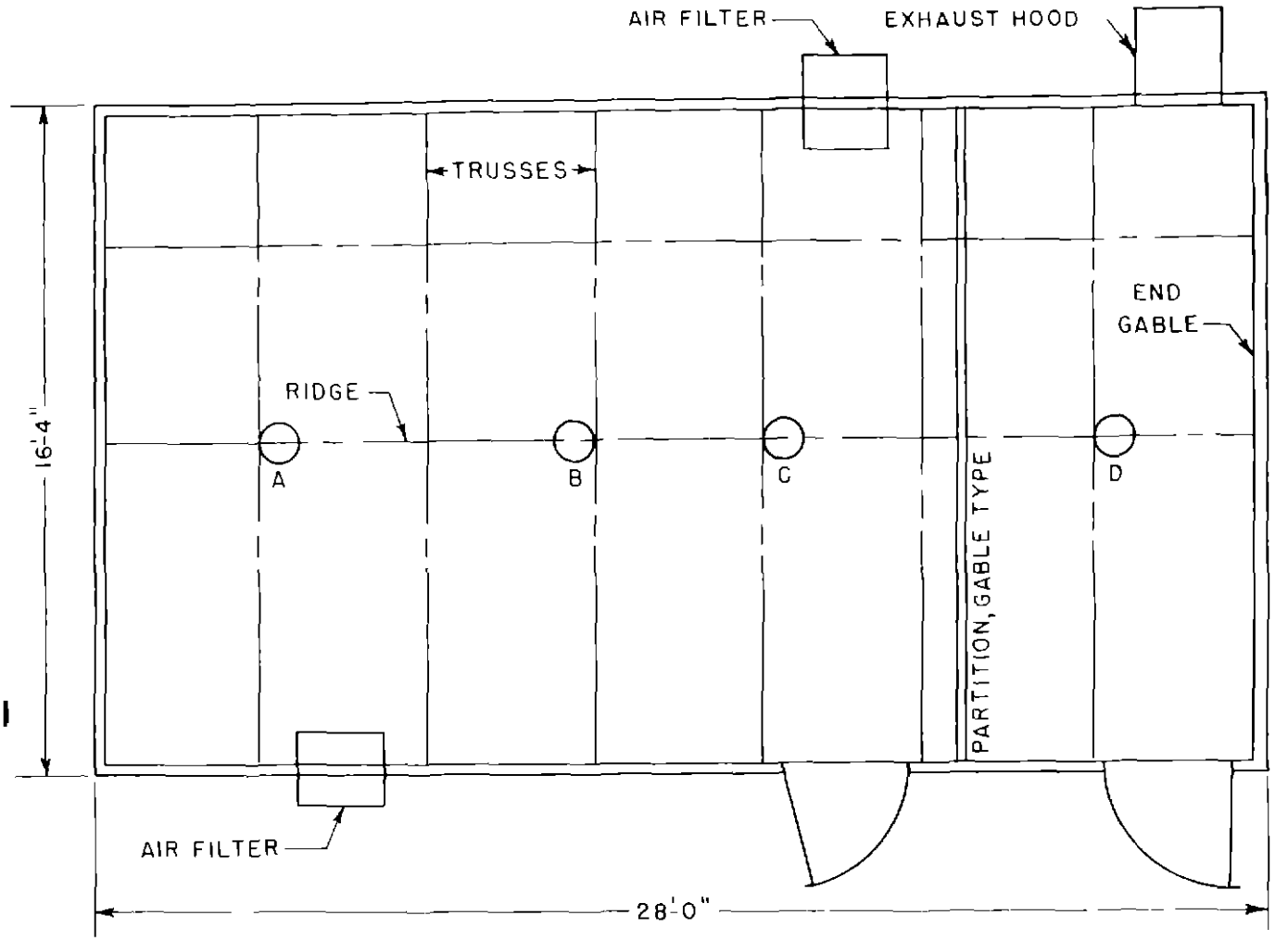
FIG 4 EXTINGUISHER UNIT IN ENGINE ROOM (AFTER FIRE)



I	(a) L & M	III	(a) P
	(b) L & M	IV	(a) H
	(c) L, M, K & P		(b) F & G
	(d) L, M, P & R		(c) J
	(e) L, M, P & R		(d) J
	(f) L, M, P & R		(e) F & H
	(g) L, M, P & R		(f) F & H
II	(a) L & S		(g) F & H

P & J - BUCKET (12 QUART) FIRES
R & K - 6" DEEP, 3' SQUARE PAN FIRES
F, G, H, L, M, & S - 2" DEEP, 20" X 30" PAN FIRES

FIG 5 LOCATION OF FIRE PANS



I	(a)	A & C
	(b)	A & C
	(c)	A & C
	(d)	A, B & C
	(e)	A & C
	(f)	B
	(g)	A & C
II	(a)	A & C
III	(a)	A & C
IV	(a) to (g)	D

FIG 6 PLAN LOCATION OF EXTINGUISHER BOTTLES