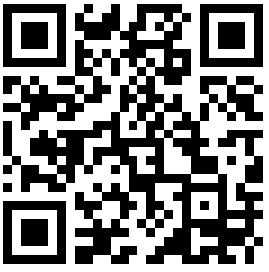

TM 10-1160

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

PETROLEUM LABORATORY MOBILE SEMITRAILER MOUNTED

DEPARTMENT OF THE ARMY • SEPTEMBER 1956

TECHNICAL MANUAL
No. 10–1160

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *4 September 1956*

PETROLEUM LABORATORY, MOBILE, SEMITRAILER MOUNTED

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

This manual presents information applying only to the petroleum laboratory, mobile, semitrailer mounted (Federal Stock No. 9999–360–0152, Specification No. MIL–P–10923 (QMC)). The manual, which is limited to procedures for the use and maintenance of specific apparatus and equipment, must be supplemented by reference to other publications that provide testing procedures (app. IV) in order to perform desired tests and analyses on petroleum products.

2. Requisitioning

Requisitions for component parts, spare parts, or supplies for the mobile laboratory must include standard nomenclature and stock number as listed in appropriate Department of the Army supply manuals. In the absence of stock numbers, requisitions must also include name of manufacturer and manufacturer's model number, part number, and nomenclature, whenever possible. In addition, all requisitions must show that replacement parts are components of the mobile petroleum laboratory. Forms used for requisitioning are listed in paragraph 3.

3. Forms

Blank forms that may be used in the preparation of records, reports, and requisitions pertaining to the mobile laboratory as follows:

a. General.

(1) DD Form 6 (Report of Damaged or Improper Shipment) (AR 700–58).
(2) DA form 285 (Accident Report) (SR 385–10–40).
(3) DA Form 468 (Unsatisfactory Equipment Report) (AR 700–38).

b. Maintenance.

(1) DA Form 460 (Preventive Maintenance Roster).
(2) DA Form 1511 (Field Maintenance Operations) (AR 750–15).
(3) DA Form 811 (Work Request and Job Order).

c. Requisitioning.

(1) DA Form 445 (Requisition).
(2) DA Form 446 (Issue Slip).
(3) DA Form 447 (Turn-In Slip).

Note. Refer to AR 711–16 for use of DA Forms 445, 446, and 447.

Section II. DESCRIPTION AND DATA

4. General

The mobile petroleum laboratory (fig. 1) is equipped for the performance of certain designated tests in the field on petroleum products such as gasoline, diesel fuel, kerosene, lubricating oil, and grease. It consists of a van-type 7-ton, 2-wheel semitrailer, and a 6-ton, 2-wheel, trailer converter dolly, M364. The van interior (figs. 2 and 3), partitioned into a utility compartment, a laboratory compartment, and a rear compartment, houses the equipment and apparatus needed to perform the tests. An electric heater (par. 32) or a gasoline heater (par. 33) is supplied for heating the laboratory compartment in cold or arctic climates. An air-conditioning unit (app. V) may be provided for use in tropical and desert climates. A modified knock-testing engine (par. 58) is provided as a component in some mobile laboratories for testing knock characteristics of motor fuels. The

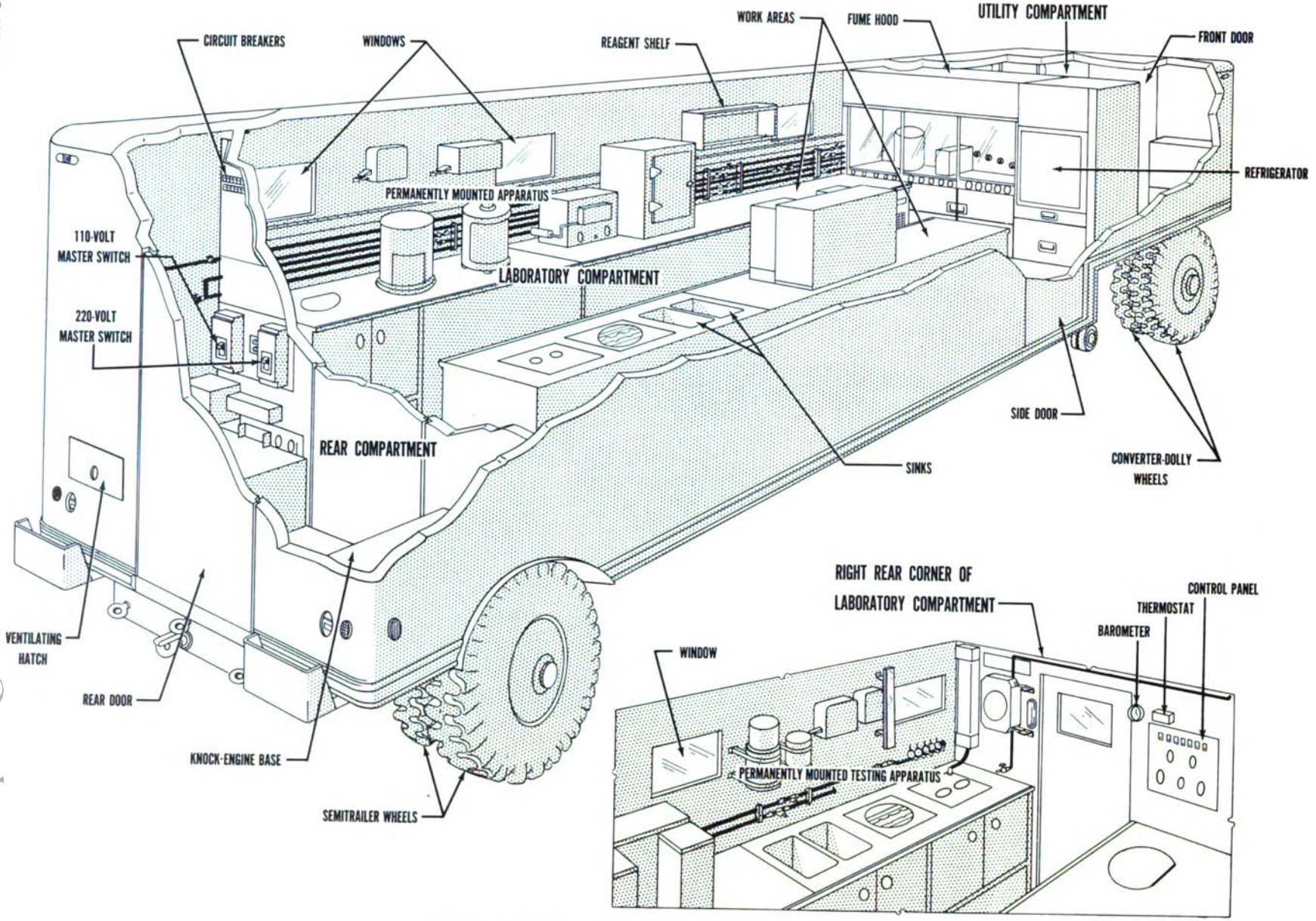


Figure 1. Mobile petroleum laboratory (cutaway view).

various models of the petroleum laboratory are as follows:

a. Model A, 1949, Type I. Identifying features: gasoline-driven air-conditioning unit, low-temperature test cabinet, and fifth-wheel attachment without dolly.

b. Model B, 1950, Type I. Identifying features: low-temperature test cabinet, gasoline-driven air-conditioning unit, and fifth-wheel attachment without dolly.

c. Model C, 1951, Type II. Identifying features: gasoline heater, fifth-wheel attachment, and M364 dolly.

d. Model D, 1952, Type II. Identifying features: electric heater, fifth-wheel attachment, and M364 dolly.

e. Model E, 1952, Type II. Identifying features: electric heater and modified CFR test engine.

f. Model F, 1952, Type II. Identifying features: gasoline heater, CFR test engine, and R and D air-conditioning unit.

5. Semitrailer

a. Body. The semitrailer body is of the van type, with frame integral with the main frame (figs. 4 and 5). The body consists of an inner and outer shell, constructed of aluminum sheeting. Fiberglass is installed between the inner and outer shell to provide insulation for the interior of the semitrailer. Mounted on the semitrailer frame are the rear axle and suspension, a carrying rack for the spare tire and landing-gear supports, a carrying rack for step-ladders, the front landing gear, the leveling jacks, and a kingpin with upper fifth-wheel plate. The sides of the semitrailer are protected by a rub rail which runs along the bottom edge on all four sides.

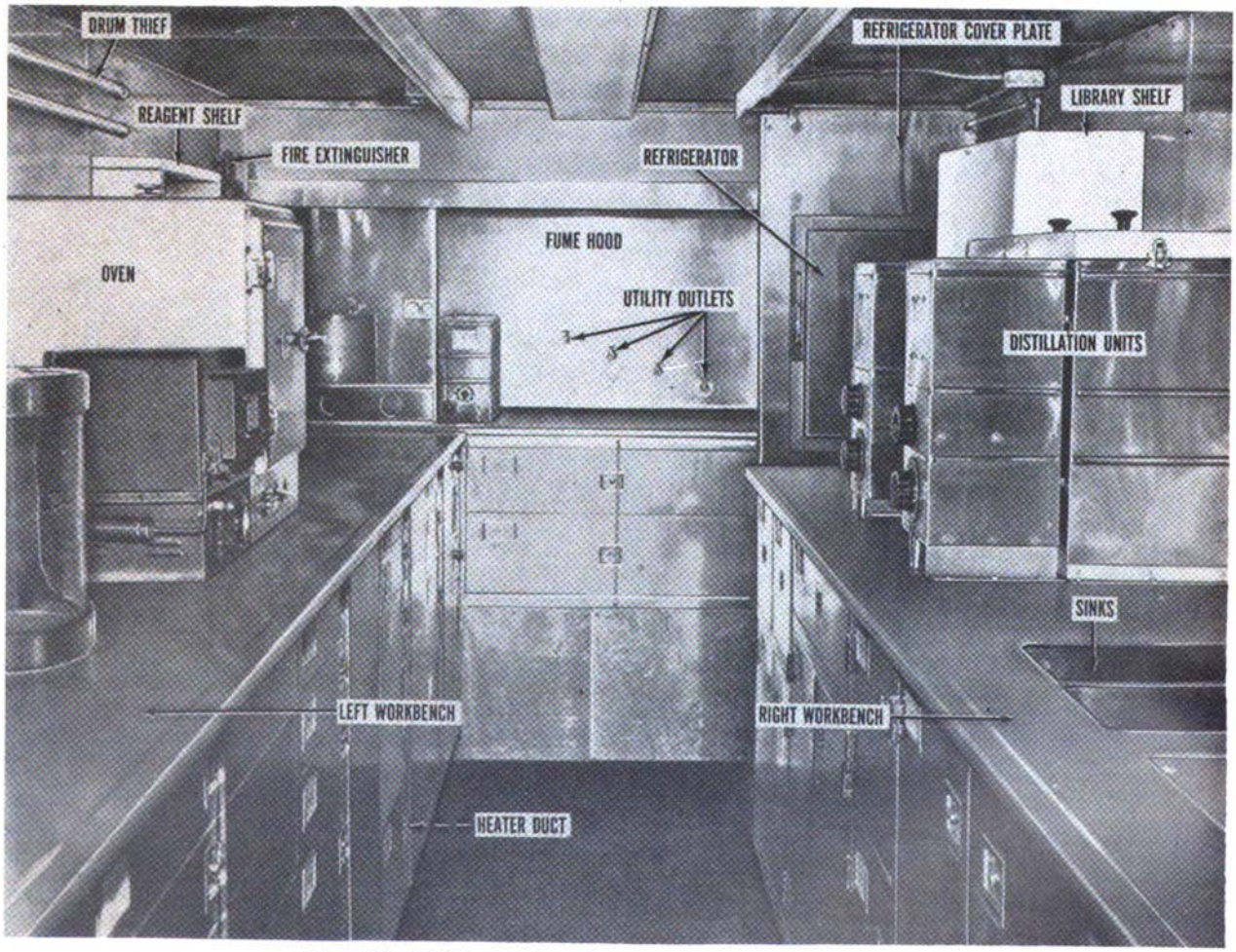


Figure 2. Mobile petroleum laboratory interior, facing front.

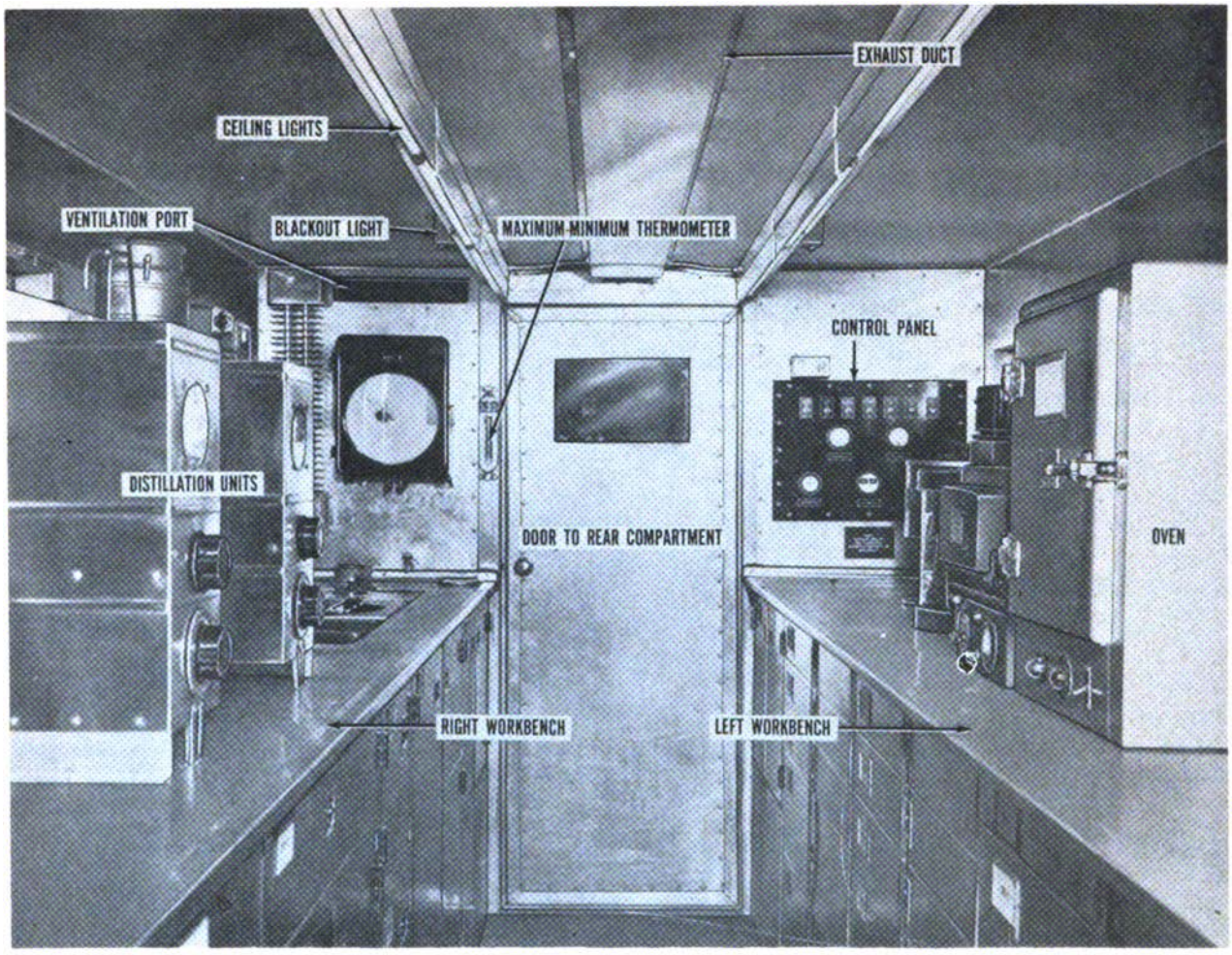


Figure 3. Mobile petroleum laboratory interior, facing rear.

b. Rear Axle. The rear axle assembly (fig. 6) is equipped with a tubular axle, 2 semi-elliptical springs, 2 shock absorbers, 2 rear-wheel chock block holders, air reservoir, hydraulic master cylinder for brakes, auxiliary handbrakes, and 2 dual wheels equipped with 10-ply nondirectional tires. The rear axle assembly is attached to the semitrailer frame.

c. Tools, Parts, and Equipment.

(1) Spare wheel and tire are carried in rack under the van body.

(2) Two rear-wheel chocks are carried in rear-wheel chock holders.

(3) Two landing-gear supports are carried in spare-tire rack.

(4) Two stepladders are carried in rack under van.

(5) A toolbox containing the following items is located in the utility compartment:

(*a*) Two rear leveling-jack handles.

(*b*) Wrench set: sockets 1½-inch, 1⅛-inch; square-drive, 1-inch.

(*c*) Wrench set: sockets $^{13}/_{16}$-inch, ¾-inch; square-drive, ⅔-inch.

(*d*) Handle, square-drive, 1-inch male end, 1-inch female end.

(*e*) Handle, sliding square-drive, 1-inch.

(*f*) Wrench, axle nut, octagonal, 3-inch with handle.

(6) Accessories for the knock engine are stored in a metal box in the utility compartment. A spare set of jets, size 56 for motor method and size 68 for research method, are included.

d. Dolly. The dolly axle assembly is identical to the type used on the semitrailer. In

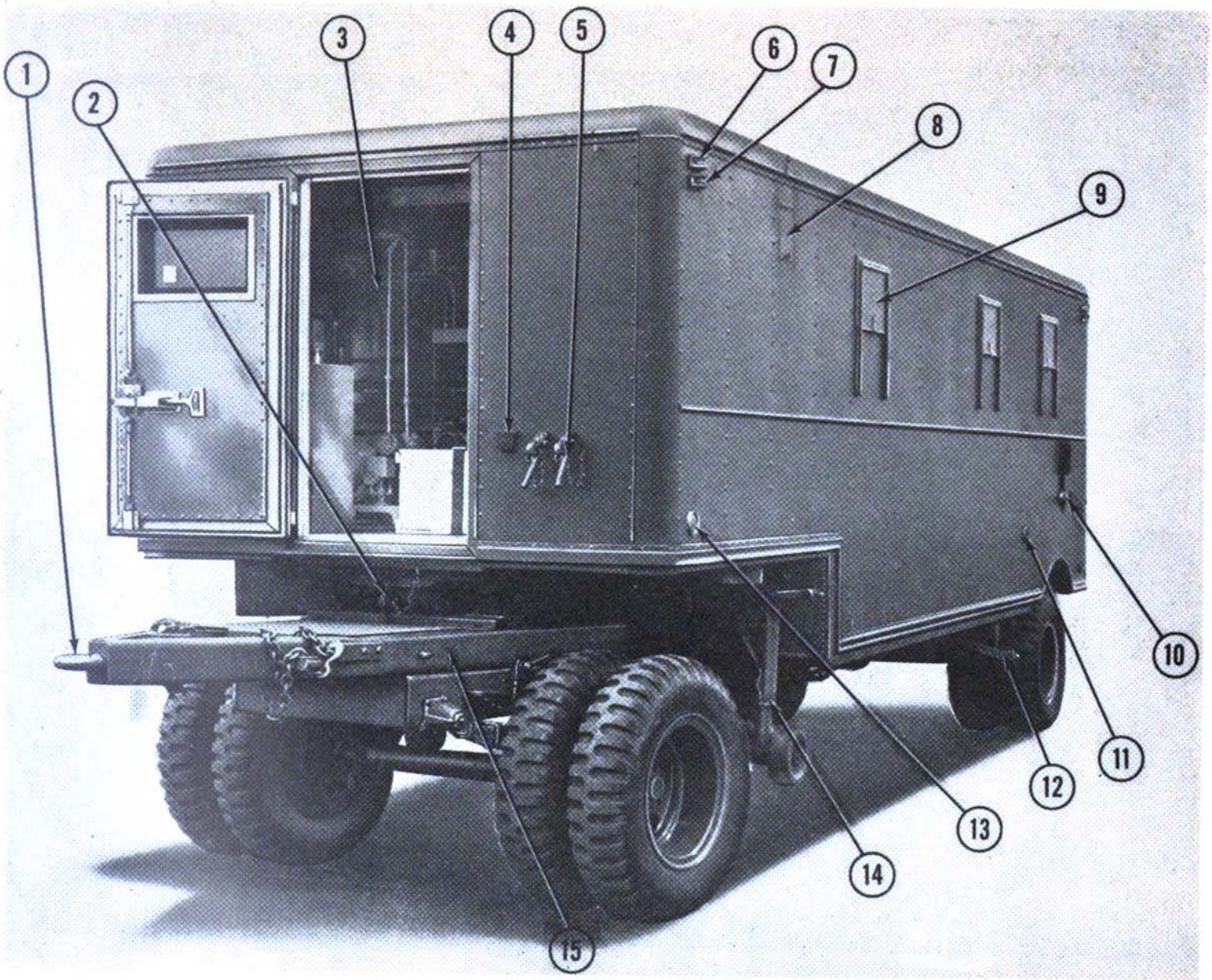


Figure 4. Mobile petroleum laboratory trailer (¾-front view).

1 Lunette
2 Dolly fifth-wheel holding latch and pin
3 Utility compartment
4 Receptacle for electrical line from truck-tractor
5 Airbrake hose coupling
6 Clearance lamp
7 Blackout clearance lamp
8 Fume-hood exhaust-blower hatch
9 Blackout cover
10 Power receptacle for generator powerline
11 Lifting shackle
12 Rear leveling jack
13 Reflector
14 Front landing gear
15 Dolly

Figure 4—Continued.

addition the dolly has a fifth wheel used for attaching and locking the dolly to the kingpin of the trailer. When the semitrailer is pulled by a truck-tractor having its own fifth wheel, the dolly is towed behind the semitrailer by connecting the lunette eye of the dolly to the pintle of the semitrailer.

e. Brake System. The brakes of the semitrailer are actuated and controlled by compressed air supplied by the truck-tractor or towing vehicle. Two lines, a service line and an emergency line (fig. 7), carry the compressed air from the tractor or towing vehicle back to the relay valve located in the rear axle assembly (fig. 6). A compressed-air reservoir is connected to the relay valve. If, by accident, the brake lines are torn, 120 pounds of air is released from the reservoir to actuate the brakes. The service line actuates the brakes during normal operation. It carries 120 pounds of air to the relay valve. From here the air is relayed to the air chamber, which pushes fluid out of the hydraulic master cylinder into the brake cylinder to actuate the brakes. Another air hose is attached to the air line between the relay valve and the hydraulic master cylinder. It carries compressed air to the dolly for brake actuation. Since air reaches the rear brakes first, buckling is prevented.

f. Leveling Jacks. The two leveling jacks, each provided with a small handcrank, are located at the rear of the trailer in front of the rear wheels. The jacks are used to level the rear of the trailer.

g. Front Landing Gear. When the semitrailer is not coupled to the dolly or towing vehicle, its front end is supported by the front landing gear. The landing gear consists of two vertical-acting screw-type retractable shafts (fig. 8). The two gears may be operated in unison. When the landing gears are used for leveling the front end of the semitrailer, they are operated independently of each other. Each landing gear has its own handcrank. The bottom of each landing-gear shaft is provided with two small steel wheels, which rest in landing-gear supports when the semitrailer is not connected to the dolly or towing vehicle.

h. Lighting. The trailer and dolly are equipped with a 24-volt electrical system controlled from the cab of the towing vehicle by means of light switches located on the dashboard. The petroleum laboratory trailer is equipped with a 12-contact coupling socket located beside the airbrake hose receptacles on the front of the trailer. The dolly is also provided with a socket which carries electricity for the taillight when the dolly is towed behind the trailer. The trailer and dolly are equipped with blackout taillight and blackout spotlight assemblies. In addition, the trailer is equipped with 2 sets of clearance lamps and running lights, 1 set for normal use and 1 set for blackout lighting. The lights operate off a 24-volt system. The wiring diagram for exterior lighting is shown in figure 9. The interior lights operate off a 110-volt, 60-cycle electrical system supplied by an electric generator or another outside source.

i. Doors and Windows. The semitrailer is equipped with 3 refrigerator-type doors. One at the front opens into the utility compartment, 1 on the right side opens into the laboratory compartment, and 1 in the rear opens into the rear compartment. The semitrailer is provided with 5 high-altitude, nonconducting, all-weather, double-glazed window assemblies, 3 on the left and 2 on the right side of the semitrailer. The laminated glass panes in the window assemblies are constructed so that condensation does not form at temperatures above —40° F. Each window is equipped with a sliding rigid steel blackout cover, attached to the outside window assembly and operated from the outside of the semitrailer.

j. Stepladders. The semitrailer is equipped with 2 stepladders, 1 for the rear entrance, and the other for either the side or front entrance.

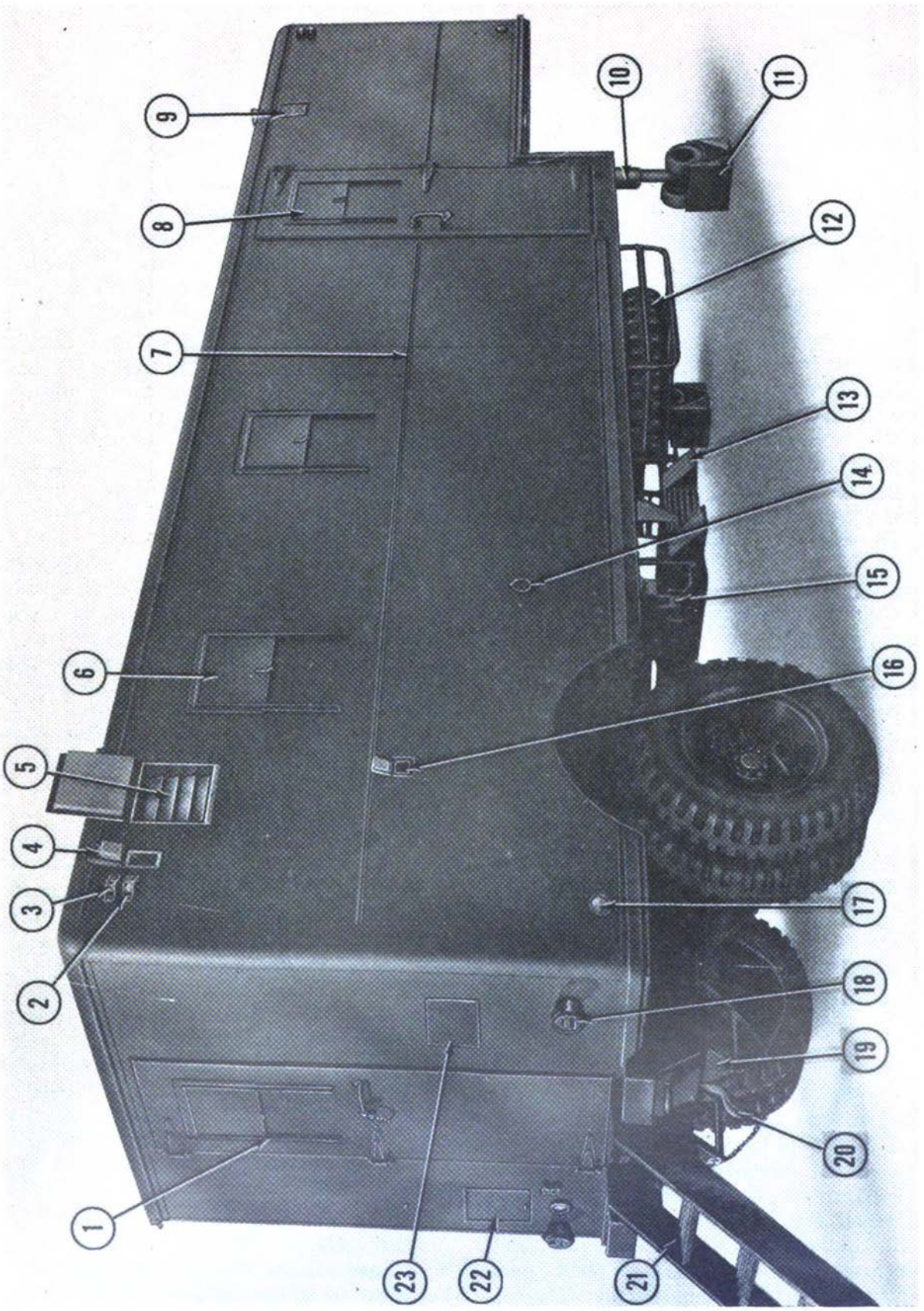
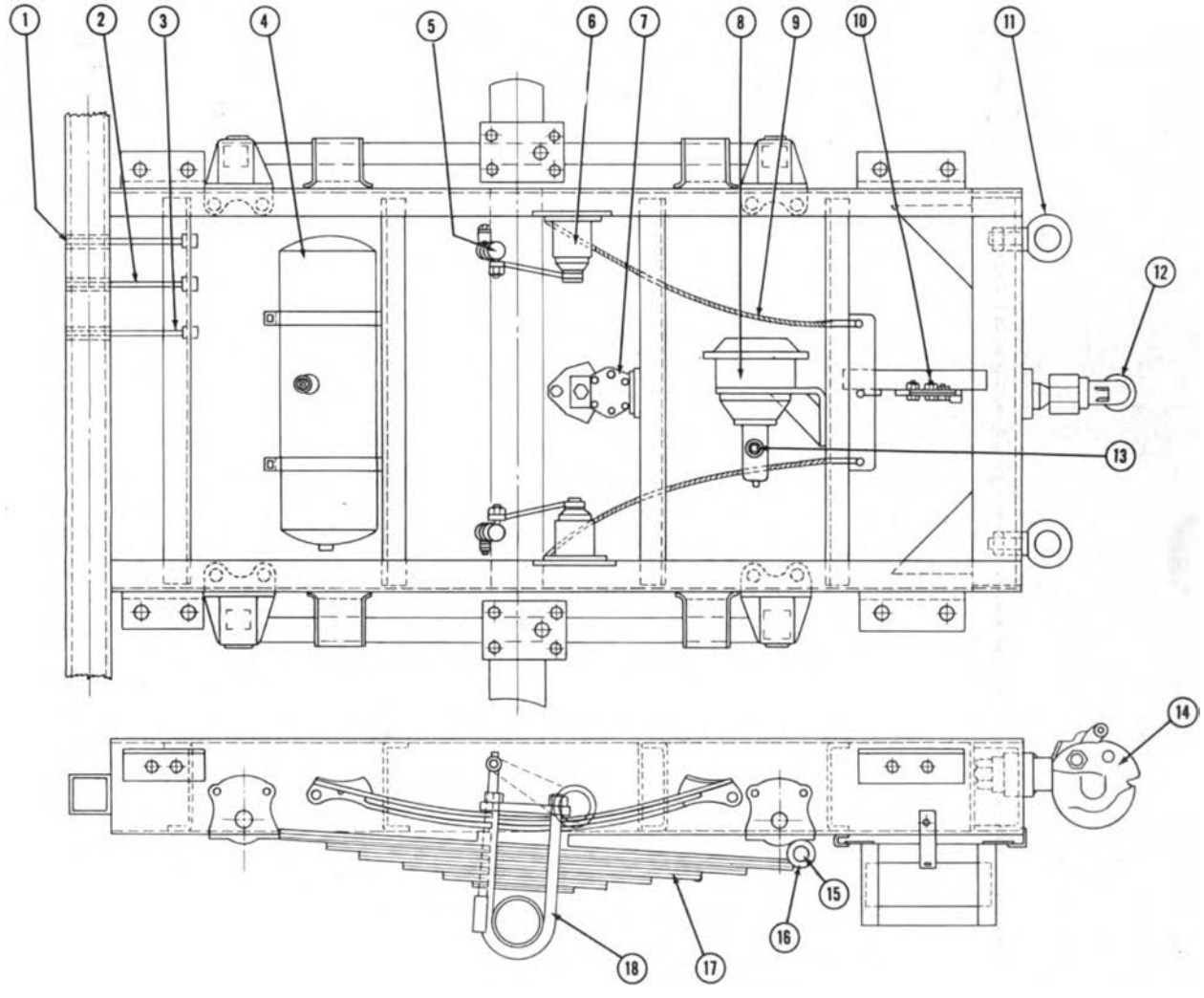


Figure 5. Mobile petroleum laboratory semitrailer (¾-rear view).

1 Rear door
2 Blackout clearance lamp
3 Clearance lamp
4 Knock-engine exhaust hatch
5 Knock-engine condenser-fan hatch
6 Blackout cover
7 Side rail
8 Side door
9 Condenser-blower intake hatch
10 Front landing gear
11 Front landing-gear support
12 Spare-wheel rack with spare wheel
13 Stepladder rack with stepladder
14 Lifting shackle
15 Rear leveling jack
16 Knock-engine oil-breather hatch
17 Reflector
18 Rear light
19 Rear-wheel chock in rack
20 Semitrailer handbrake
21 Rear-door stepladder
22 Ventilating hatch
23 Nameplate

Figure 5—Continued.



1 Airbrake line to dolly
2 Service airbrake line
3 Emergency airbrake line
4 Hydraulic-brake air reservoir
5 Shock absorber linkage
6 Shock absorber
7 Relay valve
8 Hydraulic-brake air chamber
9 Hand parking-brake cable
10 Hand parking brake
11 Lunette
12 Pintle
13 Hydraulic master cylinder
14 Pintle
15 Spring pin
16 Shackle
17 Spring
18 U-bolt

Figure 6. Rear axle assembly (top and side views).

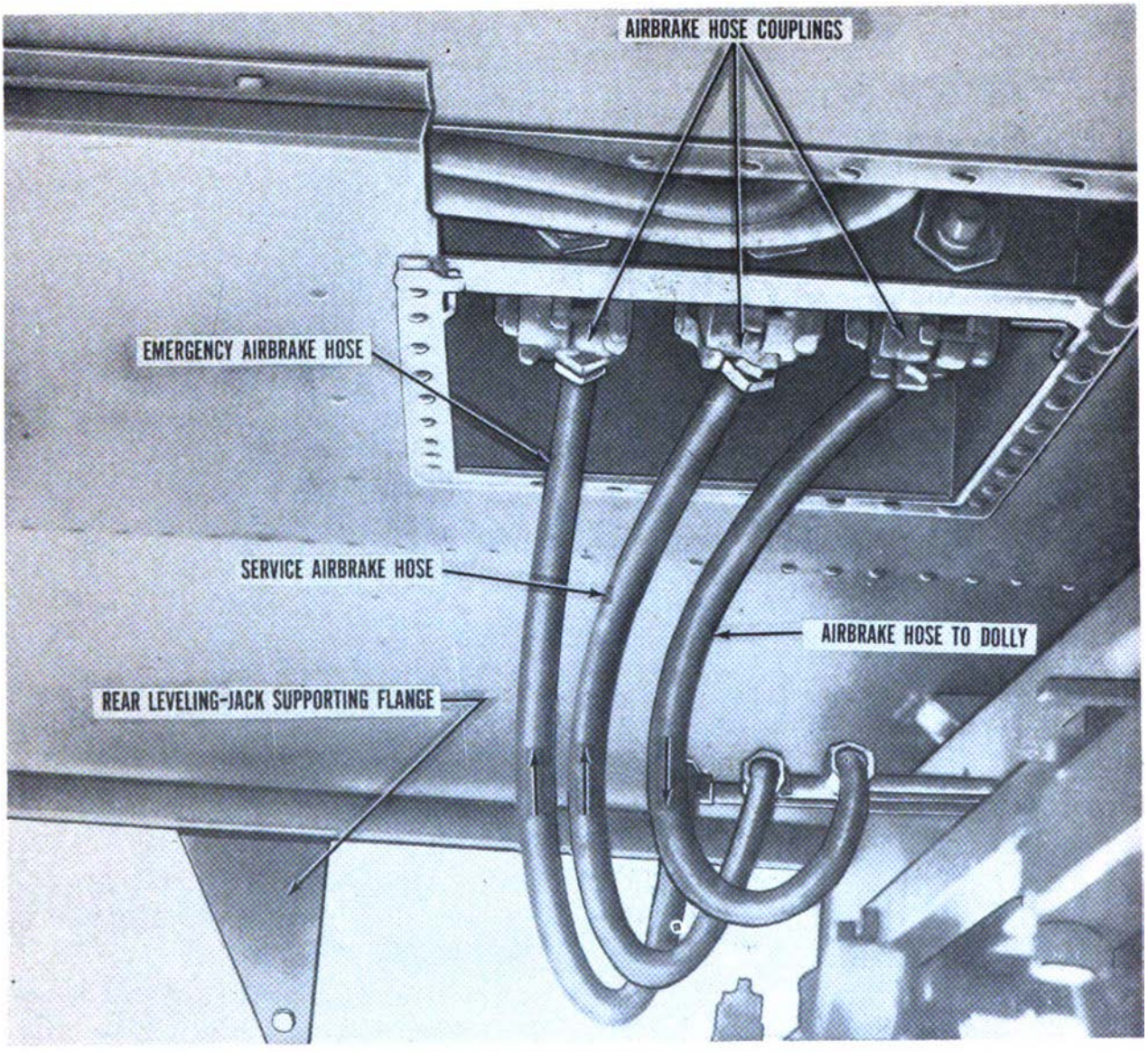


Figure 7. Airbrake hose connections, looking beneath semitrailer from left side.

They are stored in a rack attached to the underside of the semitrailer.

k. Rear-Wheel Chock Blocks. Two chock blocks are provided for the rear wheels. The two rear-wheel chock blocks are stored in holders at the right and left rear of the rear axle assembly, and are chained to the holders. The chock blocks are triangular and can be set either in front of or behind the rear wheels.

l. Front Landing-Gear Supports. The two front landing-gear supports are clamped to the spare wheel and tire rack. When landing gear is lowered they are placed under the landing-gear wheels, with the wheels resting in the curved part of the supports. Their purpose is to prevent the landing-gear wheels from sinking into the ground, and also to act as chocks.

m. Lifting Shackles. Lifting shackles, to be used in freight loading, are provided. One is attached to the left and one to the right side of the semitrailer.

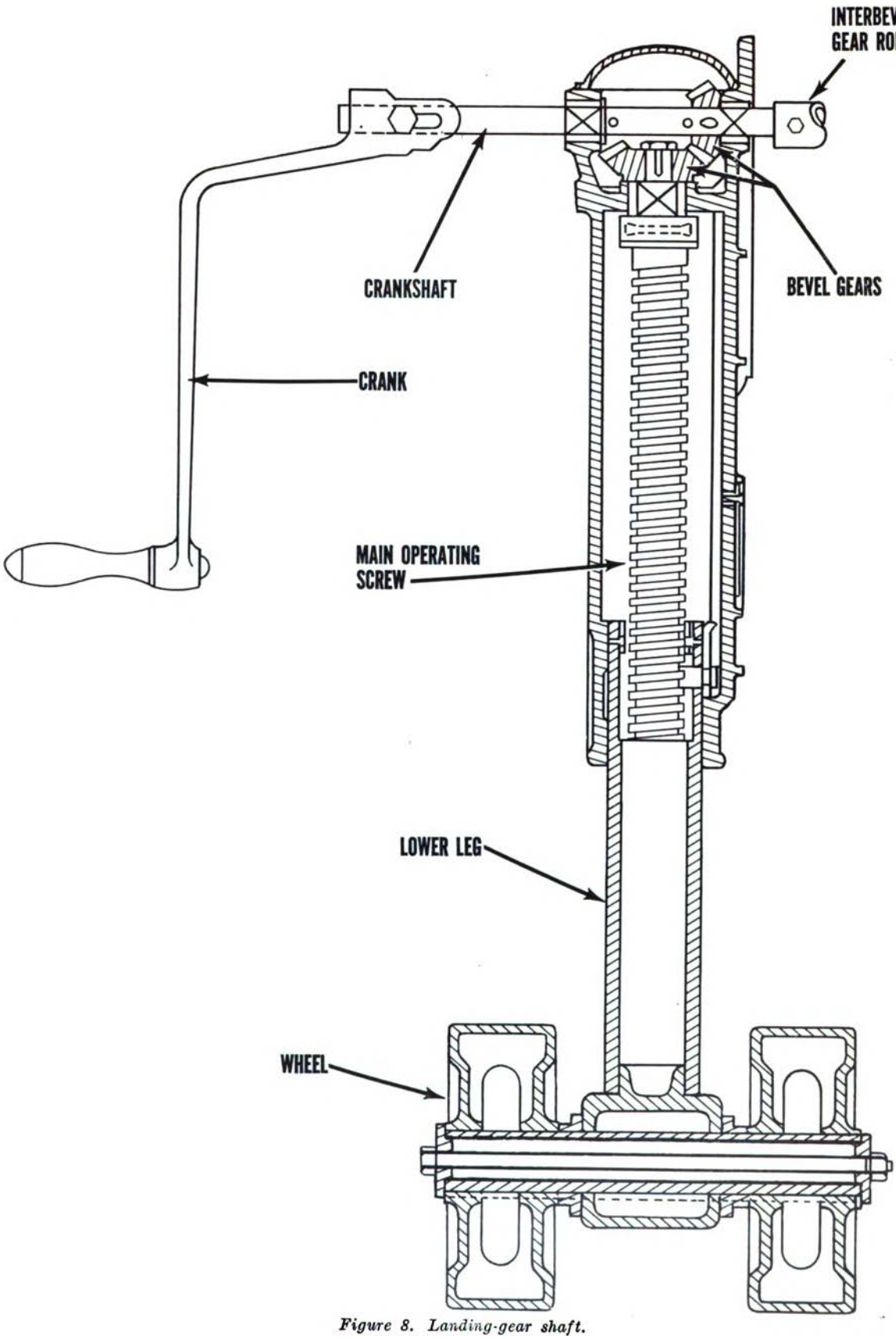


Figure 8. Landing-gear shaft.

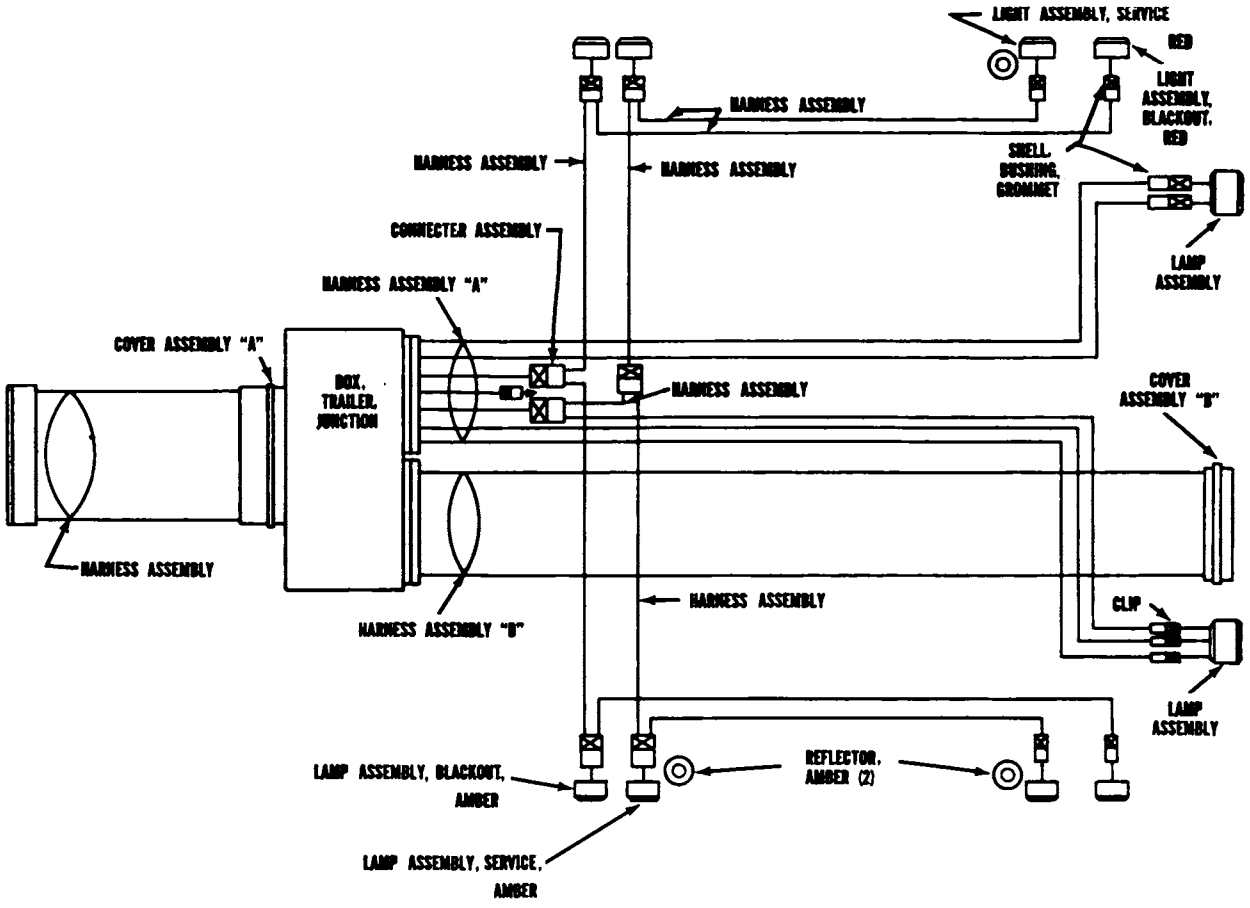


Figure 9. Exterior lighting wiring diagram.

6. Data

Body type_____Van
Tires:
Operating (dolly or semitrailer)4
Ply_____10
Pressure (cool)_____65 pounds
Size_____9.00 by 20
Towing facilities:
Dolly_____Lunette to towing vehicle, fifth wheel to semitrailer.
Semitrailer_____Kingpin at front and pintle hook at rear.
Dimensions:
Height:
Inside:
Rear and laboratory compartments. 6 feet 7 inches
Utility compartment__4 feet 6 inches
Outside:
Van body_____7 feet 4 inches
Van body, with rear axle assembly. 9 feet 10 inches
Length:
Compartments:
Laboratory_____18 feet
Rear_____2 feet 10 inches
Utility_____6 feet 5 inches
Dolly_____9 feet
Semitrailer:
Without dolly_____26 feet
With dolly_____31 feet 10 inches
Width:
Semitrailer, inside_____7 feet 6 inches
Semitrailer, outside_____8 feet
Speed per hour:
Cross-country_____15 miles
Highway_____45 miles
Turnability_____90° angle
Weight:
Equipment and supplies___11,350 pounds
Semitrailer_____7,950 pounds
Maximum gross weight:
Allowed_____22,000 pounds
With equipment installed. 19,300 pounds

CHAPTER 2
SEMITRAILER OPERATION AND MAINTENANCE

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

7. Inspection

Upon initial receipt of the mobile petroleum laboratory, the maintenance mechanic for the using organization should immediately inspect the van body, windows, doors, rear axle assembly, dolly, racks under the trailer, utility equipment, leveling jacks, front landing gears, lighting fixtures, and tools to be sure they are properly assembled, secure, clean, and correctly adjusted and/or lubricated. All trailer tools and equipment should be checked (par. 5*c*) to be sure every item is present, in good condition, clean, and properly mounted or stored. The laboratory technicians should remove the sealing tape and bracing from the laboratory equipment and check for damage. Apparatus stored in drawers must be carefully inspected for breakage. All testing apparatus, equipment, and chemicals should be checked (apps. II and III) to be sure every item is present and in good condiiion.

8. Run-in Test

Fill fuel and water tanks in utility compartment. Attach semitrailer and dolly to towing vehicle. Make brake and light connections and test their operation. Road-test trailer to check operation of springs, shock absorbers, wheels, tires, brakes, dolly, and towing connections. Stop trailer in selected location and set up for laboratory operation. Connect generator, observe control-panel gages, and test utility equipment. Operate lighting and blackout switches. Turn on and test each piece of mounted testing apparatus for satisfactory electrical connections.

9. Correcting Deficiencies

Correct deficiencies disclosed by inspection and run-in test in one of the following ways:

a. New Equipment. Common deficiencies in any component part of the mobile petroleum laboratory will be listed on DA Form 468, and forwarded to The Quartermaster General, Department of the Army, Washington 25, D. C.. Deficiencies in new equipment are the responsibility of the manufacturer and are not to be corrected at the expense of the using organization.

b. Used Equipment. Treat deficiencies noted in used or reactivated equipment in one of the following ways:

(1) Correct deficiences within the scope of organization maintenance.
(2) Refer deficiencies beyond the scope of organization maintenance to a higher echelon for correction.
(3) Refer deficiences of a serious nature to the supplying organization through proper channels.

Section II. OPERATING FACILITIES

10. Lights

Exterior electric lights of the trailer are operated from the 24-volt electrical system of the towing vehicle. The electrical system for exterior lights is connected through the coupling socket located beside the airbrake hose receptacles on the front of the trailer. In the event the towing vehicle is equipped with a 6-volt system, modification of the trailer wiring system is required as follows: discard the 4-

and 6-wire trailer plug and cable assembly provided with the trailer. Attach ordnance adapter assembly No. D872976 or D8713799 to either the 4- or 6-connector light-socket receptacle on tractor. Attach one end of inner vehicular assembly No. 7728811 to adapter and the other end to receptacle on trailer. Replace bulbs in clearance lamps and running lights with 6-volt bulbs.

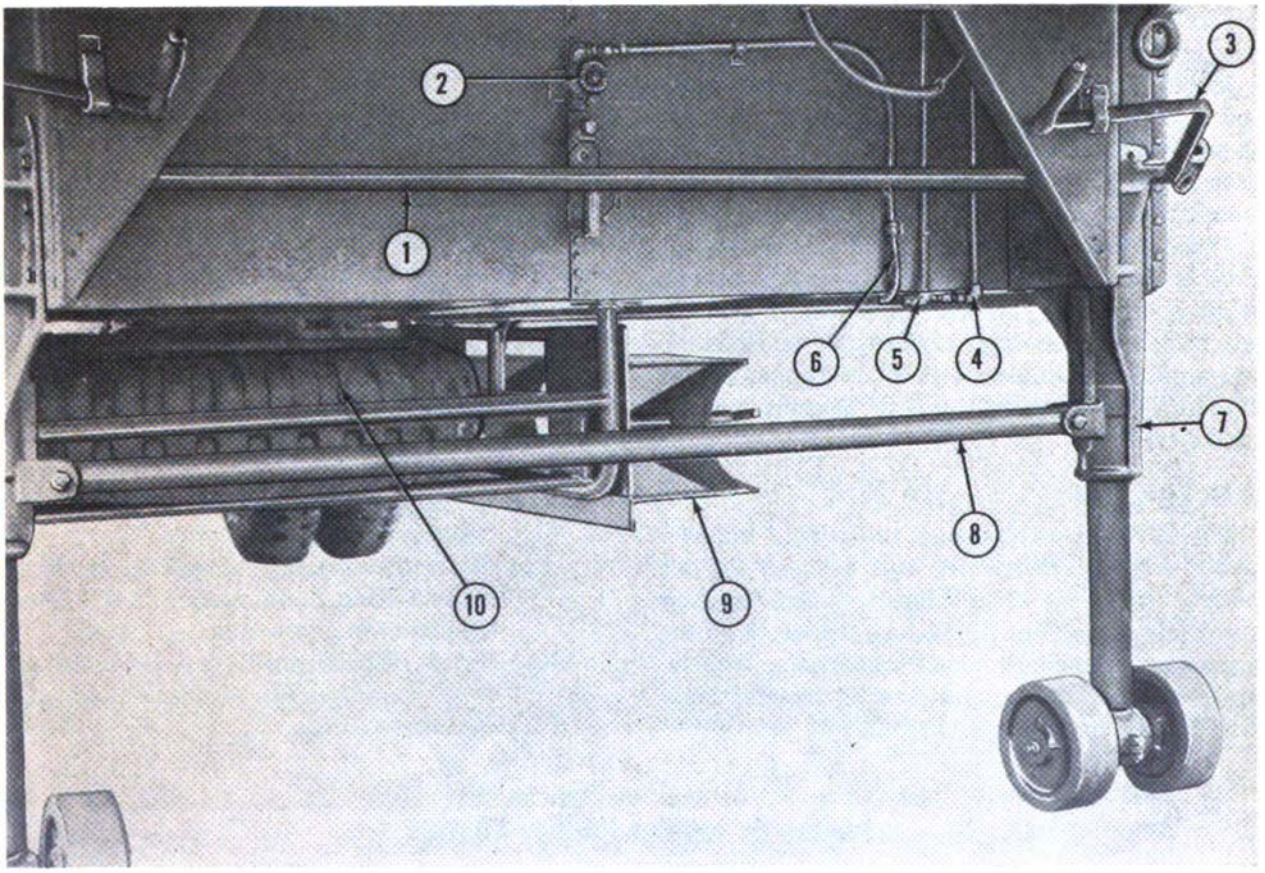
11. Brakes

a. Airbrakes. The semitrailer and dolly brakes are controlled from the cab of the towing vehicle. When the dolly is used in pulling the semitrailer, the dolly airbrake line valve (2, fig. 10) in the dolly cavity of the semitrailer is opened to allow air from the semitrailer air reservoir to pass into the dolly brake system. When the dolly is not used, the valve is closed to prevent air from escaping.

b. Hand Parking Brakes. The hand parking brakes are located at the rear of the semitrailer and at the front of the dolly. When parking for an extended period of time, hand parking brakes should be applied. The airbrakes should not be depended on as parking brakes as air may leak from the system and cause the airbrakes to release. Each hand parking brake is applied by squeezing and pulling back its handle, and released by squeezing and pushing forward on the handle.

12. Front Landing Gear

The handcranks for the front landing gears (3, fig. 10) are held in the disengaged position on hooks which are attached to the front of the



1 Interbevel gear rod
2 Dolly airbrake valve
3 Landing-gear crank handle uncoupled and placed in hook
4 Emergency airbrake line
5 Service airbrake line
6 Dolly airbrake line
7 Landing-gear shaft
8 Cross tube
9 Landing-gear support blocks attached to spare-tire rack
10 Spare tire

Figure 10. Landing gear and dolly airbrake control valve in semitrailer cavity.

landing-gear bracing. When the two front landing gears (7) are to be operated as a single unit, the interbevel gear rod (1) is installed and coupled to both crankshafts, and both front landing-gear cranks (3) are removed from their hooks and engaged on the crankshafts. Lowering the two front landing gears as a unit is then accomplished by turning either crank clockwise; raising is accomplished by turning the crank counterclockwise. Cranks are disengaged by pulling them outward from the crankshafts. When not in use, cranks are disengaged, turned in toward semitrailer body, and hung on their hooks. When landing gear is raised, it should be raised to its maximum travel to prevent damage to landing-gear legs while semitrailer is in transit. The front landing gear is used to raise or lower front of trailer as necessary to couple or uncouple the dolly or towing vehicle (par. 14). When the trailer is parked on uneven or sloping ground, the landing gear may be used to level the front of the semitrailer. After the landing gear has been lowered as a unit and the landing-gear wheels positioned in their supports, the interbevel gear rod is removed or the bolt at the left landing-gear shaft is removed, and the two landing-gear shafts are operated independently of each other by their respective cranks.

13. Leveling Jacks

The leveling jacks are used to level the rear of the semitrailer. Each jack is first lowered and braced by hand, then further adjusted by its operating handcrank.

14. Fifth-Wheel Coupling Mechanism

The fifth-wheel coupling mechanism consists of a jaw-cocking handle and lock (fig. 11). When the jaw-cocking handle is pulled outward, the jaws are opened, disengaging the semitrailer kingpin from the dolly fifth wheel. The fifth wheel remains unlocked and cocked for recoupling to the kingpin. When coupling the dolly fifth wheel to the semitrailer kingpin, all movement of the locking mechanism is semiautomatic, provided the jaw-cocking handle is pulled to the unlocked position.

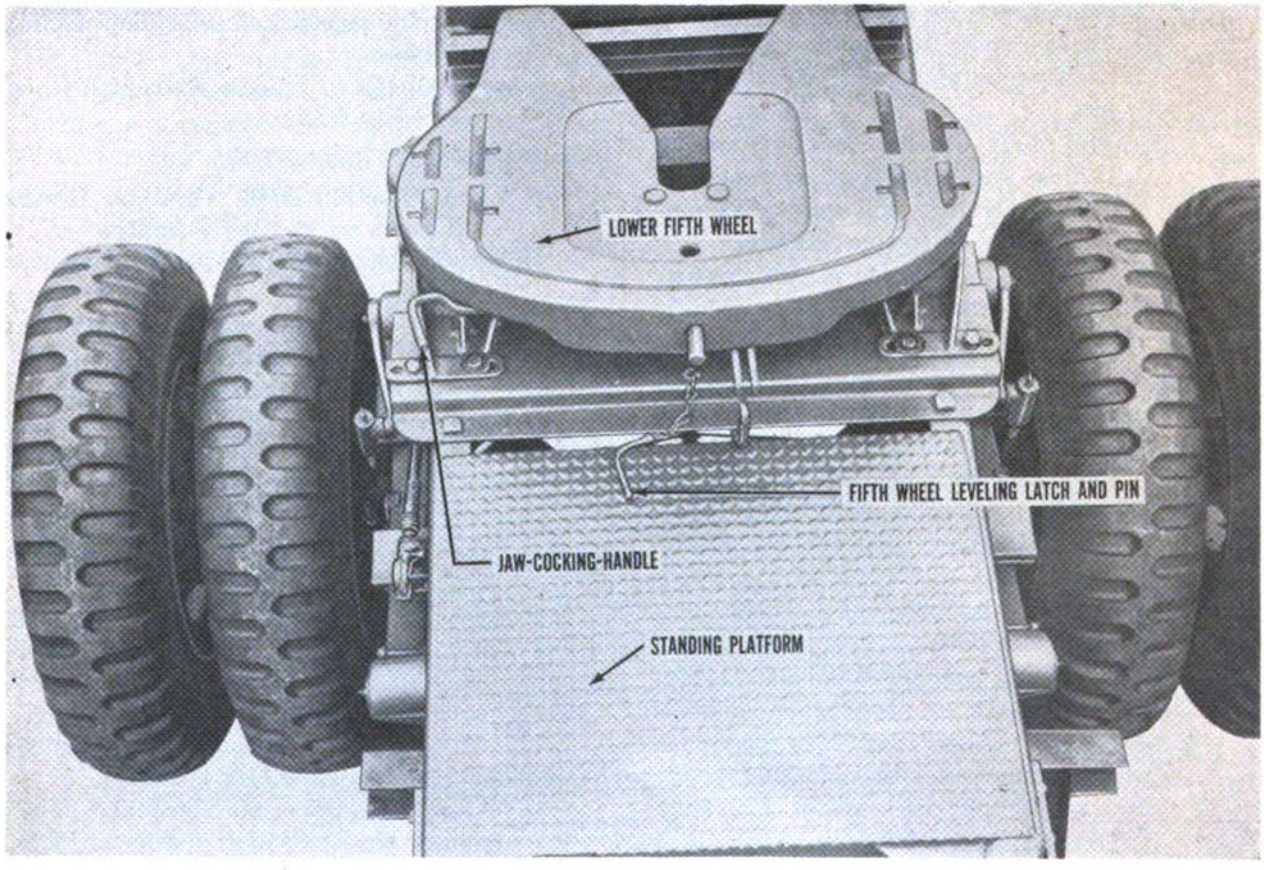


Figure 11. Dolly (top view).

15. Pintles

The semitrailer and dolly are both provided with identical rear pintles. The coupling operation may be accomplished automatically. When the lunette of the vehicle to be towed hits against the outside of the pintle, it opens the pintle. The top half of the pintle opens upward from the lower stationary part. The hood closes over the lunette and locks automatically. The lunette is released by pulling pintle latch up and releasing top half of pintle.

Section III. OPERATION UNDER USUAL CONDITIONS

16. Preparation for Movement

Check laboratory compartment to make certain that all chemicals and apparatus are stored in place, drawers fastened, switches off, and fume-hood sliding doors latched to left. Check outside of semitrailer to make certain that all outside hatches are closed and latched, that all equipment in racks is properly stored, and that all operating equipment is in proper operating condition.

a. Operation With Dolly. The dolly is used when the trailer is pulled by any vehicle not equipped with a fifth wheel. Towing vehicle must be equipped with an airbrake system.

(1) *Coupling dolly to towing vehicle.*

(*a*) Fasten dolly fifth wheel in a level position by using holding latch and pin.

(*b*) Pull dolly toward rear of towing vehicle and raise front end so that lunette contacts and locks with pintle at rear of towing vehicle.

(*c*) Fasten safety chains to bull rings at rear of towing vehicle.

(2) *Coupling dolly to semitrailer.*

(*a*) Pull out on jaw-cocking handle until dolly fifth-wheel jaws are cocked. Be sure fifth wheel is held level by latch and pin.

(*b*) Apply hand parking brake at rear of semitrailer by squeezing handle and pulling to the rear.

(*c*) Place rear-wheel chock blocks behind rear wheels of semitrailer.

(*d*) Crank up rear leveling jacks.

(*e*) Slowly back dolly under a semitrailer so that kingpin in dolly cavity is centered, or nearly so, with jaws of dolly fifth wheel. Continue backing until kingpin locks into fifth wheel.

(*f*) Couple brake air hose; couple service line to service coupling and emergency line to emergency coupling.

(*g*) Couple light jumper cable, plugging end into socket at front of semitrailer near brake airhose couplings.

(*h*) Try to pull dolly forward. If coupling is complete, movement will be difficult.

(*i*) Remove the two rear-wheel chock blocks and place them in their racks.

(*j*) Crank up front landing gear.

(*k*) Fasten front landing-gear supports to spare-tire rack.

(*l*) Release handbrake of semitrailer by squeezing on handle and pushing forward.

(*m*) Pull pin to release dolly fifth-wheel leveling latch.

b. Operation Without Dolly.

(1) Make certain fifth wheel on towing vehicle is cocked for coupling.

(2) Apply hand parking brake at rear of semitrailer.

(3) Place rear-wheel chock blocks behind rear wheels of semitrailer.

(4) Crank up rear leveling jacks.

(5) Back towing vehicle under semitrailer so that semitrailer kingpin is centered, or nearly so, on ramps of coupler. Continue backing until fifth wheel of towing vehicle locks firmly to semitrailer kingpin.

(6) Attempt towing semitrailer. If coupling is complete, forward movement of semitrailer will be extremely difficult.

(7) Make sure dolly airbrake valve in dolly cavity of semitrailer is closed.

(8) Connect service air lines and emergency air lines to couplings at front of semitrailer.

(9) Open the two cutout cocks on towing vehicle to permit air to enter semitrailer brake system.
(10) Couple light jumper cable from electrical source in towing vehicle into electrical coupling socket at front of semitrailer.
(11) Crank up front landing gear.
(12) Release hand parking brake.
(13) Place rear-wheel chock blocks and front landing-gear supports in their racks and secure.
(14) If desired, hitch dolly to pintle at rear of semitrailer (fig. 12).
(15) Couple light jumper cable from socket at rear of semitrailer to socket on drawbar of dolly to provide dolly with an operating rear stoplight.

c. Before-Movement Check. Before movement, check to see that all doors are locked; outside hatches closed and latched; and spare wheel and tire, stepladders, rear-wheel chock blocks, and front landing-gear supports are mounted in their racks.

17. Driving Instructions and Precautions

a. The tractor and trailer combination, either as a semitrailer or full trailer, is driven in much the same manner as the straight truck. When turning corners, allow space for the semitrailer wheels to turn inside the turning circle of the towing vehicle.

b. Never attempt driving downgrade with the towing vehicle in neutral, as the trailer and towing vehicle may pick up speed in excess of braking power. Shift to a lower gear before starting down any steep grade or hill.

c. When following another vehicle, travel at a sufficient distance to permit ample time to apply brakes if the forward vehicle should make a sudden stop.

d. Be alert for low bridges, viaducts, tree limbs, and underpasses that may damage the top of the semitrailer.

e. Apply trailer brakes in coordination with the truck brakes. Do not expect the trailer brakes to carry the entire braking load. Such abuse will result in rapid lining wear and greatly reduce the life of the trailer brakes.

f. When backing the trailer, turn the towing vehicle in the opposite direction to which the trailer is to be turned. If it becomes necessary to back the full trailer a great distance, lock the dolly lock to prevent the trailer from jackknifing.

18. Setting-up Operations

a. Parking.
(1) Park trailer in a location as level as possible and, if necessary, easily camouflaged.
(2) Place rear-wheel chock blocks in front of or behind rear wheels and front landing-gear supports under landing-gear wheels. Lower front landing-gear wheels into landing-gear sup-

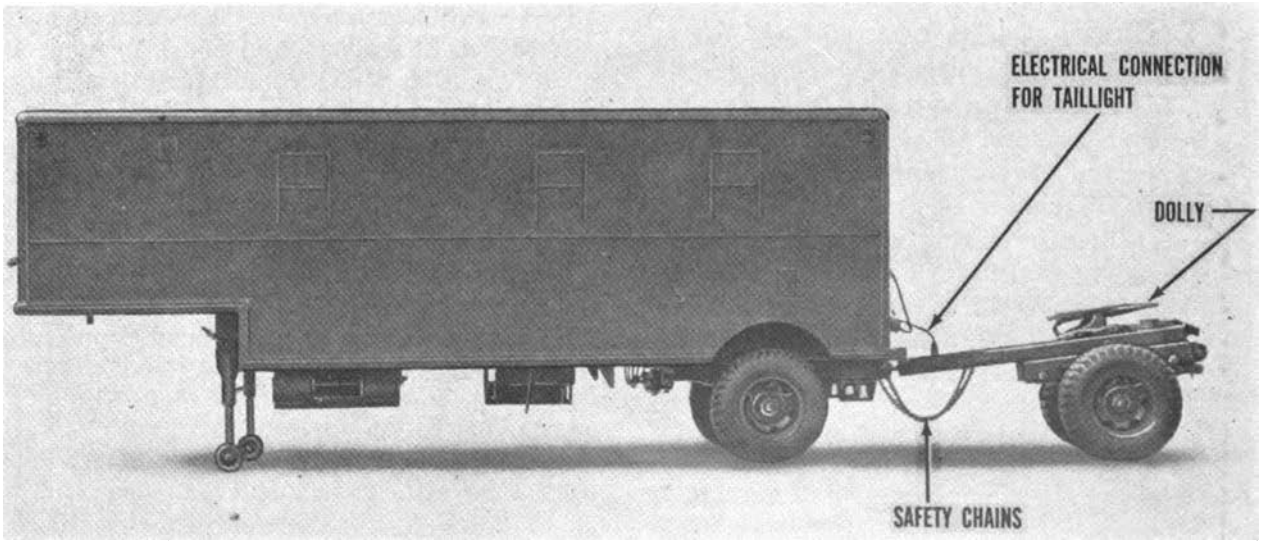


Figure 12. Semitrailer with dolly attached to rear.

ports. The front landing gear and rear leveling jacks are used to level semitrailer after dolly or towing vehicle is uncoupled from the semitrailer.

(3) Apply handbrake at rear of semitrailer. When parking the semitrailer do not depend on the airbrake system of the semitrailer to hold the brakes. Air may leak from the semitrailer brake system and cause the brakes to release.

b. Uncoupling.

(1) *Uncoupling trailer.*

(*a*) *Uncoupling dolly from semitrailer.* The procedure for uncoupling the dolly from the semitrailer is identical to that for uncoupling the towing vehicle as outlined in (2) below. Pull dolly forward to complete the uncoupling.

(*b*) *Uncoupling dolly from towing vehicle.* Chock front and rear of dolly wheels. Uncouple the two safety chains and hang the chains on their eyebolts. Pull electrical jumper cable from coupling socket at rear of towing vehicle and dolly drawbar. Open pintle hook and lift the lunette eye out. Lower the drawbar to the ground.

(2) *Uncoupling semitrailer from towing vehicle.*

(*a*) Make certain handbrake at rear of semitrailer is applied.

(*b*) Make certain front landing gear is in the complete down position.

(*c*) Shut off air to trailer brake system.

(*d*) Disconnect air hose from semitrailer and towing vehicle.

(*e*) Disconnect electrical jumper cable.

(*f*) Release locking mechanism of towing vehicle fifth wheel.

(*g*) Slowing drive towing vehicle forward until semitrailer and towing vehicle are separated.

c. Operating Instructions.

(1) Level trailer.

(2) Remove stepladders from rack. Place rear-door stepladder at rear door and place other stepladder at either right side door or utility compartment door.

(3) Connect generator electrical line to receptacle located on left side of semitrailer, outside of rear compartment (fig. 4). Check switches inside semitrailer to make sure they are open before starting generator. Start generator.

(4) Turn on main power switches located below fuse box in rear compartment.

(5) Turn on necessary lights.

(6) Check gages on control panel for proper line voltage and current.

(7) Check water supply, and gasoline supply if gasoline space heater is used, in tanks located in utility compartment. Replenish if necessary.

(8) If heat is required for semitrailer, set wall thermostat to desired temperature and turn on heater switches on control panel.

(9) If semitrailer ventilation without heat is desired, turn on blower fan switch on control panel. Adjust duct slides under bases of left and right cabinets.

(10) If semitrailer is provided with air-conditioning unit, and air conditioning is desired, turn on air-conditioning-unit switches.

(11) Turn on fume-hood exhaust fan blower switch located on left cabinet near hood. Adjust hand slides in exhaust duct at top of compartment.

(12) Turn on refrigerator switch; set temperature control switch to temperature desired. Turn on refrigerator-blower fan switch located on left cabinet near hood.

(13) Turn on water pump, vacuum pump, and compressor if necessary. Check compressed-air and vacuum-pressure gages on control panel.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

19. Extreme Cold

a. General. As subzero temperatures affect both metals and lubricants, operation of equipment at subzero temperatures presents problems that demand special precautions. Extremely careful servicing is required if poor performance and total functional failure are to be avoided.

b. Lubrication. Lubrication of the dolly and semitrailer in cold weather requires rigid adherence to instructions in the lubrication order. Fill shock absorbers with OHA (hydraulic fluid, petroleum base (arctic)) at subzero temperatures. At subzero temperatures drain brake fluid and flush master brake cylinder with denatured alcohol, grade III. Dry entire system with moisture-free compressed air. Fill brake system, including reservoir, with HBA (hydraulic fluid, nonpetroleum base, automotive (arctic)). Check brake hose, brakeshoes, and wheel cylinders, which must be kept as dry as possible. Use OES (lubricating oil, internal combustion engine (subzero)) on jaw, jaw release, pintles, leveling jacks, front landing gear, and handbrake in subzero temperatures.

c. Maintenance.

(1) *Body.* Inspect frequently. Resistance of metal against breakage is greatly reduced at extremely low temperatures. Operation of semitrailer or dolly on hard, frozen ground causes strain and jolting which may result in screws breaking or nuts jarring loose.

(2) *Wiring.* Check, clean, and tighten all connections. Be sure that no short circuits are present.

(3) *Brakes.* Freezing has a tendency to cause brakes to stick or bind when the dolly or semitrailer is parked at subzero temperatures. A blowtorch may be used with caution to warm up frozen brakes and lines when the dolly or semitrailer must be moved. Although parking with brakes released eliminates most of the binding, make sure to block wheels or otherwise prevent movement of semitrailer.

(4) *Utility equipment.*

(*a*) If the laboratory is operated in freezing temperatures, clear the each day's use by opening drain plugs on bottom of water tank, at base of water pump, on water return line located in the utility compartment, and water valves over sinks in the laboratory compartment.

(*b*) As the heater will be in constant use in extremely low temperatures, heater maintenance must be more frequent and thorough.

20. Desert Conditions

When the semitrailer is used under conditions of extreme heat and dust, such as those found in desert regions, observe the following precautions:

a. Expose equipment as little as possible. When shade for equipment is available, give primary consideration to locating air conditioner in the coolest area.

b. Keep equipment as free from dust as possible. Make frequent preventive-maintenance checks.

c. Make sure air-conditioner maintenance is performed more frequently and thoroughly.

d. Reduce lubrication intervals of dolly and semitrailer as required. Instructions for lubrication of moving parts of the utility equipment should be closely followed.

e. Check equipment frequently for overheating.

f. Clean air filters on air compressor daily.

g. Wipe off electric motors frequently, especially around bearings.

h. Clean all blower fan blades frequently.

21. Tropical Conditions

Under tropical conditions use the same precautions as for desert conditions. In climates of high humidity, inspect the equipment for traces of mold, mites, fungus, and metallic corrosion. Remove all fouling immediately. Clean all equipment frequently and lubricate as required. Keep all exposed outer metal surfaces of dolly and semitrailer painted to prevent rust formation.

LUBRICATION ORDER

LO 10 - 1160

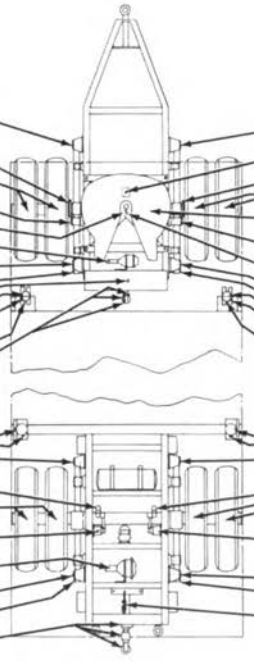
PETROLEUM LABORATORY, MOBILE

Intervals given are maximum for normal operation. For abnormal conditions or activities, intervals should be shortened to compensate. During inactive periods, intervals may be extended commensurate with adequate lubrication.

Clean fitting before lubricating.

Clean parts with Solvent, dry-cleaning, (Federal Stock No. 6850-00-19010 or 6850-00-19011). Dry before lubricating.

		Lubricant	Interval
Fig. 16	Spring Pin	GAA	BM
Fig. 17	Shock Absorber Linkage (See Note 1)	GAA	BM
	Wheel Bearings (See Note 2)	GAA	S
Fig. 17	Shock Absorber (See Note 4)	OH	BM
	Jaw	OE	BM
	Master Brake Cylinder (See Note 5)	HB	S
Fig. 16	Spring Pin	GAA	BM
Fig. 16	Shackle	GAA	BM
	Ramp (See Note 3)	GAA	BM
Fig. 14	Leg and Wheels	GAA	BM
	Operating Shaft	GAA	BM
Fig. 14	Internal Parts	GAA	S
	Pintle Hook	OE	BM
Fig. 15	Leveling Jack	OE	BM
Fig. 16	Spring Pin	GAA	BM
Fig. 17	Shock Absorber Linkage (See Note 1)	GAA	BM
	Wheel Bearings (See Note 2)	GAA	S
Fig. 17	Shock Absorber (See Note 4)	OH	BM
	Master Brake Cylinder (See Note 5)	HB	S
Fig. 16	Spring Pin	GAA	BM
Fig. 16	Shackle	GAA	BM
Fig. 18	Pintle Hook	OE	BM



Interval	Lubricant		
BM	GAA	Spring Pin	Fig. 16
BM	OE	Jaw Release	
BM	GAA	Shock Absorber Linkage (See Note 1)	Fig. 17
S	GAA	Wheel Bearings (See Note 2)	
BM	GAA	Fifth Wheel Plates, Upper and Lower (See Note 3)	
BM	OH	Shock Absorber (See Note 4)	Fig. 17
BM	OE	Jaw	
BM	GAA	Spring Pin	Fig. 16
BM	GAA	Shackle	Fig. 16
BM	GAA	Leg and Wheels	Fig. 14
BM	GAA	Operating Shaft	
S	GAA	Internal Parts	Fig. 14
BM	OE	Leveling Jack	Fig. 15
BM	GAA	Spring Pin	Fig. 16
BM	GAA	Shock Absorber Linkage (See Note 1)	Fig. 17
S	GAA	Wheel Bearings (See Note 2)	
BM	OH	Shock Absorber (See Note 4)	Fig. 17
BM	GAA	Spring Pin	Fig. 16
BM	GAA	Shackle	Fig. 16
BM	OE	Hand Brake	

—KEY AND NOTES—

LUBRICANTS	EXPECTED TEMPERATURES			INTERVALS
	above plus 32° F.	plus 40° to minus 10° F.	0° to minus 65° F.	
OE—Lubricating Oil, Internal Combustion Engine OES—Lubricating Oil, Internal Combustion Engine (Subzero)	OE-30	OE-10	OES	BM . . . Bimonthly
GAA—Grease, Automotive and Artillery	GAA	GAA	GAA	S . . . Semiannually
OH—Hydraulic Fluid, Petroleum Base OHA—Hydraulic Fluid, Petroleum Base (Arctic)	OH	OH	OHA	
HB—Hydraulic Fluid, Non-petroleum Base, Automotive HBA—Hydraulic Fluid, Non-petroleum Base, Automotive (Arctic)	HB	HB	HBA	
SD—Solvent, Dry Cleaning	SD	SD	SD	

1. SHOCK-ABSORBER LINKAGE. Oil both sides of shock-absorber linkage.

2. WHEEL BEARINGS. S, remove the bearing cone assembly from the hub. Wash bearing cones, spindle, and inside of hub with SD and allow to dry. Coat spindle and cone of hub cap with GAA to a maximum thickness of 1/16 inch. Lubricate bearing with GAA with a packer or by hand, kneading lubricant into all spaces in the bearing.

3. UPPER AND LOWER FIFTH WHEELS, KINGPIN, AND RAMP. With dolly detached, clean, and using hand paddle, coat with GAA faces of both fifth wheels, the kingpin on the upper fifth wheel, and the ramp on the dolly.

4. SHOCK ABSORBER. M, remove plug and check amount of fluid in shock absorber. Shock absorber should be full. At subzero temperatures drain and fill with OHA.

5. MASTER BRAKE CYLINDER. S, remove plug and check amount of fluid in brake cylinder. Add fluid if necessary. At subzero temperatures drain brake fluid and flush system with Alcohol, denatured, grade III. Dry entire system with compressed moisture-free air. Fill brake system, including reservoir, with HBA. Check brake hoses, brake shoes, and wheel cylinders, which must be kept as dry as possible.

Copy of this lubrication order will remain with the equipment at all times; instructions contained herein are mandatory and supersede all conflicting lubrication instructions dated prior to the date of this lubrication order.

By Order of Wilber M. Brucker, Secretary of the Army:

Official:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Figure 13. Lubrication Order 10–1160.

Section V. ORGANIZATION MAINTENANCE

22. Responsibility

Responsibility for the performance of organization maintenance service rests with the commanding officer of the mobile petroleum laboratory. Such services are performed by the driver, laboratory personnel, or organization mechanic as assigned.

23. Records and Reports

Preparation of records and reports relating to the mobile petroleum laboratory is a responsibility of the commanding officer of the organization charged with the unit. Information concerning the forms to be used is contained in paragraph 3.

24. Lubrication

a. Lubrication maintenance services for semitrailer and dolly are prescribed in the lubrication order (fig. 13). The lubrication order is placed on the inside of the door of the utility compartment. Lubrication instructions on the lubrication order are binding on all levels of maintenance.

b. Service intervals specified on the lubrication order are for normal operating conditions and continuous use of the trailer. Time between service intervals should be reduced under extreme conditions, such as extremely high or low temperatures, prolonged periods of operation, operation in sandy or dusty areas, or exposure to moisture. Time between service intervals should be extended when equipment is not in use.

c. Lubricants are prescribed in the key and notes in accordance with three temperature ranges. The time to change grades of lubricants is determined by close observation of operation of the major items during the approach to changeover periods. Grades of lubricants are to be changed only when the surrounding temperature is regularly in the next higher or next lower range.

d. Lubricating equipment should be cleaned before and after use. Lubricating gun should be operated carefully to insure proper distribution of lubricant.

e. Lubrication fittings, grease cups, oilers, and oilholes are readily identified by reference to lubrication orders and illustrations (figs. 14–18). Lubricators and surrounding surface should be wiped clean before lubricant is applied.

f. Unless otherwise specified, use dry-cleaning solvent (Federal Stock No. 6850–264–9037 or 6850–285–8012) to clean or wash all parts. Use of gasoline for this purpose is forbidden. After washing, thoroughly dry all parts before applying lubricant.

25. Painting

All normally painted exterior surfaces of the mobile petroleum laboratory must be protected by paint at all times. For general painting instructions, refer to TM 9-2851.

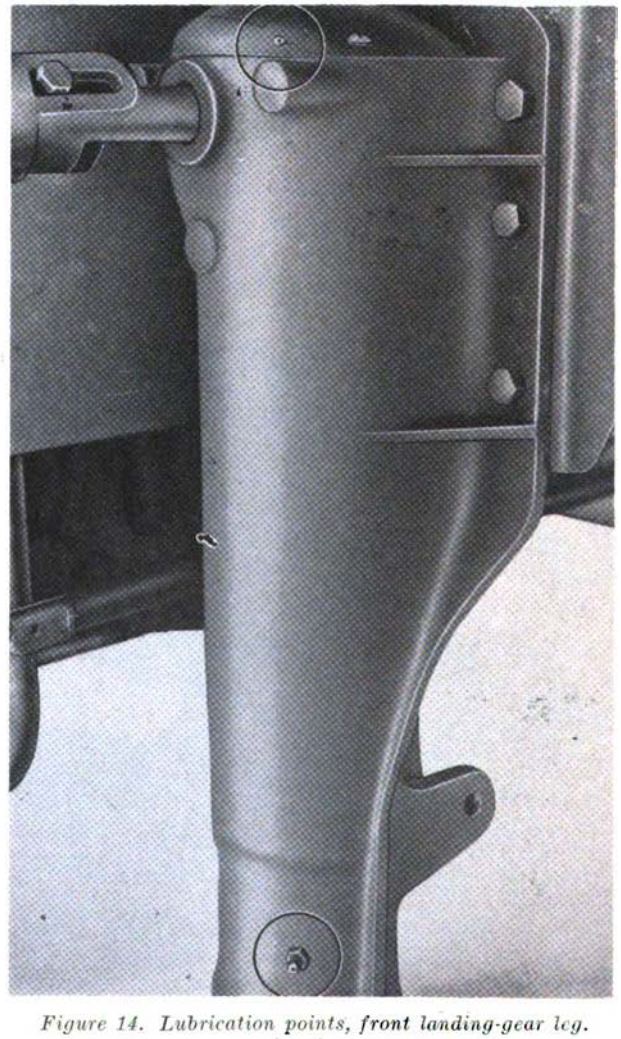


Figure 14. Lubrication points, front landing-gear leg.

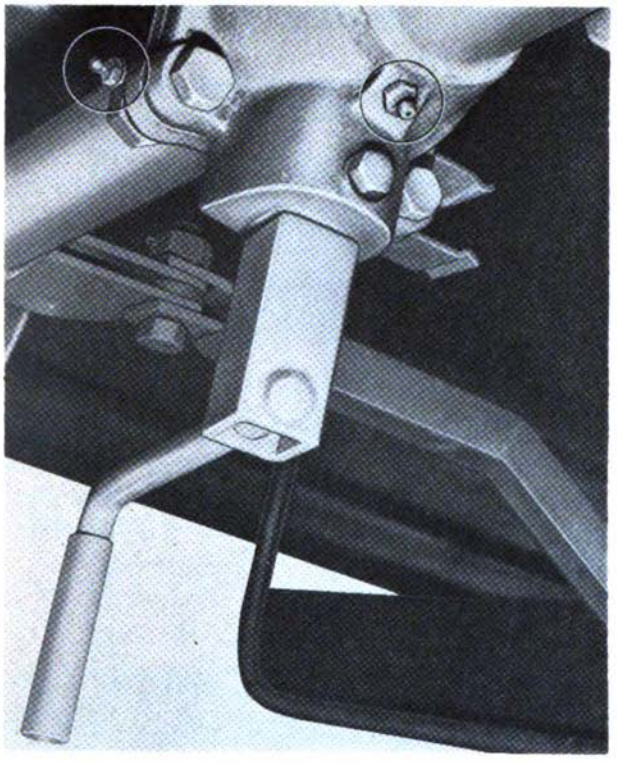


Figure 15. Lubrication points, rear leveling-jack operating shaft.

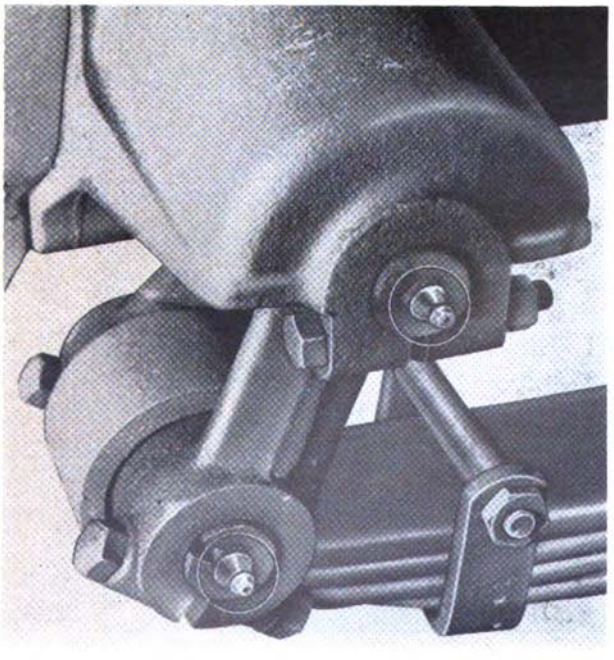


Figure 16. Lubrication points, spring pin and shackle.

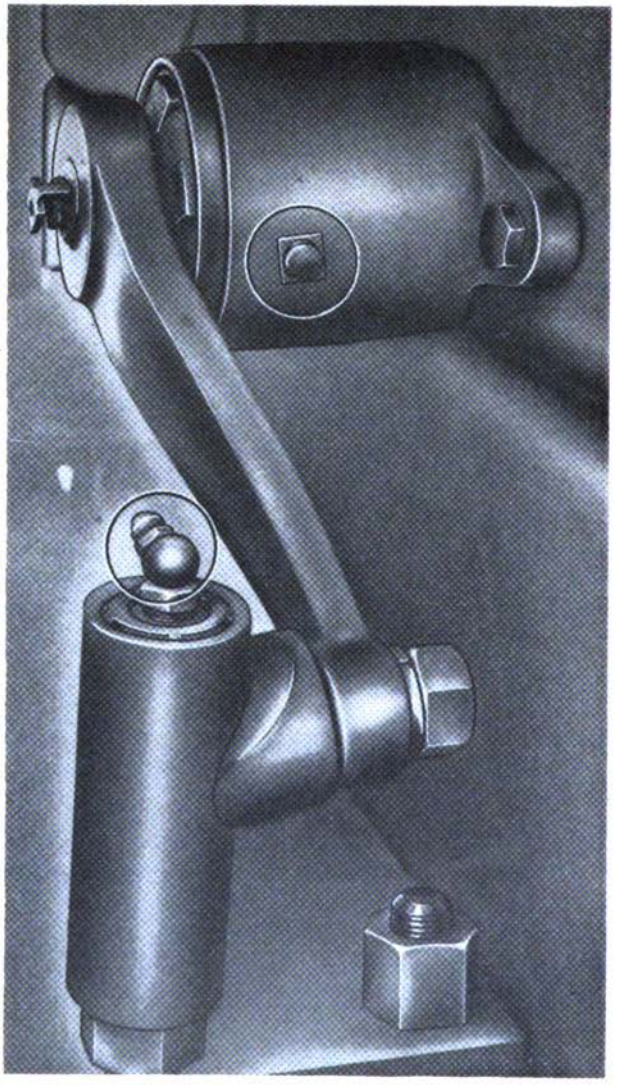


Figure 17. Lubrication points, shock absorber.

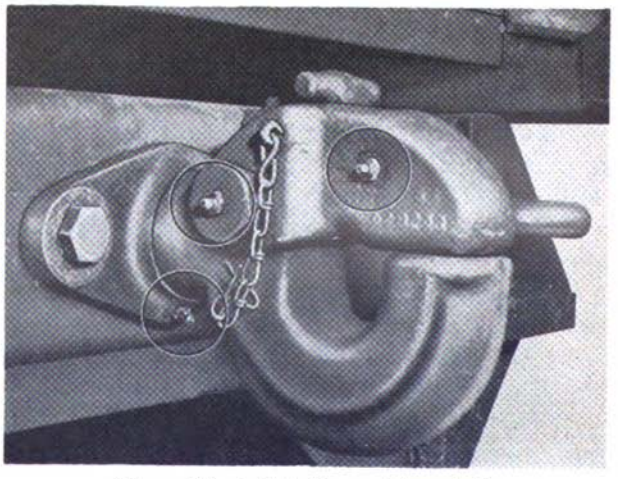


Figure 18. Lubrication points, pintle.

26. Preventive-Maintenance Services

a. Before-Operation Service. Components of the trailer are checked to see that they have not been damaged, tampered with, or sabotaged since the after-operation service was performed and to make sure that the trailer is in operating condition. Before-operation service consists of following the procedures described in (1) through (11) below and of correcting or reporting any deficiencies. Results of this service will be reported promptly to the designated person in authority.

(1) Examine airbrake reservoir tank, air lines, and connections for looseness or damage. If trailer is connected to towing vehicle, listen for air leaks. If dolly is not in use, be sure dolly airhose valve on semitrailer is closed.
(2) Clean all light lenses and warning reflectors and inspect units for looseness or damage. If towing vehicle is connected, open and close trailer light switches to see if lamps respond properly.
(3) See that all wheel and hub assembly mounting nuts are present and secure.
(4) Be sure all trailer tires are properly inflated. Remove foreign objects lodged in treads, on carcasses, or between dual wheels; inspect for damage.
(5) Examine springs, U-bolts, and shock absorbers for looseness or damage. Look for excessive spring sag or shifted leaves.
(6) Inspect all towing devices for looseness or damage.
(7) Examine racks and rear axle assembly mounting bolts for looseness. Make certain that spare tire and wheel, ladders, wheel chocks, and landing-gear supports are in their racks and secure.
(8) Examine leveling jacks and front landing gear to determine whether they operate freely or are damaged or bent.
(9) Examine fifth wheel, jaws and jaw release, and trailer kingpin for looseness or damage.
(10) Inspect trailer body for damage, rust, and absence of paint.
(11) Make certain all doors are properly closed and that all hatch covers are in place and secure.

b. During-Operation Service. While the trailer is in motion, be on the alert for unusual noises, such as rattles, knocks, squeaks, or hums, that may indicate trouble. Observe whether there is abnormal sag, sidesway, or drag that might indicate broken suspensions, disconnected towing equipment, or dragging brakes. Deficiencies noted by the following tests must be corrected at the earliest opportunity.

(1) Test brakes to determine whether they operate effectively or pull to one side.
(2) When at halt, place hand cautiously on each wheel hub and brakedrum to determine if they are abnormally hot.
(3) Examine the source of any peculiar odor that may be due to burning or friction.
(4) Listen for noises indicating looseness in any trailer component.

c. After-Operation Service. After-operation service on the trailer consists of correcting or reporting deficiencies found during operation. It also includes a thorough inspection of all parts of the trailer to detect any other deficiencies which may have developed while the trailer was in transit and the correction of any such deficiencies.

27. Maintenance Chart

Table I (Maintenance Chart) should be referred to by persons responsible for performing organization maintenance.

Table I. Maintenance Chart

Interval			Maintenance
Weekly	Monthly	Semi-annually	
	X		AIRBRAKES *Airbrake system leaks.* Test airbrakes for leaks with air pressure at governed maximum. With all brakes applied and engine stopped, there should not be a noticeable drop in pressure within 1 minute. If any pressure drop occurs during this check,test system for leaks

Table I. Maintenance Chart—Continued

Interval			Maintenance
Weekly	Monthly	Semi-annually	
			by soapsuds method. Open drain cocks on semitrailer air reservoir and drain condensate.
	X	--------	*Brake lines.* Examine all lines and fittings and airbrake hose to see if they are in good condition, securely connected, and supported so that lines or hose will not chafe against other vehicle parts.
	X	--------	*Brakeshoes.* Without removing drums, examine brake linings through inspection holes to see whether they are worn to such extent that rivet heads may contact drums within next 1,000 miles of operation. If trailer has been operated in deep water, mud, or loose sand, remove a wheel and drum and examine lining for damage. If lining must be replaced, remove other wheels also, and service brakes in a like manner, being sure to clean, lubricate, and adjust all removed wheel bearings.
		X	Remove wheels and drums and inspect linings to see that they are in good condition, tightly secured to brakeshoe, in good contact with drums, and not excessively worn. Clean all dirt and grease from linings with wire brush, cloth, or compressed air. Check to see that shoes are in good condition, properly secured to anchors and retracting spring, and that springs have sufficient tension to return shoes properly to released position.
		X	*Brakedrums.* Remove drums and clean all dirt and grease from inside drums, supports, and dust shields. Inspect drums for scores inside surfaces and cracks or distortion.
	X	--------	*Reservoir.* Inspect for loose mountings and connections and for indications of damage or leaks. Open drain cocks and drain off water and sediment.
			MECHANICAL BRAKES
	X	--------	Inspect mechanical brake lever and all linkage to be sure they are in good condition, correctly assembled, securely supported and connected, and not excessively worn. Make certain that mechanical brake lever holds parking brakes in applied position.
			BODY AND CHASSIS
	X	--------	Lubricate, following instructions outlined in LO 10–1160 (fig. 13).
X	--------	--------	If conditions permit, wash trailer. Keep water out of wheel bearings and brakes. Do not rub painted surfaces enough to create shine.
			DOLLY FIFTH WHEEL
	X	--------	Examine fifth-wheel unit on dolly to make certain it is in good condition and correctly assembled. Tighten all assembly and mounting nuts. Inspect all accessible friction surfaces, jaws, and kingpin latch assembly for damage or excessive wear. clean rocker, base plate, and kingpin latch mechanism thoroughly and lubricate according to LO 10–1160 (fig. 13). Make certain that kingpin latch mechanism operates freely and lever latch locks securely.
			MOUNTINGS
X	--------	--------	Inspect towing devices, racks, and axle suspension mounting nuts to make sure they are secure and undamaged. Inspect semitrailer kingpin and upper fifth-wheel plate for damage, excessive wear, and secure mountings.
			SHOCK ABSORBERS AND LINKS
	X	--------	Check to see that shock absorber bodies are fastened to frame, that links which

Table I. Maintenance Chart—Continued

Interval			Maintenance
Weekly	Monthly	Semi-annually	
			connect their arms to the axle are in good condition and secure, and that there are no fluid leaks.
			SPRINGS
X			Tighen shackles, spring clips, and U-bolts.
	X		Check springs to see that they are in good condition, and correctly assembled. Check position of clips, bolts, and leaves; shifted spring leaves may indicate sheared center bolt. Using a pry bar, test the hangers and bolts for excessive wear.
			TIRES
	X		Examine dolly and semitrailer tires for damage and excessive wear, and replace badly worn tires. Observe tires for excessive wear caused by mechanical defects. Observe condition of valve stems and presence of valve caps. Hand-tighten loose valve caps. Make sure that all rims, rim-lock rings, or flanges are in good condition and secure.
			WHEELS
	X		Revolve wheels while listening for evidence of dry or damaged bearings. Check for looseness of wheel-bearing adjustment. Check areas around flanges and brake supports for presence of lubricant leaks. Observe condition of flanges. Check nuts for tightness.

28. Troubleshooting Chart

Table II (Troubleshooting Chart) should be used as an aid in determining the probable causes of troubles occurring in the operation of trailer with dolly or semitrailer without dolly.

Table II. Troubleshooting Chart

Trouble	Possible cause	Remedy
Braking System:		
No brakes	Source of air supply shut off at towing vehicle.	Open cutout cocks at rear of towing vehicle.
	Air jumper hose between truck and trailer not properly coupled.	Make certain service air jumper hose is connected to service coupling, and emergency to emergency coupling.
	Low brake-line pressure.	Check air-pressure gage on towing vehicle. Run motor on towing vehicle until pressure builds up to 120 pounds.
	Reservoir drain cock open.	Close reservoir drain cock.
	Trailer-to-dolly airbrake valve open when dolly not used.	Close valve.
Brakes running hot.	Improper adjustment.	Adjust brakes.
	Broken release spring in drum.	Replace spring.
	Brake assembly binds.	Lubricate.
	Bent chamber push rod.	Replace brake chamber.
	Drum out of round.	Replace drum.
Slow brake application, or slow release.	Low brake-line pressure.	Check air-pressure gage on towing vehicle. Run motor on towing vehicle until pressure builds up to 120 pounds.
	Excessive travel in cylinder push rod.	Adjust brakes.
	Restriction in tubing.	Check for kinked or dented tubing. Replace or repair.
	Lack of lubrication.	Lubricate brake assembly.
Drop in air pressure.	Leakage in relay valve.	Repair or replace relay valve.
	Leakage at tubing connecters.	Tighten connector bodies and nut.

Table II. Troubleshooting Chart—Continued

Trouble	Possible cause	Remedy
	Leakage at service or emergency line couplings.	Replace coupling.
Intermittent brakes.	Grease on lining, caused by overlubrication.	Replace lining.
	Brake out of adjustment.	Adjust brakes.
	Scored brakedrum.	Replace drum.
	Improper lining	Use specified lining.
	Wheel bearings out of adjustment.	Adjust wheel bearings.
Brakes do not release.	Brake system improperly connected from towing vehicle.	Connect lines properly.
	Brake control in applied position at towing vehicle.	Place control in released position.
	Relay emergency valve in emergency position.	Build up pressure at towing vehicle or open drain cock at reservoir.
	Cutout cocks closed on towing vehicle.	Open cutout cocks.
	Restriction in tubing or hose.	Check all tubing and hose. Repair or replace.
Axle Suspension:		
Shifted spring.	Broken spring center bolt.	Replace spring center bolt.
	Clip bolts missing or broken.	Repair or replace.
	Loose U-bolts	Tighten U-bolts.
Uneven riding.	Broken spring leaves.	Replace spring leaves.
	Main or auxiliary spring has lost its arch.	Replace main or auxiliary spring.
	Shock absorber not functioning properly.	Replace shock absorber.
Excessive noise.	Worn pins or bushing.	Replace with new parts.
	Loose shackles, U-bolts, or spring clips.	Tighten.
	Loose shock absorber.	Tighten linkage and mounting bolts.
Springs too flexible.	Broken spring leaves.	Replace broken leaves.
	Overlubricated	Lubricate as specified by LO 10-1160 at time of next scheduled lubrication (fig. 13).
	Lack of fluid in shock absorber.	Refill.
	Shock absorber not operating.	Remove and inspect for broken parts. Repair or replace.
	Broken spring-leaf clips.	Place leaves in alinement and install new clips.
Front Landing Gear:		
Operating crank hard to turn.	Lack of lubrication or use of improper lubricant.	Lubricate according to LO 10-1160 (fig. 13).
	Bent operating shaft.	Straighten or replace.
	Bevel gear worn	Replace bevel gear.
	Bevel-gear shaft screw bent.	Disconnect bevel-gear shaft. Replace bent screw.
	Lower leg bent, causing bind in frame bracket.	Replace lower leg.
Landing gear does not respond when crank is turned.	Bolt missing in operating shaft or in bevel-gear shaft.	Replace missing bolt.
	Woodruff key is sheared in bevel-gear shaft.	Replace woodruff key.
	Feather key sheared in screw.	Replace feather key.
Wheels and Hubs:		
Wobbly wheel.	Loose wheel stud nuts.	Tighten.
	Inner or outer wheel bearings burned out.	Replace wheel bearings.
	Bent axle	Check axle for bend. Replace if bent.
Hot hub	Lack of lubrication.	Lubricate.
	Damaged bearing or cup.	Replace bearing or bearing cup.
	Improper wheel-bearing adjustment.	Adjust wheel bearings.
Semitrailer wheels not tracking with those of dolly or towing vehicle.	Axle out of alinement.	Realine axle.
	Rear axle suspension to semitrailer skid base loose.	Tighten bolts.
Oil or grease in brakedrum or on outside of wheel.	Defective grease retainer.	Replace grease retainer.
	Cracked hub	Replace hub.
	Improper or excessive lubrication.	Relubricate properly or remove excess lubrication.

Table II. Troubleshooting Chart—Continued

Trouble	Possible cause	Remedy
Tires:		
Excessive tire wear.	Overinflation or underinflation.	Inflate to correct pressure.
Inner tires wearing more rapidly than outer tires.	Axle out of camber.	Replace axle.
	Bent axle spindle.	Replace axle.
Outer tires wearing more rapidly than inner tires.	Too much camber in axle.	Replace axle.
All four tires wearing uneven and cupping.	Axle out of alinement.	Realine axle.
	Bent axle	Replace axle.
Fifth Wheel:		
Excessive lash or end play between fifth wheel and kingpin.	Fifth-wheel jaws worn.	Replace jaws.
	Semitrailer kingpin worn.	Replace kingpin.
	Fifth wheel loose in its mountings.	Tighten mounting bolts.
Uncoupling difficulties.	Plunger lock binding in jaws.	Move towing vehicle closer to semitrailer.
	Fifth-wheel jaws bent.	Replace jaws.
	Bent or damaged plunger on fifth wheel.	Replace plunger.
	Lack of lubrication.	Lubricate jaw pins and place several drops of oil on plunger.
Electrical System:		
Lights will not burn.	Jumper cable not plugged into trailer from towing vehicle.	Plug in jumper cable.
	Battery of towing vehicle not fully charged.	Check battery of towing vehicle and charge.
	No current from towing vehicle.	Check wiring on towing vehicle.
	Broken or damaged wires.	Replace or repair wiring.
Dim lights.	Dirty or corroded contact blades in coupling socket or jumper cable.	Clean blades.
	Dirty lens	Clean lens.
	Battery at towing vehicle not fully charged.	Check battery at towing vehicle, charge.
	Dirty or corroded lamp sockets.	Remove lamp unit and clean.
Defective lighting.	Burned out lamp unit.	Replace lamp unit.
	Broken wire	Repair or replace.
	Damaged light assembly.	Replace light assembly.
	Dirty or corroded lamp socket.	Remove lamp unit and clean.

CHAPTER 3
LABORATORY UTILITIES

Section I. GENERAL

29. Laboratory Electrical System

The electrical system described in this paragraph is related only to operation of electrical equipment within the laboratory (fig. 19) and is not related to the trailer electrical system for operation of taillights, stoplights, etc. (par. 10).

a. General. Electric power for the laboratory is supplied by a line providing 220-volt, 3-phase, 60-cycle, alternating current. Outside power is connected to the laboratory at the 4-pole receptacle box located in the left side of the trailer directly above the rear wheels. Inside the trailer, wiring is arranged to provide the following types of current:

(1) *Single-phase, 2-wire, 110-volt.* Provides current for operating all lights and equipment, except as noted in (2) and (3) below.

(2) *Three-phase, 3-wire, 220-volt.* Provides current only for operating the synchronous motor of the knock-testing engine and air-conditioning unit when required.

(3) *Single-phase, 2-wire, 220-volt.* Provides current only for operating the elements of the electric space heater.

b. Source. Normally, a portable generator set, gasoline-engine-driven, liquid-cooled, 60-cycle, 120/208–240/416-volt, 30-kw., 3-phase, 4-wire, is issued as the power source for the mobile petroleum laboratory. However, any suitable power source such as powerlines at a depot or other permanent installation, or another portable generator set may be used when the line has the prescribed characteristics (*a* above). (Generator sets are Engineer Corps items. For operation and maintenance instructions refer to applicable publications (app. I).)

c. Master Switches. Two master switchboxes are located in the rear compartment. The switchbox at the left controls the 110-volt circuits; the box at the right controls the 220-volt circuits. ON-OFF positions are marked on each box. Each switch is provided with protection against current overload by a circuit breaker that automatically opens contacts in case of overload. The 110-volt circuit breaker opens when current load exceeds 200 amperes; the 220-volt circuit breaker opens at loads exceeding 225 amperes.

d. Circuit Breaker Switches. Individual circuit breaker switches (figs. 19 and 20), located on the wall above the master switches, further protect each circuit against current overload. Each circuit breaker switch is numbered and labeled to correspond with the equipment it controls, as shown in figures 19 and 20. Each circuit breaker switch has its load capacity indicated on the circuit breaker switch assembly cover. Any current exceeding rated capacity for any particular circuit breaker switch causes switch to open circuit. After overload cause has been determined and corrected, the switch must be closed again before resuming operation. All circuit breaker switches must be kept in OFF position except when circuits are in use.

Note. In mobile laboratories equipped with gasoline space heaters, circuit breaker switches 6 and 7 are spare, switch 21 controls water pump, and switches 23, 25, 27, and 29 are not included.

e. Main Control Panel. The main control panel (fig. 21), located on the left rear wall of the laboratory compartment, contains controls and instruments for the laboratory utilities.

(1) *Controls.* The control panel contains toggle switches for controlling space-

heater blower, vacuum pump, air compressor, refrigerator, water pump, blackout lights, main ceiling lights, and space heater. The item controlled and the ON and OFF positions are indicated for each switch. Operating instructions for switches are described in pertinent paragraphs in section II of this chapter.

(2) *Instruments.* The control panel includes a voltmeter, ammeter, and frequency meter to indicate characteristics of the 110-volt current being used by the mobile laboratory. The voltmeter and the frequency meter are used as a check on current being furnished the laboratory by the generator, to assure that current, alternating at a frequency of 60 cycles per second, is supplied at a power differential of 110 volts at all times. The ammeter indicates in amperes the total amount of current being used at any particular time by laboratory and utility equipment. The air-compressor gage and the vacuum-pressure gage indicate pressures in the compressed-air line and in the vacuum line (par. 30).

f. Fume-Hood Control Panel. The fume-hood control panel is located at the space-heater intake register in the side of the left workbench near the front of the laboratory compartment. It contains ON-OFF toggle switches for the fume-hood exhaust blower and the refrigerator auxiliary blower, and the light switch for the fume-hood light. The two blower switches are provided with red pilot lights that remain on while blowers are operating.

g. Motor Starter-Relay Boxes. The air-compressor, vacuum-pump, and water-pump motors, and the electric elements on the space heater are provided with starter-relay boxes located near the equipment in the utility compartment. Each starter relay is a magnetic contactor that completes the circuit to the motor when the ON-OFF switch on the control panel is closed. A current-overload thermal cutout switch designed to break the circuit in case of current overload is included in each relay box. After the cutout switch opens, it is reclosed by depressing the reset button located on the front of each box. Overload cause must be determined and corrected before resuming operation.

h. Lighting. Each trailer compartment is equipped with fluorescent ceiling lights and small red blackout lights (fig. 22). The laboratory compartment contains nine 30-watt fluorescent lamps, one 15-watt fluorescent lamp (in the fume hood), and four 6-watt blackout lamps. The rear compartment contains two 15-watt fluorescent lamps and one 6-watt blackout lamp. The utility compartment contains two 30-watt fluorescent lamps and one 6-watt blackout lamp. All lights are controlled by the main light switch on the control panel and by circuit breaker switch 1. In addition, ON-OFF switches are included to control lights in the rear compartment and in the utility compartment. The blackout-light circuit is designed so that, when any one of the three doors in the trailer is opened, all fluorescent lights go off and the blackout lights come on. The blackout lights remain on until all doors are closed, at which time the fluorescent lights come back on. Microswitches, located in each of the three outside doorjambs, actuate the circuit. When the blackout switch on the control panel is in the OFF position, current bypasses the microswitches permitting uninterrupted operation of fluorescent lights regardless of position of doors. The blackout switch should be kept in the OFF position except in areas subject to enemy observation or attack.

i. Receptacles. The laboratory compartment is provided with eight 110-volt dual receptacle boxes: 4 along the left wall, 3 along the right wall, and 1 in the fume hood. Another receptacle box is mounted between the two master switches in the rear compartment. Each receptacle box can accommodate two 2-prong electrical plugs. Current to receptacles is controlled by circuit breaker 2.

30. Piping Systems

Piping systems constructed of ⅝-inch copper tubing supply the laboratory compartment with gases and fluids required for performing tests. All piping systems (fig. 23) originate at equipment in the utility compartment (figs. 24 and 25), except the gas-cylinder systems, which originate in the rear compartment. Each piping system is provided with valves located along the walls of the laboratory compartment.

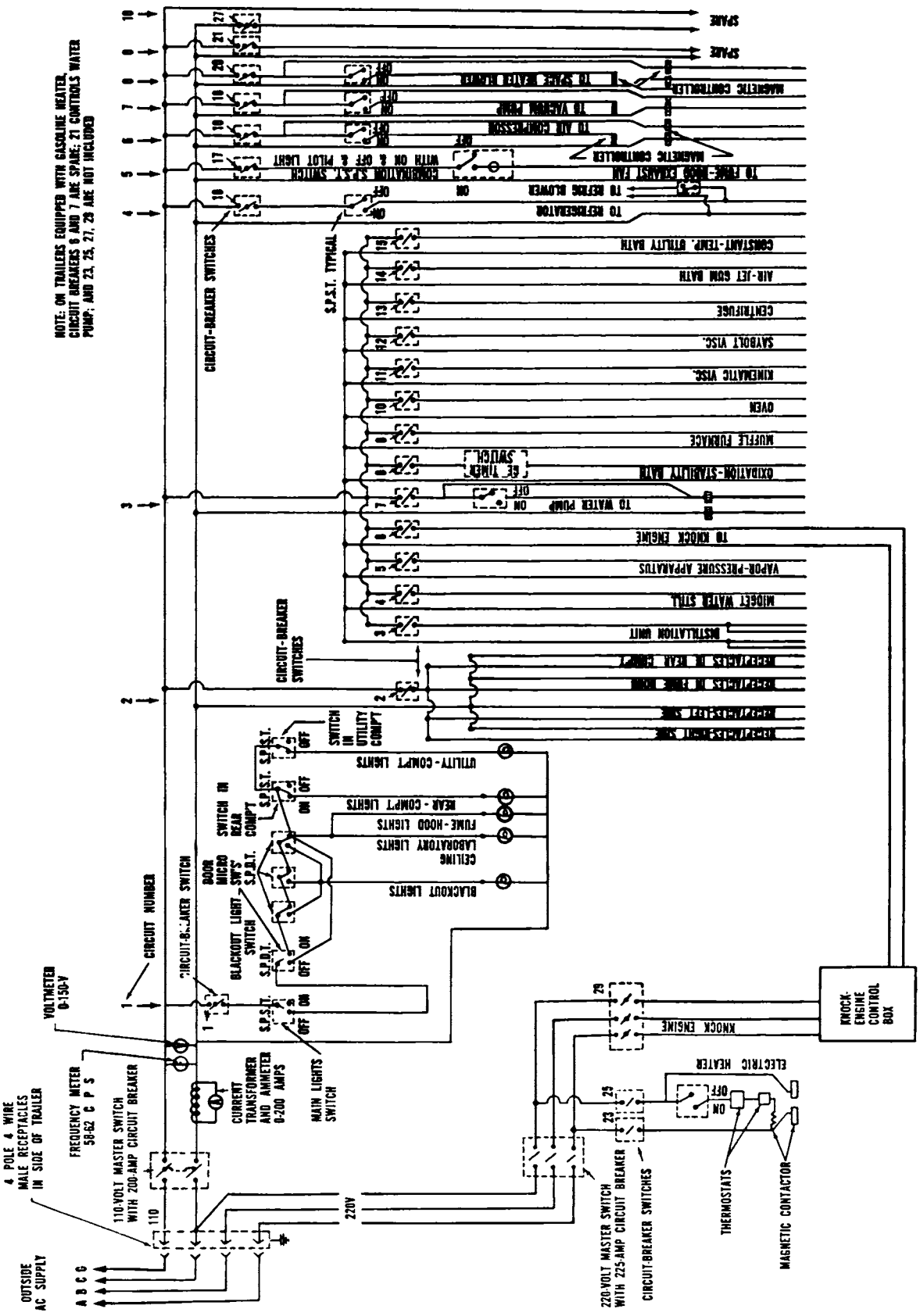
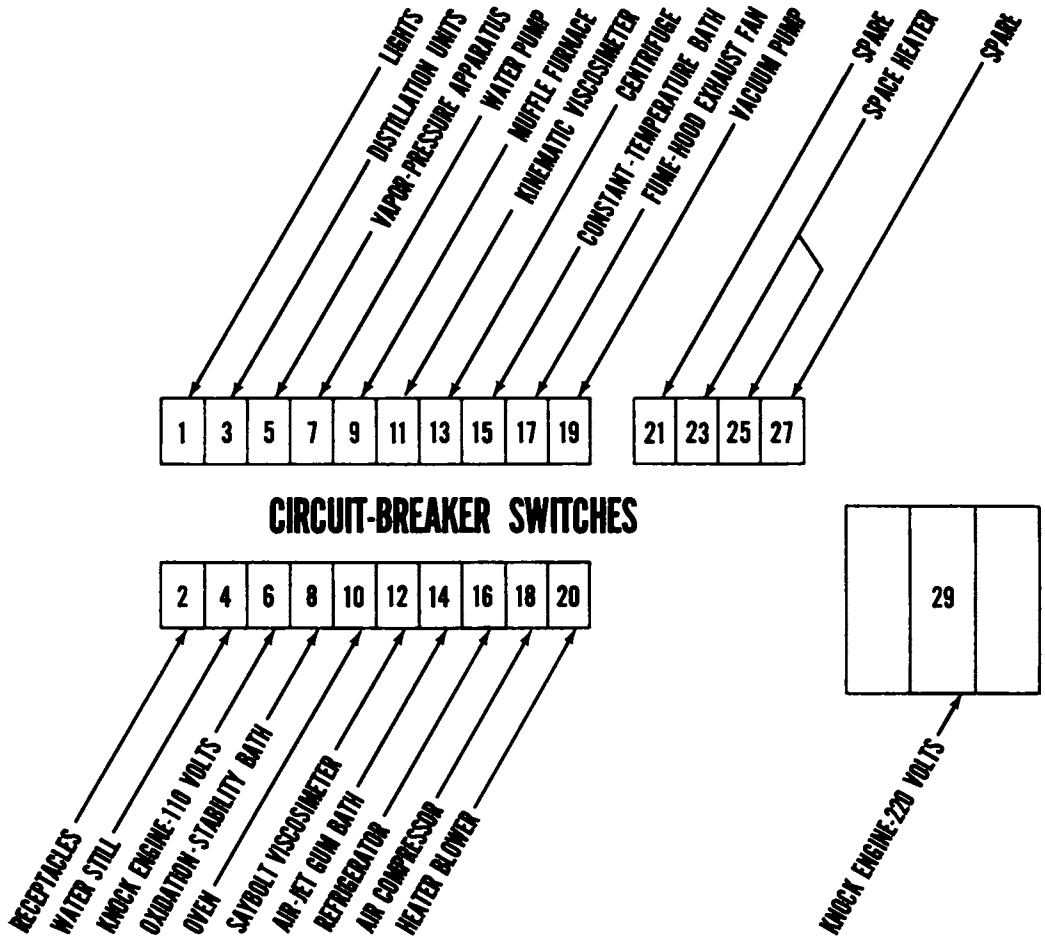


Figure 19. Laboratory electrical system (schematic diagram).



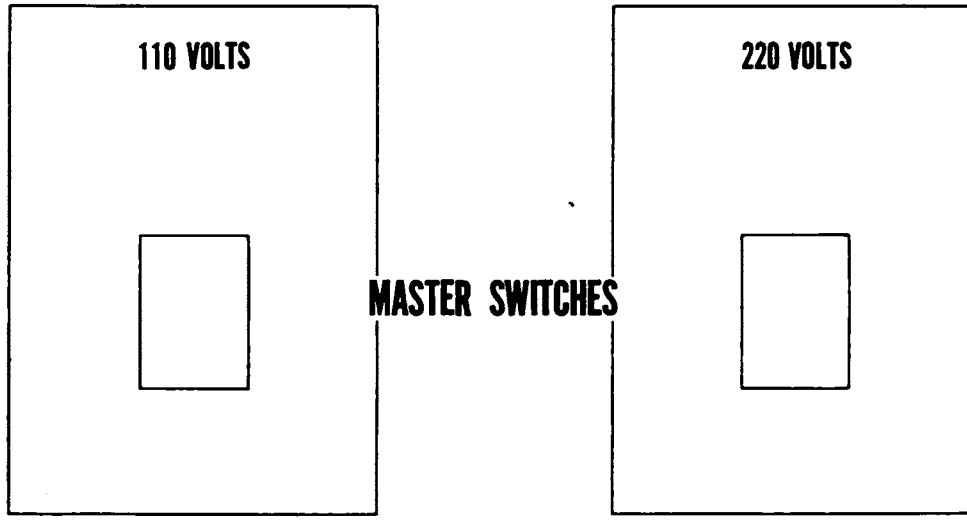


Figure 20. Master switches and circuit breakers (plan).

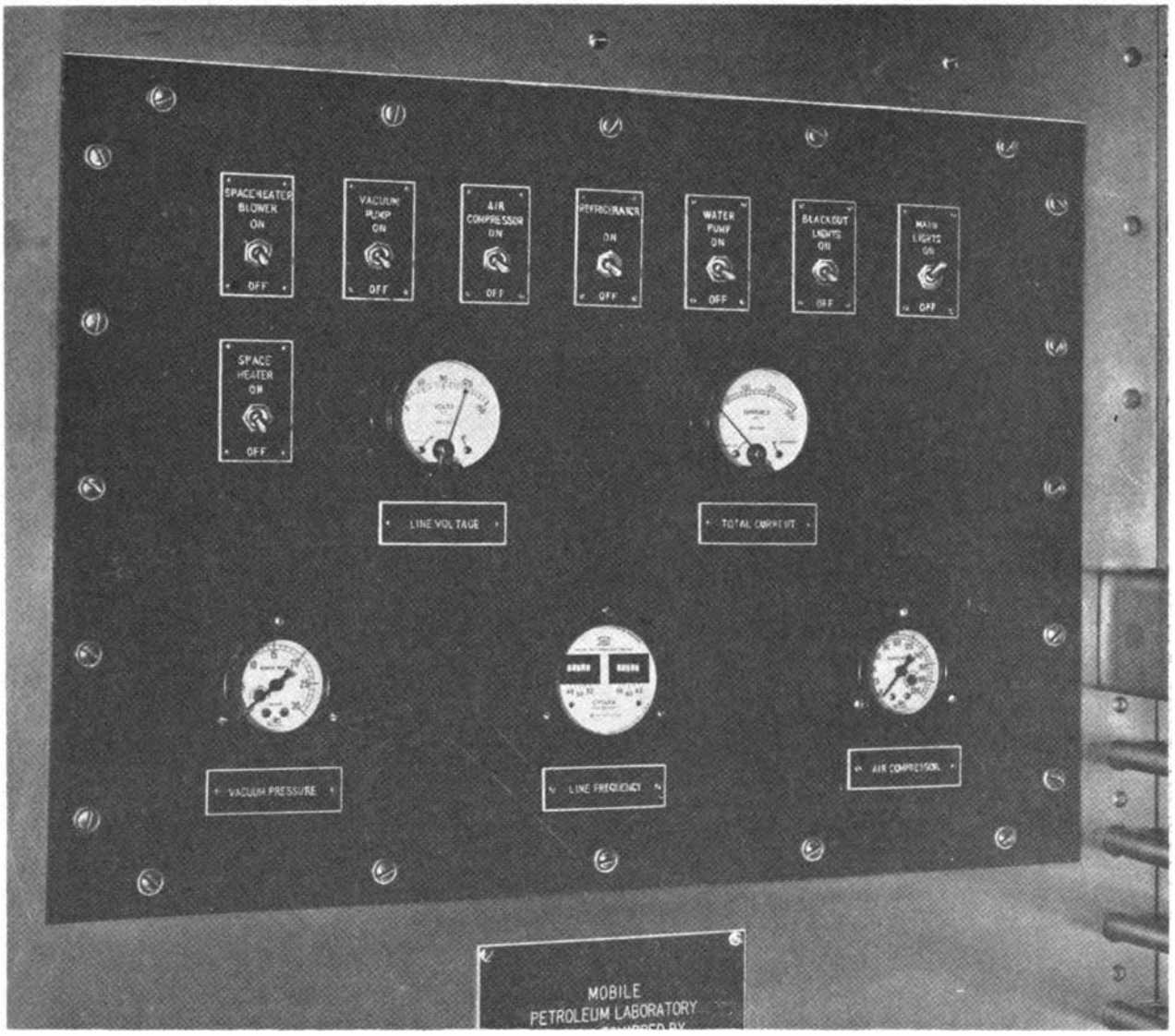


Figure 21. Main control panel.

a. Water. The water system originates at the water pump (par. 31) in the utility compartment. The system consists of a water supply line, a water return line, and a water tank. The water supply line pipes water to all parts of the laboratory compartment. The line is provided with 7 outlet valves, which include 3 on the left wall, 3 on the right wall, and 1 in the rear compartment. An eighth outlet valve is provided in the fume hood in some laboratories. The water return line pipes water to the water tank. The return line is also useful in carrying off water discharged from condensers and other apparatus that require constant water circulation. The return line is provided with 4 inlet valves on the left wall and 1 inlet valve in the fume hood.

b. Compressed Air. The compressed-air system originates at the compressed-air tank (par. 34) in the utility compartment. The air line is provided with 6 outlet valves, which include 3 on the left wall, 2 on the right wall, and 1 in the fume hood. Five additional outlet valves are located on the right wall for the purging manifold for the vapor-pressure bath apparatus. The compressed-air line on the left side of the laboratory compartment terminates in a copper tube connected to the pressure gage in the main control panel.

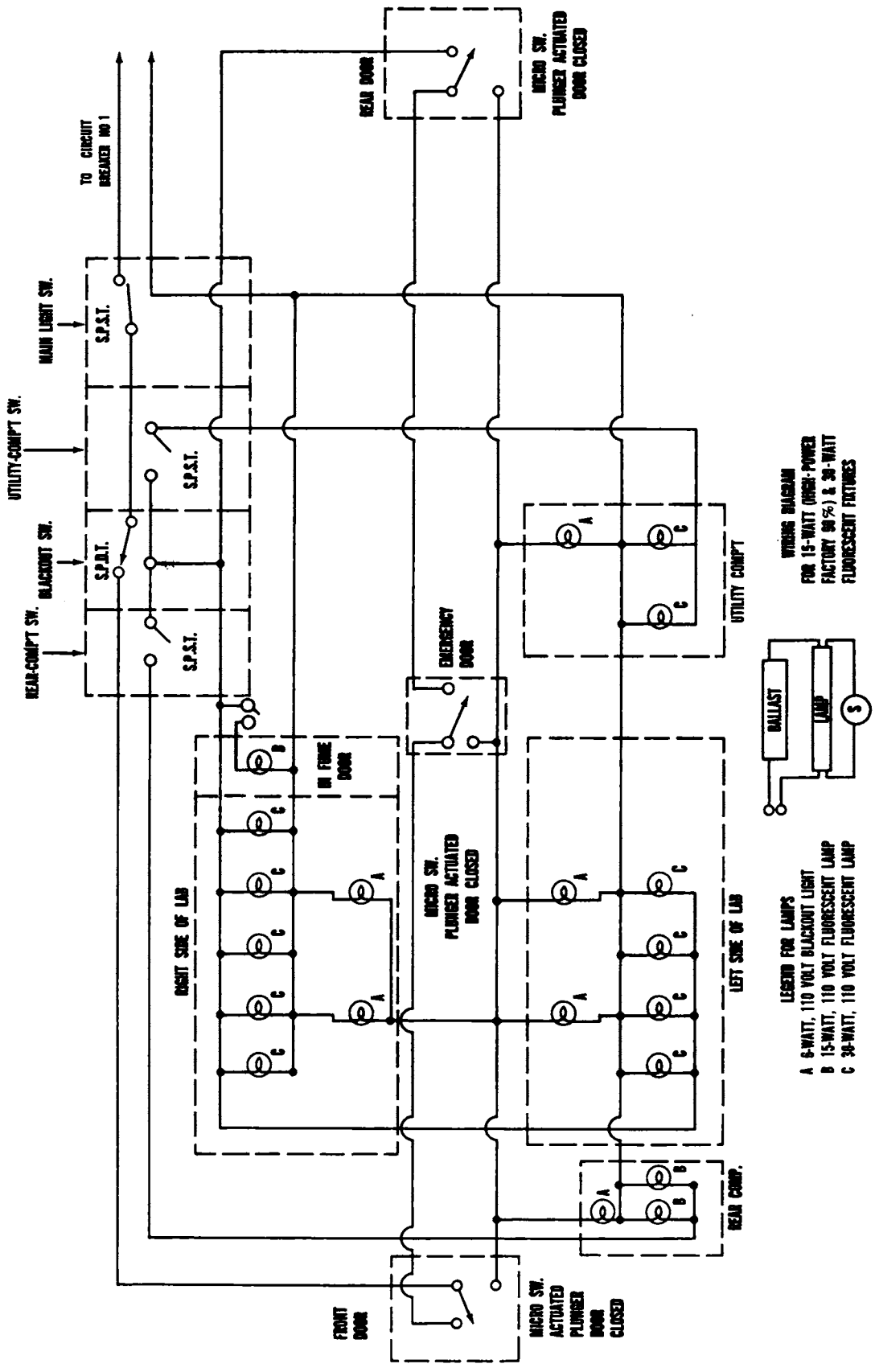


Figure 22. Laboratory lighting system (schematic diagram).

c. Vacuum. The vacuum system originates at the vacuum pump (par. 35) in the utility compartment. The vacuum system is provided with 3 inlet valves on the left wall and with 1 inlet valve in the fume hood. The line terminates in a flexible copper tube connected to the vacuum gage in the control panel.

d. Propane. The propane-gas system originates at the propane-gas cylinder (par. 38) in the rear compartment. Propane is used to operate bunsen burners in the mobile laboratory. The system is provided with 2 outlet valves on the left wall, 1 valve on the right wall, and 1 valve in the fume hood.

e. Oxygen. The oxygen line originates at the oxygen gas cylinder (par. 38) in the rear compartment. One outlet, located on the partition wall above the oxidation-stability bath, is provided.

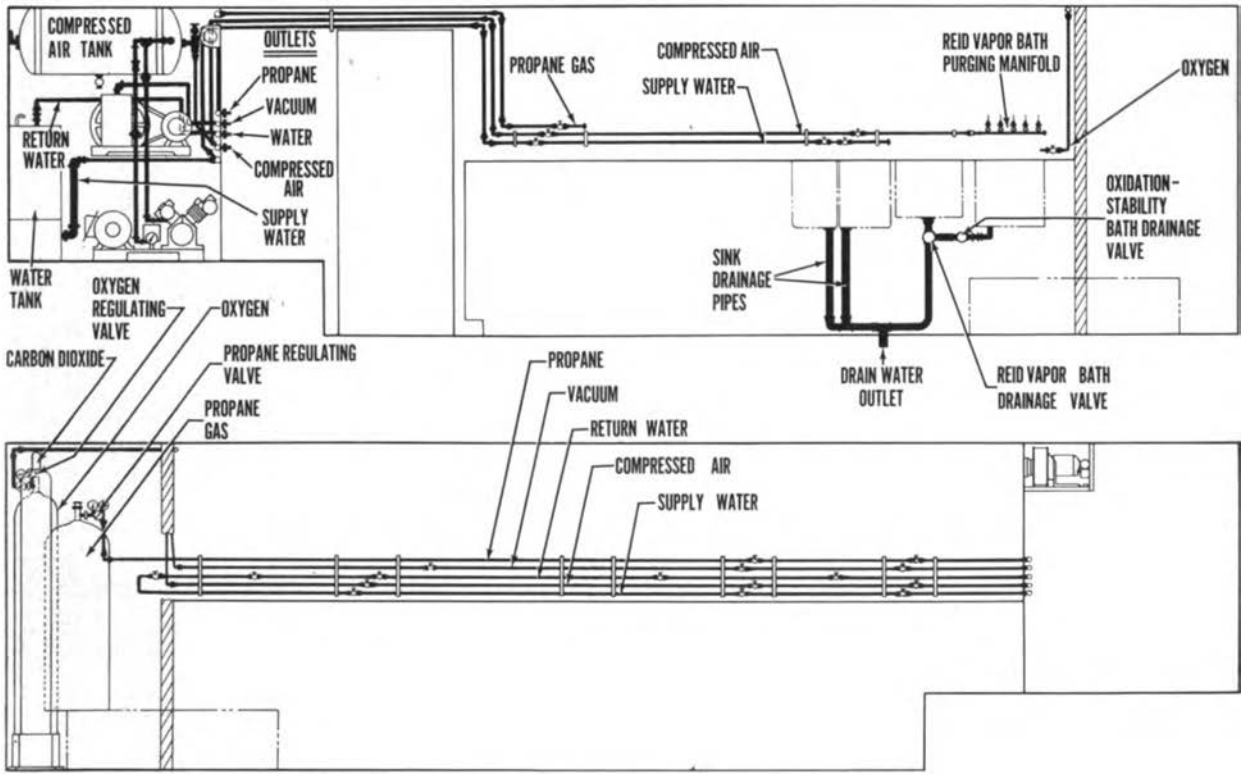
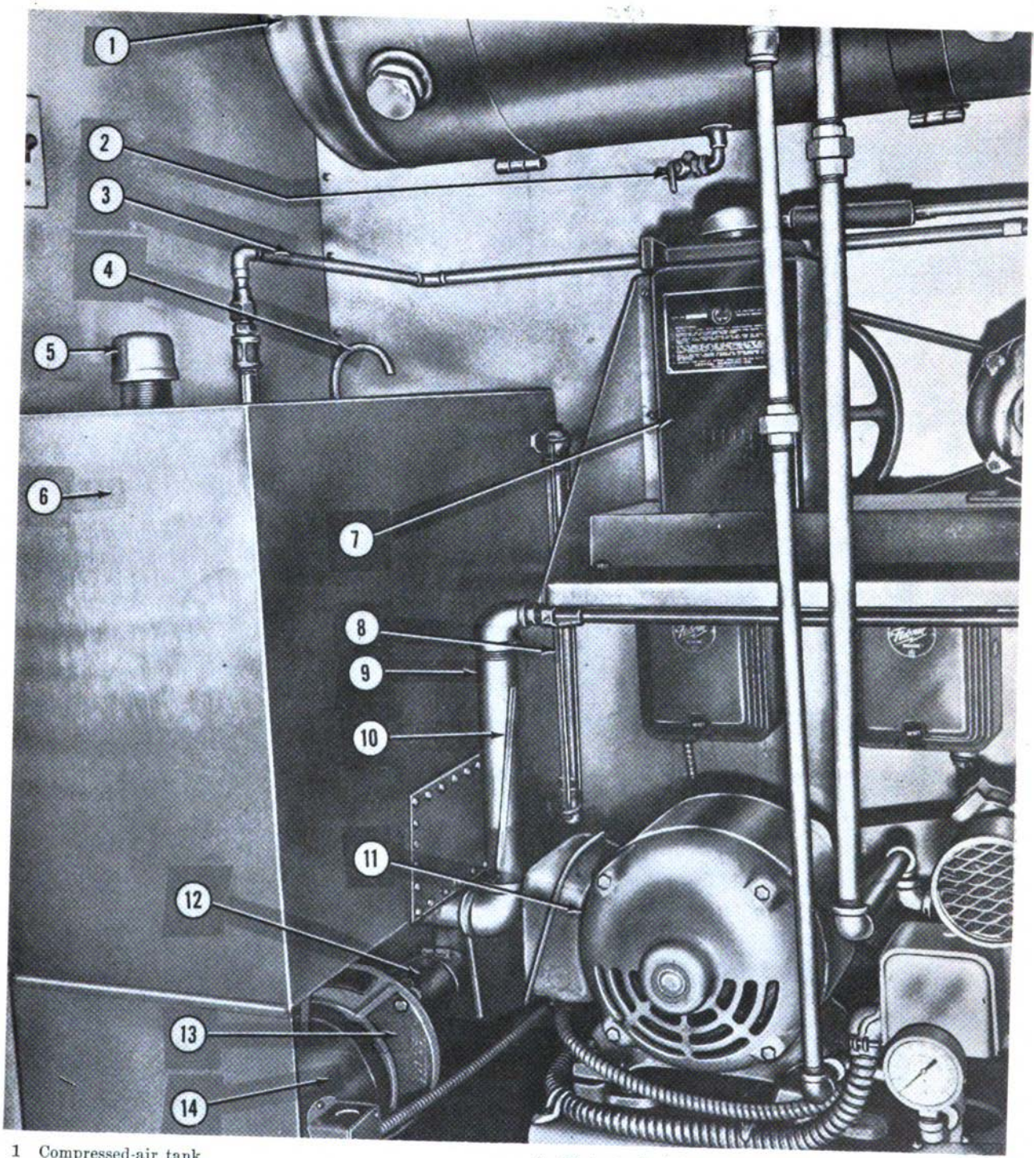


Figure 23. Utility piping system (schematic diagram).



1 Compressed-air tank
2 Air-tank drain cock
3 Water return line
4 Water-tank overflow pipe
5 Water-tank fill cap
6 Water tank
7 Vacuum pump
8 Water-tank sight level glass
9 Water-pump discharge line
10 Thermometer
11 Air-compressor motor
12 Water-pump suction line
13 Water pump
14 Water-pump motor

Figure 24. Utility compartment (right front corner).

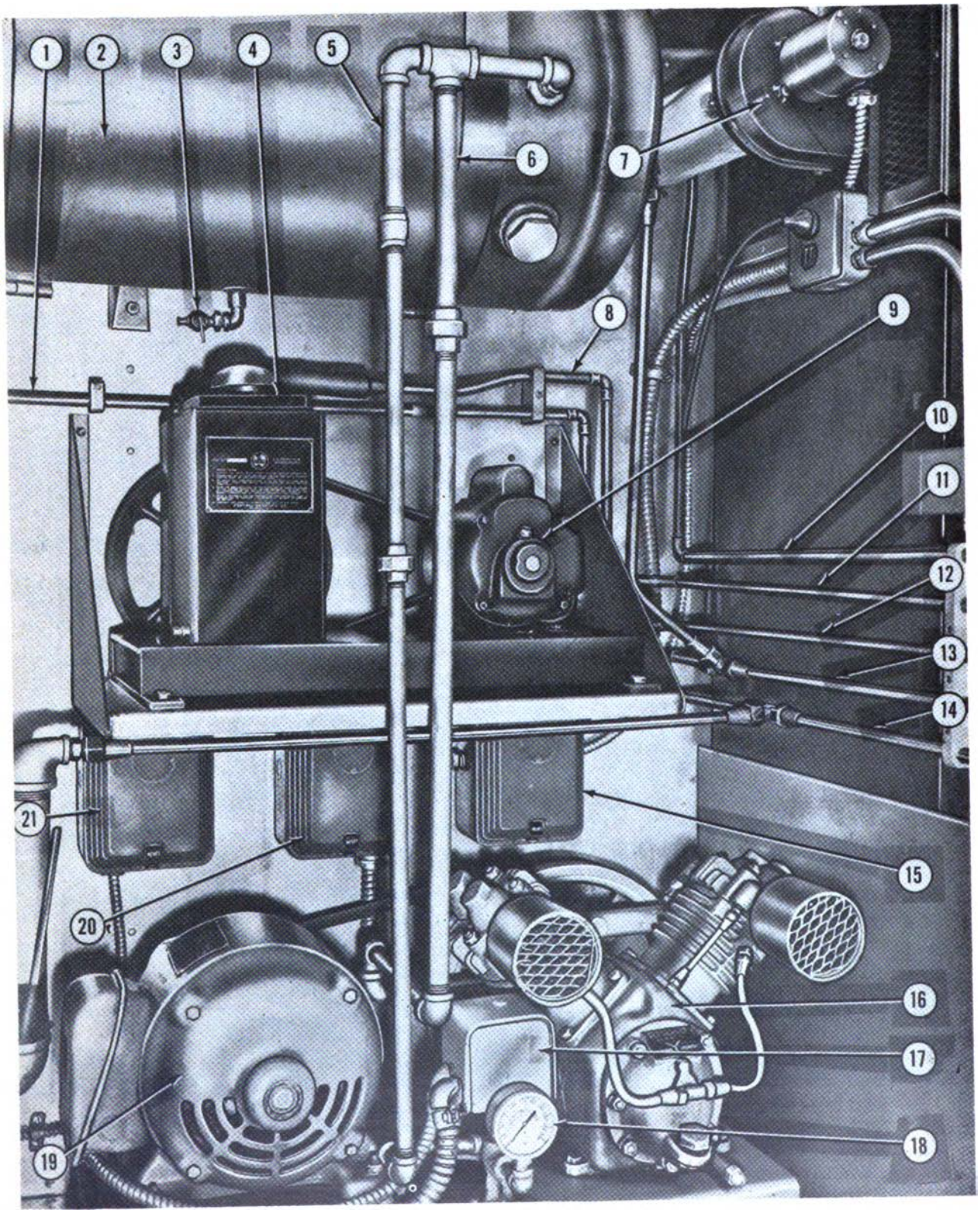


Figure 25. Utility compartment (right rear corner).

1 Water return line
2 Compressed-air tank
3 Air-tank drain cock
4 Vacuum pump
5 Pressure return pipe
6 Compression-tank pipe
7 Refrigerator condenser blower
8 Vacuum line
9 Vacuum-pump motor
10 Propane-gas line
11 Vacuum line
12 Water return line
13 Compressed-air line
14 Water supply line
15 Vacuum-pump-motor starter-relay box
16 Air compressor
17 Air-pressure switch
18 Air-pressure gage
19 Compressor motor
20 Compressor-motor starter-relay box
21 Water-pump-motor starter-relay box

Figure 25—Continued.

Section II. EQUIPMENT OPERATION AND MAINTENANCE

31. Water Pump

a. Description. The water pump (figs. 24 and 26) is a 10-gallon-per-minute centrifugal pump driven by a 3-horsepower electric motor. The pump impeller is attached directly to the end of the motor drive shaft. The pump housing, which is bolted to the motor housing, is provided with a mechanical spring-loaded shaft seal to prevent leakage around the shaft. Pump and motor are bolted to the floor beneath the water tank, to which the suction inlet of the pump is connected. The pump discharge outlet is connected to the water supply line in the laboratory compartment. At the top of the water tank is a 2-inch fill pipe with protective cap and a curved vent tube. The tank is fitted with a flanged cleanout plate. Both pump and tank are provided with drain plugs.

b. Data.

Pump:
- Manufacturer—Peerless Pump Div., Food Machinery and Chemical Corp.
- Type—Integral horsepower.
- Model—PE 75–1.
- Capacity—10 g. p. m.

Motor—3 horsepower, 110 volts, 3,450 r. p. m.

Water-tank capacity—30 gallons.

c. Controls and Instruments.

(1) *Electrical controls.* Operation of the water pump is controlled by circuit breaker 7 and the ON-OFF switch on the main control panel (fig. 21). The motor starter-relay box (par. 29*g*) is mounted on the utility compartment wall beside the pump.

(2) *Sight glass.* The sight glass (fig. 24) on the water tank is used to indicate the height of water in the tank.

(3) *Thermometer.* The thermometer taped to the pump discharge line indicates the temperature of water being discharged from the pump.

(4) *Outlet valves.* Refer to paragraph 30*a* and figure 23.

d. Operation. The pump is designed to operate continuously without damage to itself or to piping and valves. However, continuous operation should be permitted only during periods of constant need, as when circulating water through a condenser, or periods of frequent use. At all other times, the pump should be operated only as specific need arises.

(1) Check water level in tank. Replenish supply if low.
(2) Make sure all valves on water supply and water return lines are closed.
(3) Make sure circuit breaker switch 7 is closed.
(4) Push water pump toggle switch on control panel to ON position.
(5) To shut down pump, push toggle on control panel to OFF position.
(6) At end of day's operation, open circuit breaker switch 7.

e. Maintenance.

(1) *Lubrication.* The water pump requires no lubrication.

(2) *Before-operation service.*
- (*a*) Check water piping for leaks or looseness. Make sure outlet valves are closed.
- (*b*) Make sure tank contains sufficient water.
- (*c*) Check electrical connection to water-pump motor.

(3) *During-operation service.*
- (*a*) Inspect pump and motor assembly, being alert for unusual noises or

smells that could indicate malfunction.

(*b*) Make sure pump does not leak at shaft seal.

(*c*) Check water piping in utility and laboratory compartments for signs of leakage.

(*d*) Make sure all outlet valves deliver full flow when open and do not leak when closed.

(4) *After-operation service.*

(*a*) Remove fill cap from water tank and fill tank with water. Take care to keep from allowing impurities to enter tank.

(*b*) Inspect pump, motor, tank, and piping for defects, and correct all defects noted.

(5) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Pump fails to start, or stops during operation.	Defective wiring	Check wiring and correct.
	Current overload causes circuit breaker switch 7 or overload cutout switch in starter-relay box to open.	Locate and correct cause for overload. Close circuit breaker switch 7 and reset overload switch in relay box.
	Defective motor	Replace.
	Impeller broken or clogged.	Clean volute and inspect impeller. Replace, if defective.
Pump fails to deliver water at proper pressure.	Insufficient water	Fill water tank.
	Motor speed too low.	Check electrical system and correct applicable defect.
	Leak at shaft seal.	Disassemble pump and replace seal.
	Water inlet clogged.	Drain pump and tank. Disassemble and clean suction pipe.
	Worn impeller	Replace.
Pump vibrates or runs noisily.	Foreign matter in volute.	Disassemble and clean.
	Insecure mounting.	Tighten pump-motor mounting bolts.
Motor overheats	Bent shaft, warped impeller, worn bearings.	Remove and inspect volute. Replace defective parts.
	Mechanical defect in pump or motor.	Check motor for easy rotation and straight shaft, and correct condition as required.
	Incorrect voltage	Check electrical system and correct applicable defect.

32. Electrical Space Heater

a. Description. The electric space heater is a forced-air-type heater (figs. 27 and 28). The heater, located in the utility compartment under the fume hood, keeps the temperature of the laboratory compartment constant. Cool air is drawn into the intake duct from the laboratory compartment and forced through heating elements. After being heated the air is forced along ducts and through duct outlets at the cabinet bases within the laboratory compartment. The heating unit consists of a bank of 9-finstrip elements mounted side by side in a steel frame. Air is forced through the heating unit and through the ducts by means of a motor with blower blades attached. The unit can be used to provide ventilation without heat.

b. Data.

Heater:
- Manufacturer_____Edwin L. Wiegand Co.
- Type_____Single-phase, 220 volts, 12-kw., 9-finstrip elements.
- Model_____CAB–121.
- Output_____41,000 B. t. u. per hour.

Motor-blower:
- Manufacturer_____ILG Electric Ventilating Co.
- Type_____⅛ horsepower, single-phase, 60 cycles, 110 volts, 1,750 r. p. m.
- Model_____B–12–4F.

Heater thermostat:
- Manufacturer_____Edwin L. Wiegand Co.
- Type_____Chromalox, with sensitive bulb.
- Model_____AR–2529.
- Temperature limits___50° F. to 250° F.

Wall thermostat:
- Manufacturer_____Minneapolis-Honeywell Regulator Co.
- Type_____T42K, 115 volts, 1-stage heating, 1-stage cooling.
- Model_____TA42A13X1.
- Temperature limits___55° F. to 85° F.

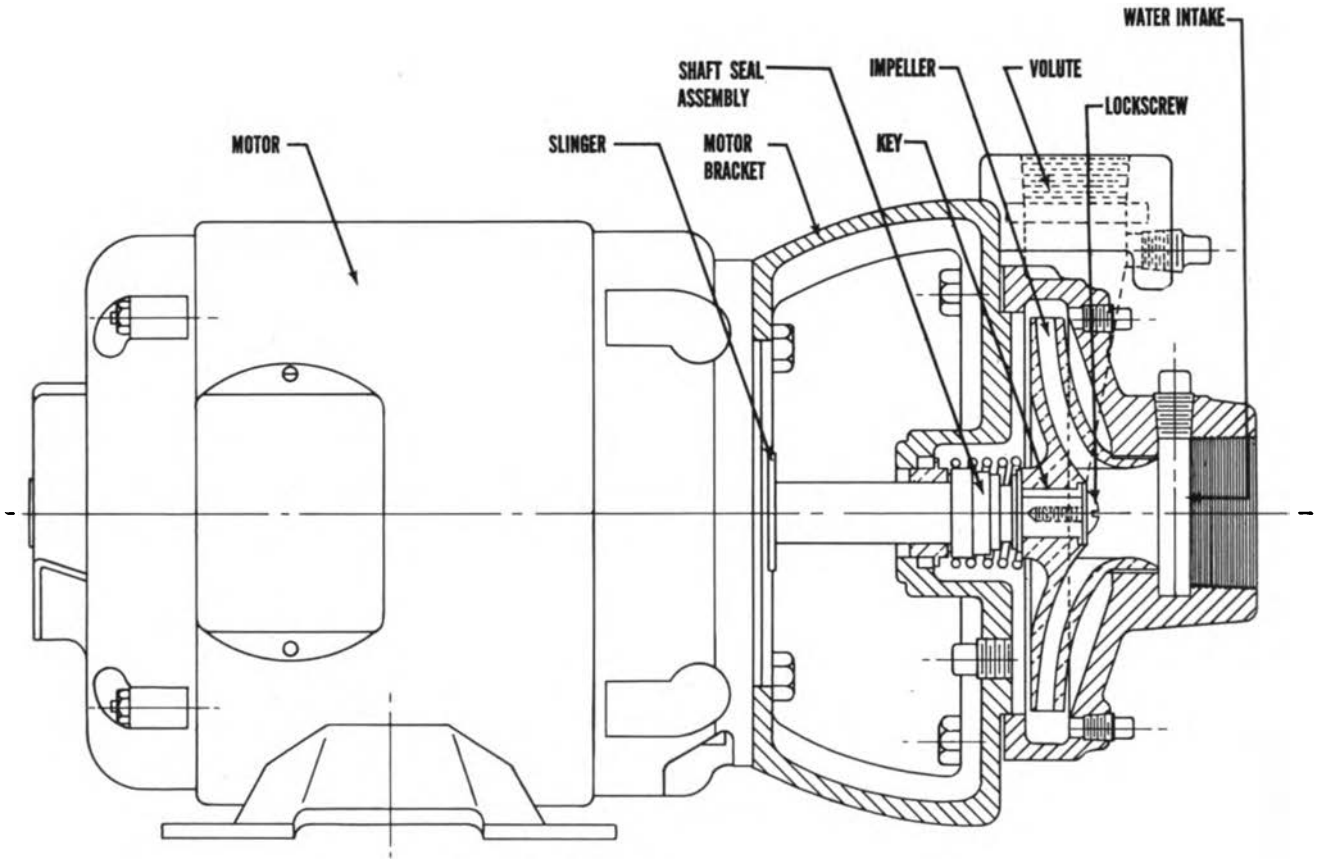


Figure 26. Water pump.

c. Controls.

(1) *Electrical controls.* Operation of the electric space heater is controlled by circuit breaker switches (23 and 25, fig. 19) and the space-heater ON-OFF switch and space-heater blower ON-OFF switch located on the main control panel (fig. 21).

(2) *Wall thermostat.* The temperature of the laboratory compartment is controlled by a wall thermostat located above the main control panel.

(3) *Heater thermostat.* A safety thermostat is mounted on the wall of the utility compartment near the heater. The thermostat is connected to a sensitive bulb that is mounted near the heating elements in the outlet duct. Its purpose is to cut on the blower fan when heating elements reach the temperature for which the heater thermostat is set and to cut off the blower when the heating elements drop to a set temperature. The thermostat also controls the current to the heating elements and prevents the elements from being burned out through overheating.

(4) *Duct outlets.* Duct outlets, located in the heating ducts at the bottom of the cabinets within the laboratory compartment, regulate the amount of warm air that enters the laboratory compartment.

d. Operation. The electric space heater is designed to operate automatically.

(1) Make certain circuit breaker switches (23 and 25, fig. 19) are closed.

(2) Push space-heater toggle switch on control panel to ON position. Allow 2 minutes for the heating elements to heat.

(3) Push space-heater blower toggle switch on control panel to ON position.

(4) Set dial on wall thermostat to desired temperature. This temperature will be

maintained without further adjustment.

(5) Open warm-air duct outlets as desired.

(6) Make no adjustments to the heater thermostat. This thermostat is set by the manufacturer at the proper operating and safety temperatures and needs no further adjustments.

(7) If the electric space heater is to be operated as a ventilator without heated air, close circuit breaker switches (23 and 25), make certain space-heater switch is in OFF position, push space-heater blower switch to ON position, and open air duct outlets.

(8) To shut down electric space heater, push the space-heater and space-heater blower toggle switches to OFF position.

(9) If heater is not to be used for at least several hours, open circuit breaker switches (23 and 25).

e. Maintenance.

(1) *Lubrication.* The heating unit and and blower-motor require no lubrication.

(2) *Before-operation service.*

(*a*) Check electrical connections.

(*b*) Check temperature setting of wall thermostat.

(3) *During-operation service.*

(*a*) Inspect blower-motor assembly, being alert for unusual noises or odors that could indicate malfunction.

(*b*) Check to see that heater is maintaining laboratory compartment temperature as set on wall thermostat.

(*c*) Check to see that warm-air duct outlets deliver full flow of warm air when open and do not leak when closed.

(*d*) Check magnetic contactor in utility compartment for chattering.

(*e*) Check heater assembly for vibration caused by loose mounting bolts.

(4) *After-operation service.* Inspect blower-motor housing, sensitive-bulb tubing, wiring, and ducts for defects, and correct all defects noted.

(5) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Heating elements fail to heat.	Defective wiring	Check wiring and correct.
	Current overload opens circuit breaker switches.	Locate and correct cause for overload.
	Wall thermostat not set at proper temperature.	Set at proper temperature.
	Defective wall thermostat.	Replace.
	Heater thermostat setting incorrect.	Reset to original factory setting.
	Defective heater thermostat.	Replace.
	Defective magnetic contractor.	Replace.
Blower fails to start, or stops during operation.	Defective wiring	Repair or replace.
	Current overload opens circuit breaker switches.	Locate and correct cause for overload.
Blower fails to force air through ducts.	Motor speed too low.	Check electrical system and correct.
	Ducts or duct outlets clogged.	Clean ducts or duct openings.
Blower vibrates or runs noisily.	Fan coated with dirt or grease.	Clean fan.
	Bent motor shaft	Replace motor.
	Worn or damaged bearings.	Replace motor.
Heating unit fails to cut off.	Defective heater thermostat.	Replace heater thermostat.

33. Gasoline Space Heater

a. Description. The gasoline space heater (figs. 29 and 30) is a fuel-injection type heater, with a rated heat output of 200,000 b. t. u. per hour. For operation, the heater requires fuel (gasoline) under pressure, electrical current for ignition, and a flow of combustion and ventilating air. Within the heater, the combustion-air and ventilating-air passages are completely separated so that the products of combustion do not enter the ventilating-air stream. The necessary connections for fuel, combustion air, electric current, and exhaust are all made outside the heater case (figs. 31 and 32).

(1) *Heat exchanger.* The heat exchanger is made of stainless steel. From the center of the heat exchanger, flues are built outwardly, in three concentric stages, to the exhaust outlet. The flue tapers from the center (inlet) to the

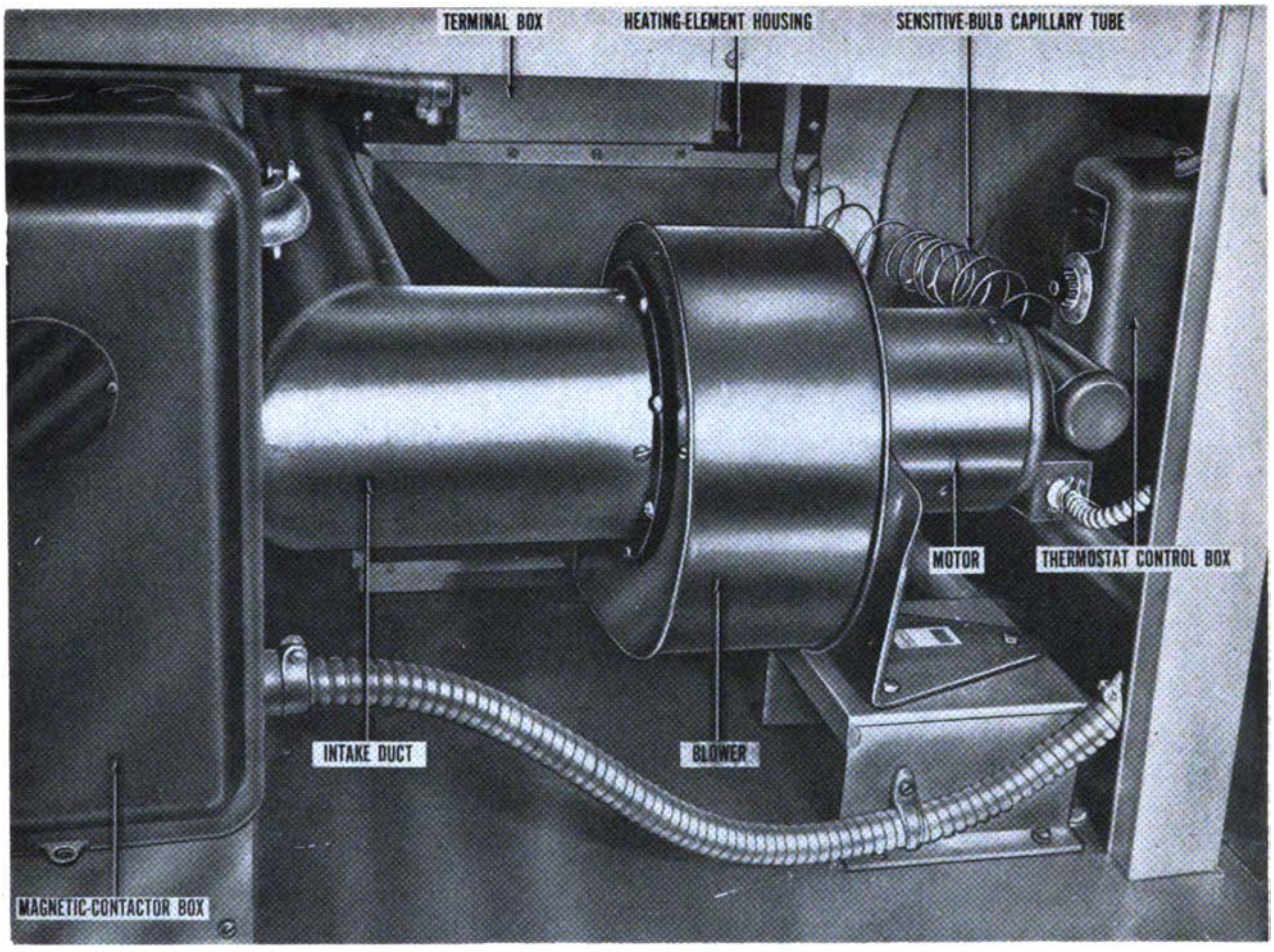


Figure 27. Electric space heater.

outside (outlet), creating an accelerated flow of hot gases. The exhaust tube is welded to the outer flue of the heat exchanger.

(2) *Burner housing.* The burner housing is welded to the heat exchanger; it incloses and provides a mounting for the burner assembly. The air inlet tube, through which the combustion air, the fuel line, and ignition cable pass, is welded to the side of the burner housing. An airtight dome-shaped cover on the burner housing provides access to the burner, fuel nozzle, spark plug, and the nozzle and spark plug connection.

(3) *Burner.* The burner is a stainless-steel cylinder, mounted in the burner housing, with its open end facing the heat exchanger. The burner mounting bracket fits onto the end of the burner. The mounting bracket contains spark plug wells, which permit insertion of the spark plug above the fuel nozzle in most heater mounting positions. Fuel is sprayed by the fuel nozzle into the burner, and combustion air enters the burner through a series of holes in the burner wall. The air, as it enters the burner, mixes with the fuel. The mixture is then ignited by the spark plug.

(4) *Fuel nozzle.* The fuel nozzle is an oil-burner-type nozzle, which meters and atomizes the fuel in a cone-shaped spray.

(5) *Spark plug.* A dual-electrode spark plug is used to ignite the fuel-air mixture.

(6) *Heater case.* The outer housing is a cylindrical stainless-steel case with openings at each end for the passage

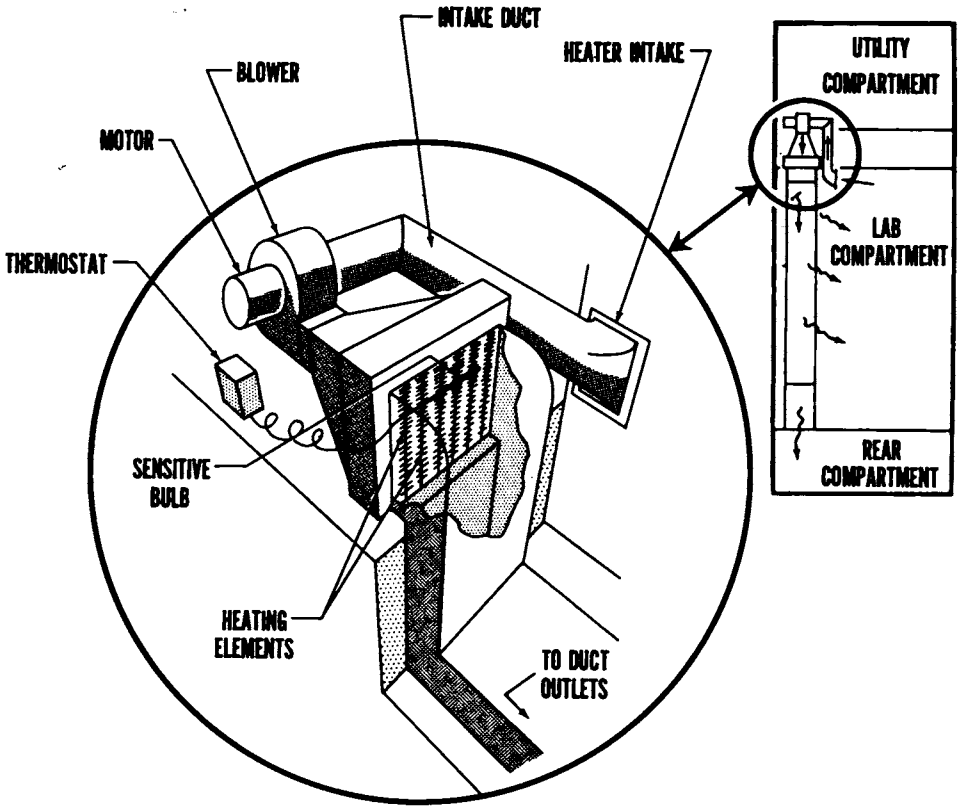


Figure 28. Electric space heater schematic diagram.

of ventlating air. These openings are beaded or have flanges to aid in attaching the ducts. The combustion-air tubes pass through the case and are welded to its side.

(7) *Ignition unit.* The ignition unit is located under the fuel tank against the wall of the trailer. It has an operating load of 1.5 amperes. The switch should be left on except when the heater is being repaired.

(8) *Ignition cable.* The spark electrodes in the burner are supplied with high-tension current through the shielded and hermetically sealed ignition cable, which passes through the air inlet tube.

(9) *Rectifier.* The rectifier, located in the utility compartment on the wall above the heater intake duct, rectifies 115 volts alternating current to 24 volts direct current for the heater spark plug.

(10) *Heater control box.* The heater control box, located above the heater, contains a fuel purifier, fuel pump, solenoid valve, terminal block, amphenol connector, and relay. The fuel travels down a copper tube from the fuel tank to the heater control box.

1 Support for ventilating-duct fume-hood blower motor
2 Fuel tank
3 Vacuum pump
4 Combustion chamber
5 Heater exhaust tube
6 Heater combustion blower
7 Heater ventilating-air fan
8 Heater intake duct
9 Stored chemicals
10 Rectifier
11 Water supply line
12 Compressed-air line
13 Water return line
14 Vacuum line
15 Propane line
16 Electric conduit

Figure 29. Utility compartment with gasoline space heater.

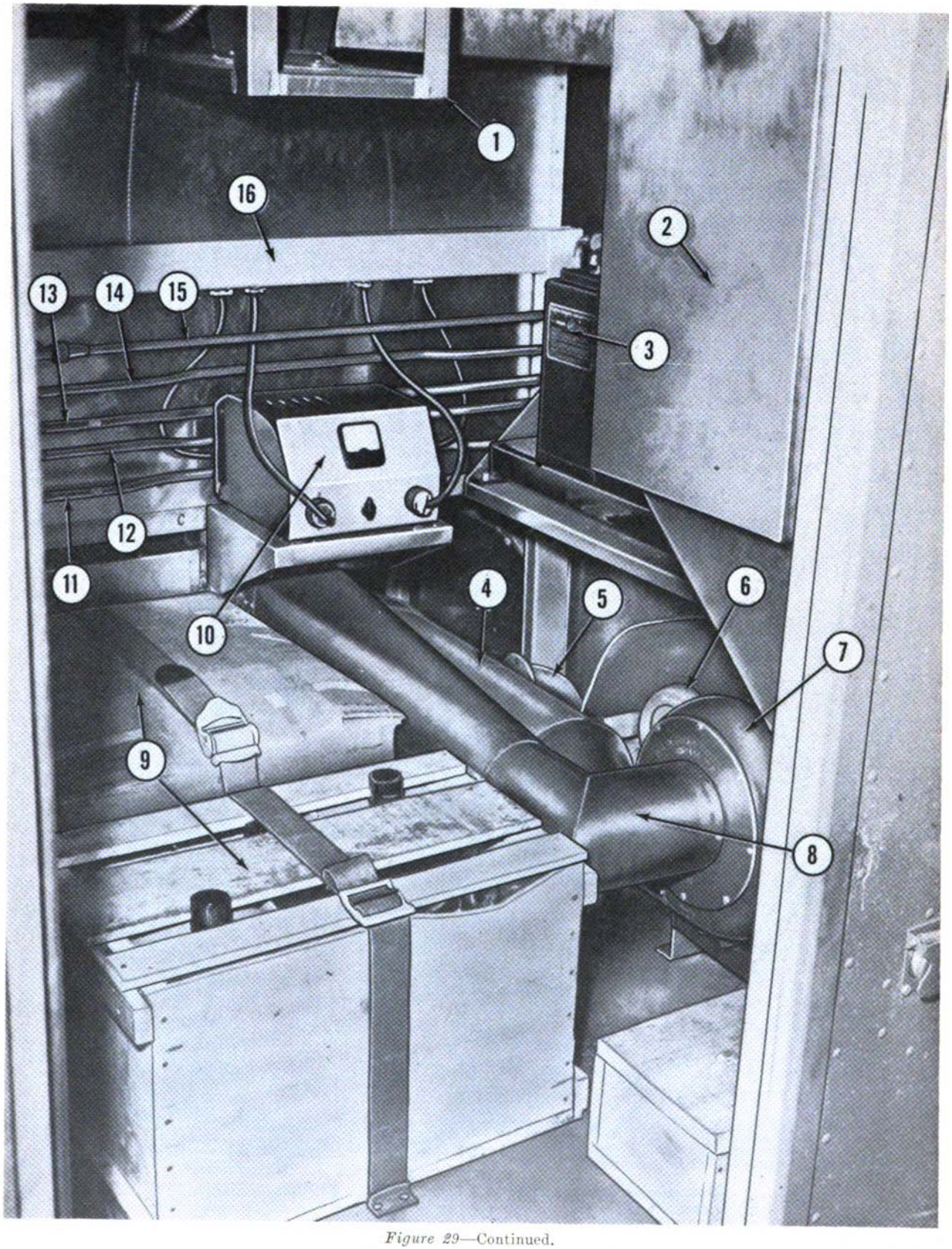
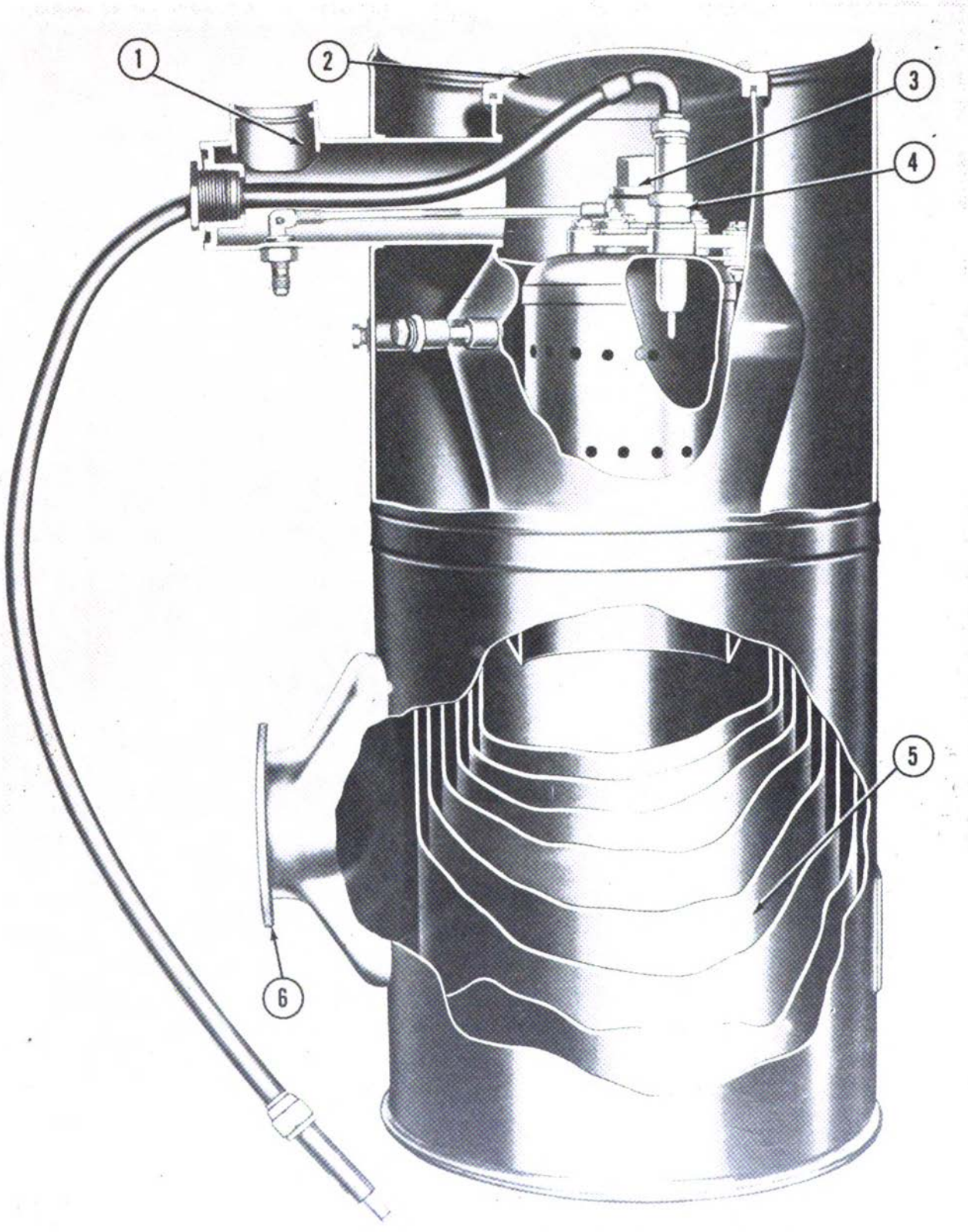


Figure 29—Continued.



1 Combustion-air intake tube
2 Burner-housing cover
3 Fuel nozzle
4 Spark plug
5 Heat exchanger
6 Exhaust outlet

Figure 30. Gasoline space heater (cutaway view).

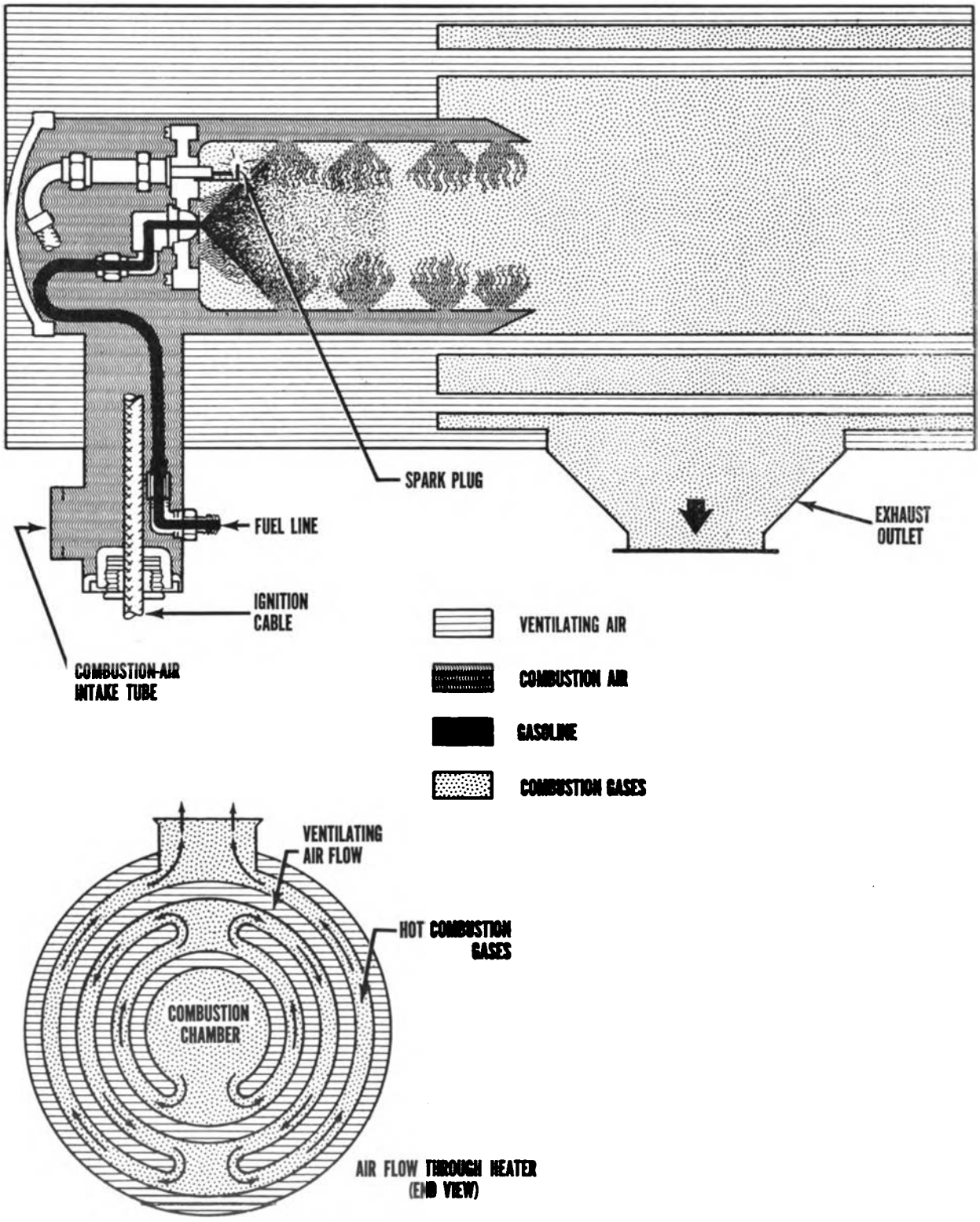


Figure 31. Gasoline heater combustion diagram.

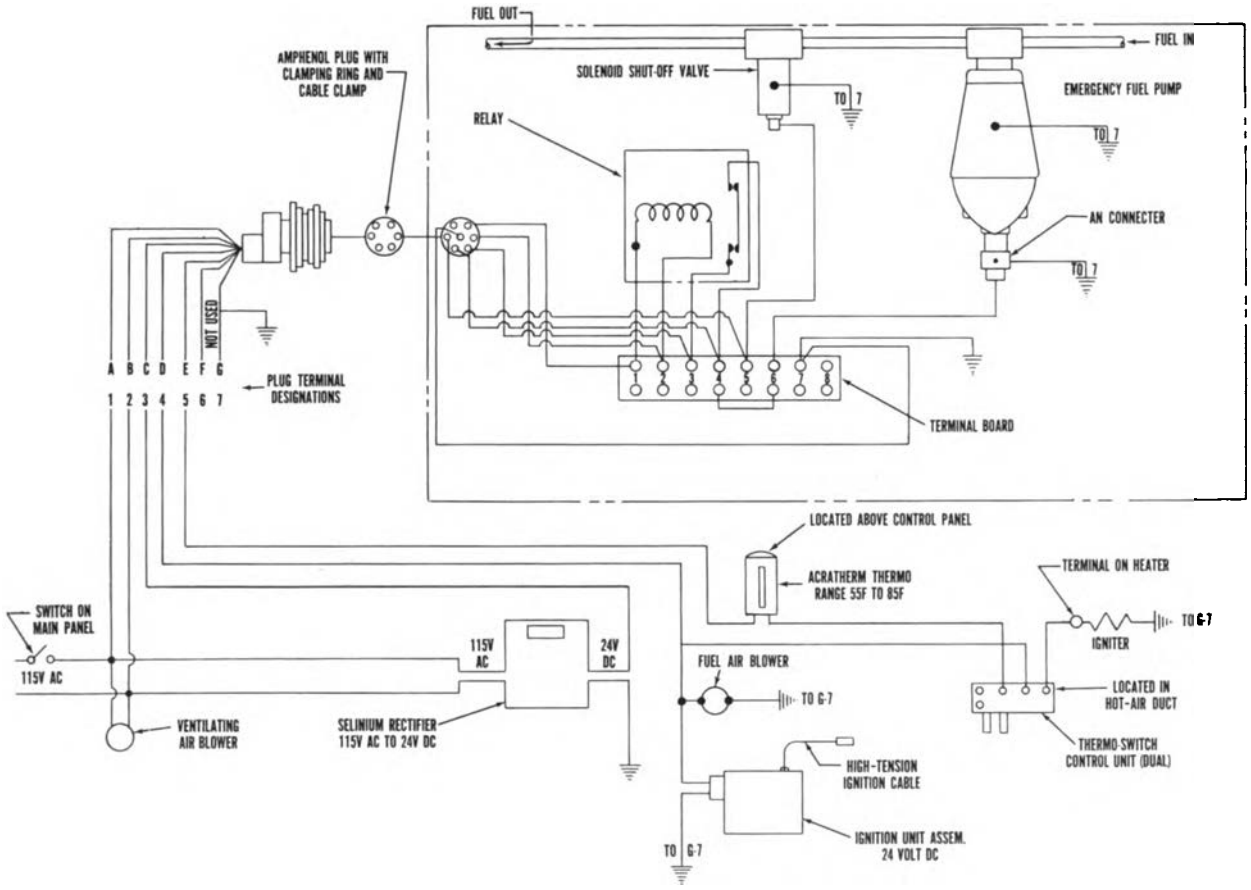


Figure 32. Gasoline heater wiring diagram.

through the fuel purifier, and into the fuel pump. From here it is pumped through the solenoid valve and into the heater. The solenoid valve is opened only if the thermostat and thermoswitch (*c* below) are open.

(11) *Combustion blower.* The combustion blower forces air into the combustion-air intake tube for mixture with the fuel. It is run by a small electric motor.

(12) *Ventilating-air fan.* The ventilating-air fan forces air through the heater for circulation around the heating elements. The heated air is further forced through the ducts to heat the trailer.

(13) *Fuel tank.* The fuel tank, mounted on the wall above the heater, is equipped with a fuel level gage and a cleanout panel.

b. Data.

Heater:

Manufacturer	Stewart-Warner.
Model	South Wind Model 921–B–1.
Fuel	Gasoline.
Fuel consumption per hour (approx.).	2¾ gallons.
Heat output per hour, maximum.	200,000 b. t. u.
Starting temperature, minimum (approx.).	−65° F.
Temperature rise, maximum (approx.).	350° F.
Motor, heater ventilating-air fan.	3.4 amperes, 60 cycles, 3,400 r. p. m.
Voltage required	24 volts dc.
Fuel-tank capacity	30 gallons.

Wall thermostat:

Manufacturer	Minneapolis-Honeywell Co.
Type	T42K, 115 volts, 1-stage heating, 1-stage cooling.
Model	TA42A13X1.
Temperature limits	55° F. to 85° F.

c. Controls and Instruments.

(1) *Thermostat.* The thermostat is an acratherm type with a 55° to 85° F.

range. It is located above the control panel on the wall separating the laboratory compartment from the rear compartment. The thermostat is set by hand at the desired laboratory temperature.

(2) *ON-OFF switch.* The heater ON-OFF toggle switch is located on the control panel.

(3) *Thermoswitch.* The thermoswitch, an automatic safety switch located in the warm-air duct, shuts off the current of the duct temperature exceeds 300° F.

(4) *Rectifier.* The rectifier, located above the heater intake duct, rectifies 115 volts alternating current to 24 volts direct current. The knob is manipulated to steady the voltage as indicated on the dial.

(5) *Duct vents.* The warm-air duct vents are located in the laboratory compartment under the cabinets. They have hand-operated sliding panels over the vents to control the amount of warm air entering the compartment.

d. Operation. The gasoline space heater is designed to operate automatically, maintaining a constant temperature within the laboratory compartment.

(1) Make certain circuit breaker switch 20 is closed.

(2) Push space-heater toggle switch on control panel to ON position.

(3) Open sliding panels of the warm-air duct vents beneath cabinets.

(4) Set wall thermostat to desired temperature.

(5) To shut down gasoline space heater push space-heater toggle switch to OFF position.

e. Maintenance.

(1) *Lubrication.* The gasoline space heater and blower-motor require no lubrication.

(2) *Before-operation service.*

(*a*) Inspect heater grill opening in laboratory compartment and exhaust outlet under trailer for possible obstructions.

(*b*) Inspect heater fuel lines for possible obstructions or leaks.

(*c*) Inspect electrical, fuel, and air-intake connections for looseness.

(3) *During-operation service.*

(*a*) Listen for unusual noises in blower-motor.

(*b*) Watch for leaks in fuel lines and heater.

(*c*) Be alert for smoke or unusual odors.

(4) *After-operation service.*

(*a*) Examine heater for loose components.

(*b*) Check level of fuel in tank and fill if necessary.

(*c*) Inspect floors beneath heater for evidence of leakage. Trace leaks to their source and correct.

(5) *Weekly servicing.*

(*a*) Check fuel lines and exhaust tube for leaks and faulty connections.

(*b*) Check electrical wiring for loose connections, faulty wiring, and possible chafing. Check ignition-box end of cable for any trace of deterioration due to arcing. Check heater control-box components for fuel-pump leakage, loose connection, and faulty wiring.

(6) *Monthly servicing.* Clean as follows: Disconnect exhaust stack from heater exhaust outlet. Scrape surface of last gas passage in approach to heater exhaust outlet. A tool made of spring steel (0.032 gage x ¾ in. w x 15 in. lg) serves well as a flexible scraping device. The loosened compounds will be removed by combustion airflow when heater is placed in operation.

(7) *Quarterly servicing.* After every 3 months of operation completely overhaul the gasoline space heater.

(8) *Semiannual servicing.* Semiannually, remove panel and clean out fuel tank. Remove and clean gage.

(9) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Gasoline does not reach burner.	Insufficient fuel pressure.	Check operation of fuel pump, valves, etc. Make certain there is fuel at pump inlet.
	Solenoid valve does not permit passage of fuel.	Check wiring; check valve operation; overhaul or replace.
	Fuel lines clogged or broken.	Check all lines and connections. Break line at convenient points to determine how far fuel flows. Repair or replace.
	Nozzle is clogged	Test nozzle operation and clean nozzle.
Gasoline reaches heater but will not burn.	Faulty ignition cable.	Replace ignition cable.
	Faulty spark plug.	Clean or replace spark plug.
	Voltage is not sufficient to operate transformer or ignition unit.	Test voltage at transformer and ignition unit and correct condition.
	Faulty transformer or ignition unit.	Replace transformer or ignition unit.
	Nozzle drips instead of spraying.	Replace nozzle.
	Combustion airflow insufficient.	Check combustion-air duct for obstruction.
Blower fails to operate.	Bad electrical connection or wiring.	Make proper connection; repair or replace wire.
Blower operates noisily.	Bent motor shaft; worn or damaged bearings.	Replace.
	Grease or dirt on blower blades.	Clean blades.

34. Air Compressor

a. Description. The air compressor (figs. 33 and 34) is a single-stage, air-cooled, pressure-lubricated type. The compressor is cooled by the deep-cast circular fins of the cylinders and the flywheel fan blades. There are two independently acting compression cylinders, both connected into the starting unloader system. The compressed air is pumped into the 30-gallon-capacity horizontal air-receiver tank, mounted on the wall above the compressor. The air compressor is powered by a squirrel-cage induction electric motor.

b. Data

Air compressor:
- Manufacturer____Westinghouse Air Brake Co.
- Two cylinders, single-stage, air-cooled, pressure-lubricated.
- Model_____1-BYS.

Motor:
- Manufacturer____Westinghouse Electric Corp.
- Type_____Squirrel-cage, single-phase, 2 horsepower, 60 cycles, 110 volts, induction motor.
- Model_____CSP.

Air-receiver-tank capacity. 30 gallons.

c. Controls and Instruments.

(1) *Electrical controls.* Operation of the air compressor is controlled by circuit breaker switch 18 and the air-compressor ON-OFF toggle switch on the main control panel (fig. 21). The motor starter-relay box (par. 29*g*) is mounted on the utility-compartment wall beside the compressor.

(2) *Pressure switch.* A pressure switch is located within the compressor to automatically cut on and cut off the air compressor at the required pressures.

(3) *Unloader pilot valve.* An unloader pilot valve automatically controls the unloaders on the compression cylinders according to the predetermined setting of 80 p. s. i. maximum and 60 p. s. i. minimum pressure. The unloader pilot valve is connected to the tank pressure and actuates the unloaders.

(4) *Safety valve.* A safety valve, located on the air-receiver tank, is set to blow off at 100 p. s. i. maximum working pressure of the tank. The valve ordinarily requires no attention after being set at time of installation.

(5) *Air-pressure gage.* The air-pressure gage located on the air compressor (fig. 33) shows air pressure being maintained by th air compressor during operation.

(6) *Air-compressor gage.* The air-compressor gage mounted on the control panel (fig. 21) shows air pressure

within the air supply lines of the laboratory.

d. Operation. The air compressor is designed to operate continuously without damage to itself or the piping and valves. However, continuous operation should be permitted only during periods of constant need.

(1) Check to make sure that all air-supply-line valves are closed.
(2) Make certain that circuit breaker switch 18 is closed.
(3) Push air-compressor toggle switch on control panel to ON position.
(4) When required pressure within the air-receiver tank is reached, open compressed-air release valve to air supply line.
(5) To shut down air compressor, push air-compressor toggle switch to OFF position.
(6) At end of day's operation, open circuit breaker switch 18.

e. Maintenance.

(1) *Lubrication.*

(*a*) *Motor.* Lubricate monthly with oil, lubricating, engine crankcase, OE–10. A few drops of oil in each oil fitting once a month is generally sufficient for average service.

(*b*) *Air compressor.* For temperatures above freezing fill crankcase with oil, lubricating, engine crankcase, OE–30; for temperatures below freezing fill crankcase with OE–10. Remove oil filling plug and check oil level weekly. If oil level is not up to the tapped opening, add sufficient oil to raise the level to this opening. Never remove oil filling plug while compressor is operating. Clean compressor monthly. To clean, drain oil, disconnect tubing to unloader valve in end cover, and remove end cover. Pull oil pump out of its bearing and release the strainer by removing a snap ring. Clean out sediment or sludge if found in crankcase as these interfere with oil-pump operation. Clean other parts in crankcase, such as relief ball check in crankshaft counterweight, ports in valve cap, and opening in counterweight (fig. 34).

(2) *Before-operation service.*

(*a*) Check compressor for loose mounting bolts.
(*b*) Check compressor crankcase oil level.
(*c*) Check air-intake filters for obstructions.

(3) *During-operation service.*

(*a*) Listen for rattles, knocks, squeaks, or hums that may indicate trouble in air compressor or motor.
(*b*) Observe compressor motor for indications of overheating and smoke.
(*c*) Observe drive belt for slippage or binding caused by excessive looseness or tightness of belt.
(*d*) Observe compressor gage for indications of unusual or unsatisfactory performance of compressor.
(*e*) Check air-compressor gage on control panel for excessive pressure drop or rise.
(*f*) Check compressed-air pipes for indications of leaks.

(4) *After-operation service.*

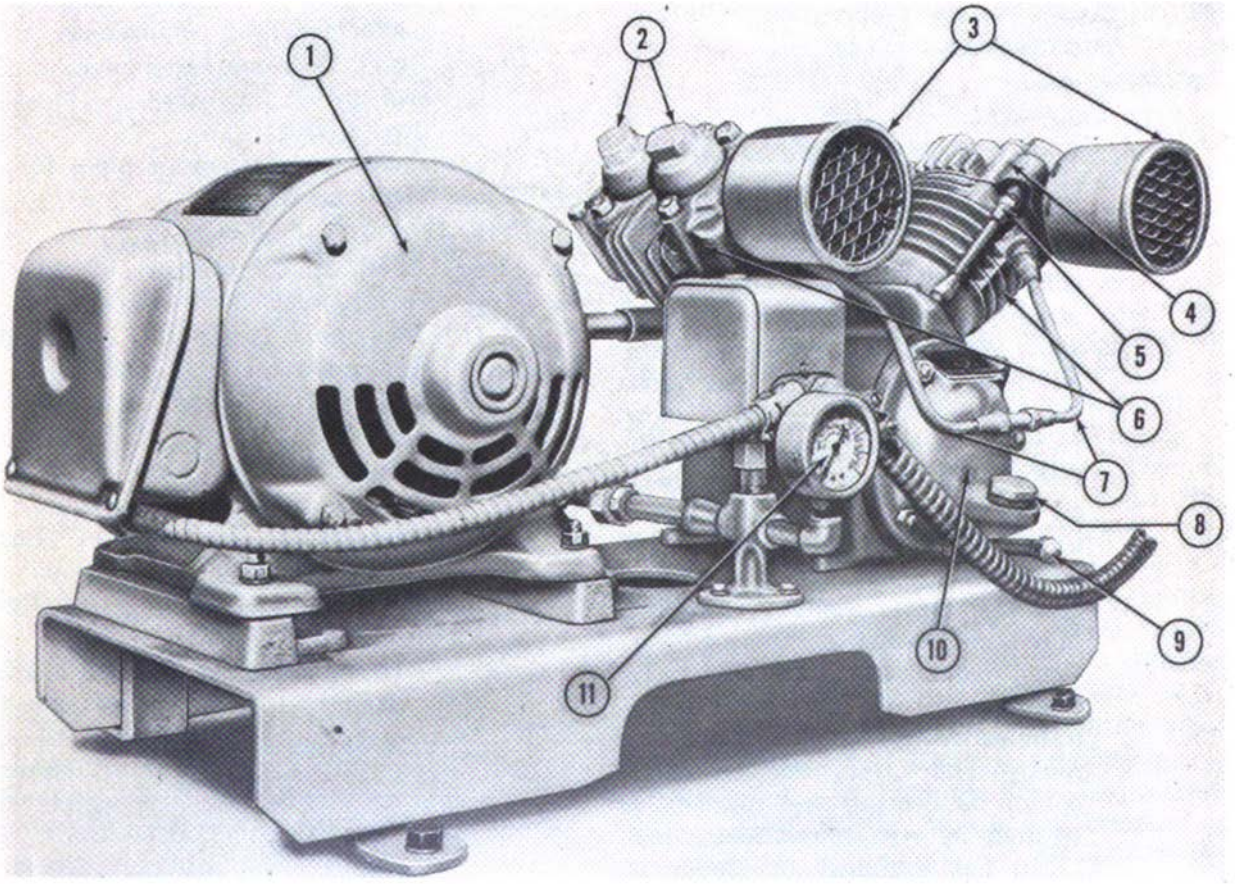
(*a*) Check air compressor and perform required periodic services.
(*b*) Determine causes for any defects discovered during operation and repair or replace defective equipment.

(5) *Weekly servicing.* Weekly, open drain cock at bottom of air-receiver tank and drain out accumulated water resulting from condensation. Leave drain cock open only as long as solid stream of water runs, then close tightly.

(6) *Quarterly servicing.* Every 3 months, or oftener if required, remove the curled hair and felt disks from the air-intake filters, wash in dry-cleaning solvent, and replace. Remove the valve caps on the cylinder heads and thoroughly clean inlet and discharge valves and their seats.

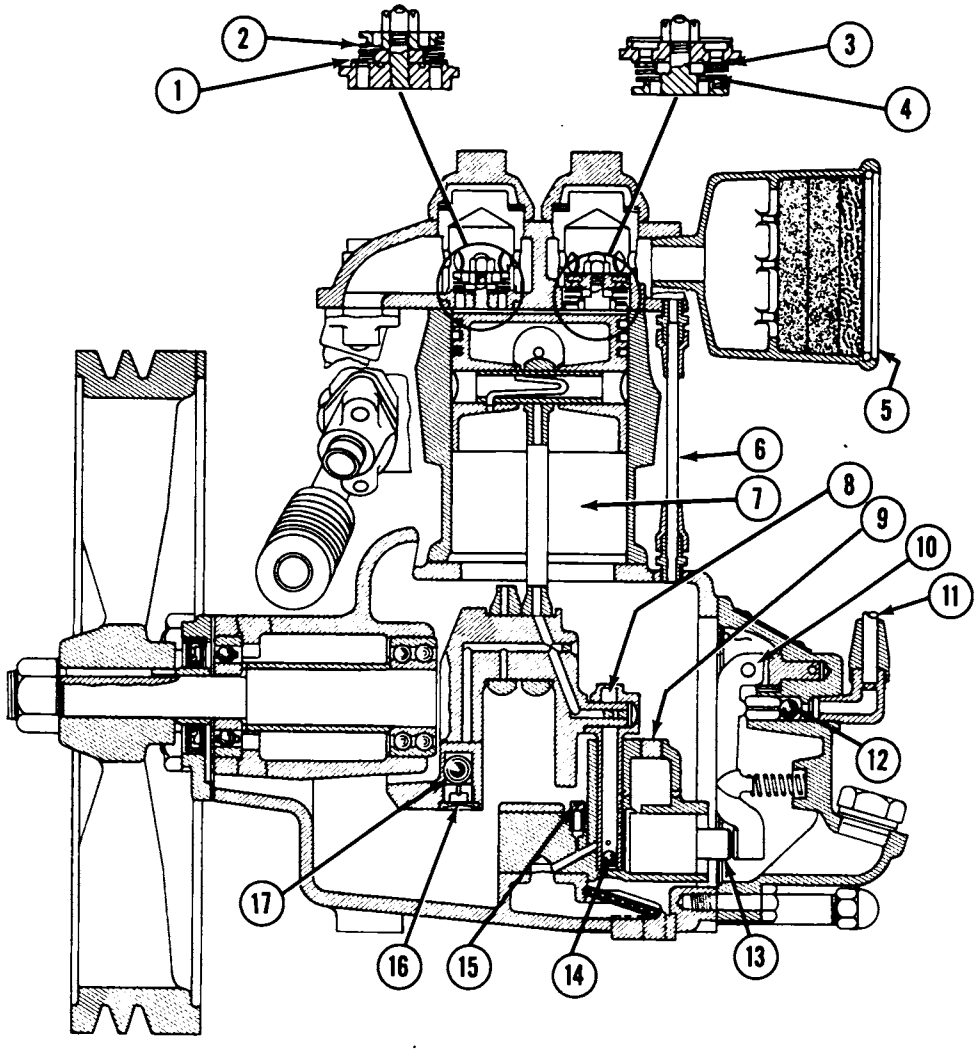
(7) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Air-compressor motor fails to start, or stops at improper time.	Defective wiring or connections.	Check wiring and connections and correct.
	Current overload opens circuit breaker 18.	Locate and correct cause of overload.
	Defective motor	Replace motor.
Air-compressor motor drive belt binding.	Drive belt too tight.	Loosen motor mounting bolts, position motor proper distance from compressor.
Motor runs, but fails to drive compressor.	Broken drive belt	Replace.
	Drive belt too loose.	Loosen motor mounting bolts, position motor in proper position.
	Motor or compressor pulley loose on shaft.	Tighten.
Air-compressor fails to compress air.	Lack of oil pressure.	Check crankcase oil level.
		Clean strainer in base of pump.
		Clean or replace ball check in plunger or pneumatic cushion port plug.
	Dirty ball check or seat.	Clean ball check or ball check seat.
Safety valve in air storage tank leaks.	Dirt around seat of valve.	Clean valve seat.



1 Motor
2 Valve caps
3 Air-intake filters
4 Cylinder head
5 Crankcase vent
6 Cylinder
7 Cylinder-to-unloader-valve connector
8 Oil filling cap
9 Oil drain cap
10 End cover
11 Air-pressure gage

Figure 33. Air compressor assembly.



1 Discharge valve
2 Discharge-valve spring
3 Inlet valve
4 Inlet-valve spring
5 Air-intake filter
6 Crankcase vent
7 Cylinder
8 Plunger
9 Oil pump
10 Unloader pilot lever
11 Unloader pilot-valve connection
12 Unloader pilot valve
13 Oil-pump unloader piston
14 Ball check
15 Port plug
16 Valve cap
17 Relief ball check

Figure 34. Air compressor (sectional view).

35. Vacuum Pump

a. Description. The vacuum pump is mounted in the utility compartment above the air compressor. The vacuum pump and component motor are mounted on a common base, and power is transmitted from the motor to the vacuum pump by means of pulleys and belt (fig. 25). The pump is connected to the vacuum air line which runs to the laboratory compartment. The pulley-belt combination provides for a speed of approximately 325 revolutions per minute. The vacuum pump has a 31-liter-per-minute free-air capacity.

b. Data.

Vacuum pump:
Manufacturer_____ Central Scientific Co.
Type_____ 31-liter-per-minute, free-air capacity.
Model_____ Megavac, Catalog No. 92010.
Motor:
Manufacturer_____ Marathon Electric Mfg. Corp.
Type_____ ⅓ horsepower, 60 cycles, 115 volts, alternating-current.

c. *Controls and Instruments.*

(1) *Electrical controls.* Operation of the vacuum pump is controlled by circuit breaker switch 19 and the vacuum-pump ON-OFF toggle switch on the main control panel (fig. 21). The motor starter-relay box is mounted on the wall of the utility compartment beside the compressor (par. 29*g*).

(2) *Oil-level gage.* The oil level within the vacuum pump is indicated in the window on the side of the pump.

(3) *Vacuum-pressure gage.* The vacuum in inches of mercury (Hg) is indicated directly on the vacuum-pressure gage located on the control panel (fig. 21). When vacuum falls below 28 inches of mercury the vacuum pump automatically turns on, provided proper electrical controls are on.

d. *Operation.*

(1) Check to see that all vacuum-pressure-line valve outlets in the laboratory compartment are closed.

(2) Make sure circuit breaker switch 19 is closed.

(3) Push the vacuum-pump toggle switch on the control panel to the ON position.

(4) To shut down the vacuum pump, push the vacuum-pump toggle switch to the OFF position.

(5) At end of day's operation open circuit breaker switch 19.

e. *Maintenance.*

(1) *Lubrication.*

(*a*) *Motor.* Lubricate monthly with oil, lubricating, engine crankcase, OE–10.

(*b*) *Vacuum pump.* Remove top plate and fill with oil supplied with the pump (Central Scientific Catalog No. 93050) until it is slightly above oil level (approx. 3 qts) as indicated in window on side of pump. In operation, the oil should be even with or slightly above the oil level as indicated in the window. If insufficient oil is used, a good seal around the vanes may not be maintained. If too much oil is used, oil may back through the pump trap into the vacuum line. The oil supplied with the pump is specially prepared for high-vacuum work. For maximum pumping speeds at low pressure, no other oil should be used. After changing oil, the pump must run for some time on a closed system before lowest pressure is obtained.

(2) *Before-operation service.*

(*a*) Make sure that vacuum-pump motor is lubricated and vacuum pump properly filled with oil.

(*b*) Make certain all vacuum-pump fittings are perfectly sealed.

(*c*) Check condition of vacuum-pump drive belt; make sure belt is not too tight or too loose; check belt pulleys.

(*b*) Check all vacuum-pipe connections for tightness.

(3) *During-operation service.*

(*a*) Check oil level of vacuum pump.

(*b*) Check vacuum-pump motor for overheating.

(*c*) Check vacuum-pipe connections and fittings for vacuum leaks.

(*d*) Check vacuum-pressure gage on control panel.

(4) *After-operation service.*

(*a*) If oil level of vacuum pump is low, fill to proper level.

(b) Correct any vacuum leaks found during operation.

(5) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Insufficient vacuum pressure.	Low oil level	Fill pump to prescribed level.
	Leakage in line	Locate leak and repair line.
	Motor not functioning properly.	Check wiring for shorts, or loose connections. Check drive belt for tightness or looseness. Correct condition.

36. Refrigerator

a. Description. The laboratory refrigerator, built into the partition separating the labora-

tory compartment from the utility compartment, is a complete plug-in-type unit powered by a ¼-horsepower hermetically sealed condensing unit (fig. 35). The refrigeration cycle employs a thermostatic expansion valve to meter the refrigerant (Freon 12) and a standard-type thermostat to control the temperature. A dehydrator-filter unit has been installed in the liquid line to the expansion valve to forestall the possibility of moisture or foreign matter entering or clogging the orifice. The refrigerator contains five ice-cube trays and a drip pan. Within the utility compartment the condensing unit is equipped with a blower fan (fig. 36).

b. Data.

Refrigerator:

Type	Complete plug-in.
Condensing unit	¼ hp., hermetically sealed, with condenser motor and fan.
Refrigerant	2 lbs. Freon 12.
Thermostat	Ranco type RJS 1080.
Ice trays	5 trays, 12 ice cubes per tray.
Condenser blower	Universal fan-motor assembly.

c. Controls and Instruments.

(1) *Electrical controls.* Operation of the refrigerator is controlled by circuit-breaker switch 16, refrigerator ON-OFF toggle switch on main control panel, thermostat control within refrigerator, and overload protector. Condenser blower fan is controlled by circuit breaker switch 16 and the refrigerator ON-OFF toggle switch located on cabinet BD at the left front corner of the laboratory compartment below the heater intake duct.

(2) *Condenser-blower hatch.* The condenser-blower hatch (fig. 5) is located on the right front of the trailer and must be open when blower motor is operating.

(3) *Condenser-blower light.* The red condenser-blower light, located to the right of the refrigerator-blower ON-OFF switch, lights whenever the blower switch is in the ON position.

d. Operation.

(1) Make certain circuit-breaker switch 16 is closed.

(2) Push refrigerator toggle switch on main control panel to ON position.

(3) Set thermostat switch within refrigerator to desired temperature setting.

(4) If refrigerator is operated in temperatures above 70° F., push refrigerator-blower toggle switch on cabinet BD to ON position. When condenser blower is in operation, open condenser-blower hatch on right side of trailer.

(5) To shut down refrigerator, push refrigerator toggle switch on main control panel to OFF position.

(6) Turn thermostat control within refrigerator to OFF.

(7) If condenser blower was used, push refrigerator-blower switch on cabinet BD to OFF position. Close condenser-blower hatch.

(8) If refrigerator is not to be used for some period of time, open circuit-breaker switch 16.

e. Maintenance.

(1) *Lubrication.* The refrigerating unit requires no lubrication. The refrigerator-blower motor should be lubricated monthly using lubricating oil OE–30.

(2) *Before-operation service.* Make sure that all electrical connections and all fittings are tight, and that refrigerator plug is in electric outlet.

(3) *During-operation service.*

(*a*) Be alert for unusual noise or vibration while refrigerating unit is in operation.

(*b*) Check for smoke or odors from overheated components or shorted wiring.

(*c*) When refrigerator blower is operating, check for unusual noise, vibration, or overheating.

(*d*) Inspect evaporator for frost. Defrost when evaporator coil accumulates one-fourth to one-half inch of frost on fins.

(4) *After-operation service.*

(*a*) Empty ice-cube trays. Wipe entire interior of refrigerator with clean damp cloth.

(*b*) Inspect all components of refrigerator and condenser blower to see that they are securely mounted,

properly connected, and undamaged.

(5) *Monthly service.* Monthly, with a stiff nonmetal brush or compressed air, clean the condenser fins.

(6) *Semiannual service.* Semiannually, unscrew inlet fitting of thermostat expansion valve and clean strainer with dry-cleaning solvent.

(7) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Unit runs continuously. No refrigeration. Suction pressure low.	Expansion valve clogged.	Remove valve and flush with solvent.
	Dryer unit plugged.	Replace unit.
Unit runs continuously, suction pressure near normal. Hissing sound at thermostatic expansion valve.	Shortage of Freon.	Recharge unit and test for leak.
Long cycle, high head pressure, unit laboring.	Condenser dirty...	Clean with brush or air pressure.
	Noncondensable gas present; overcharge of refrigerant.	Purge off until normal.
	Condenser fan inoperative.	Replace condenser fan.
Unit inoperative..	Electrical failure..	Check wiring, replace or repair.
Condenser fan and unit fail to run.	Defective thermostat.	Short across both thermostat terminals; if unit

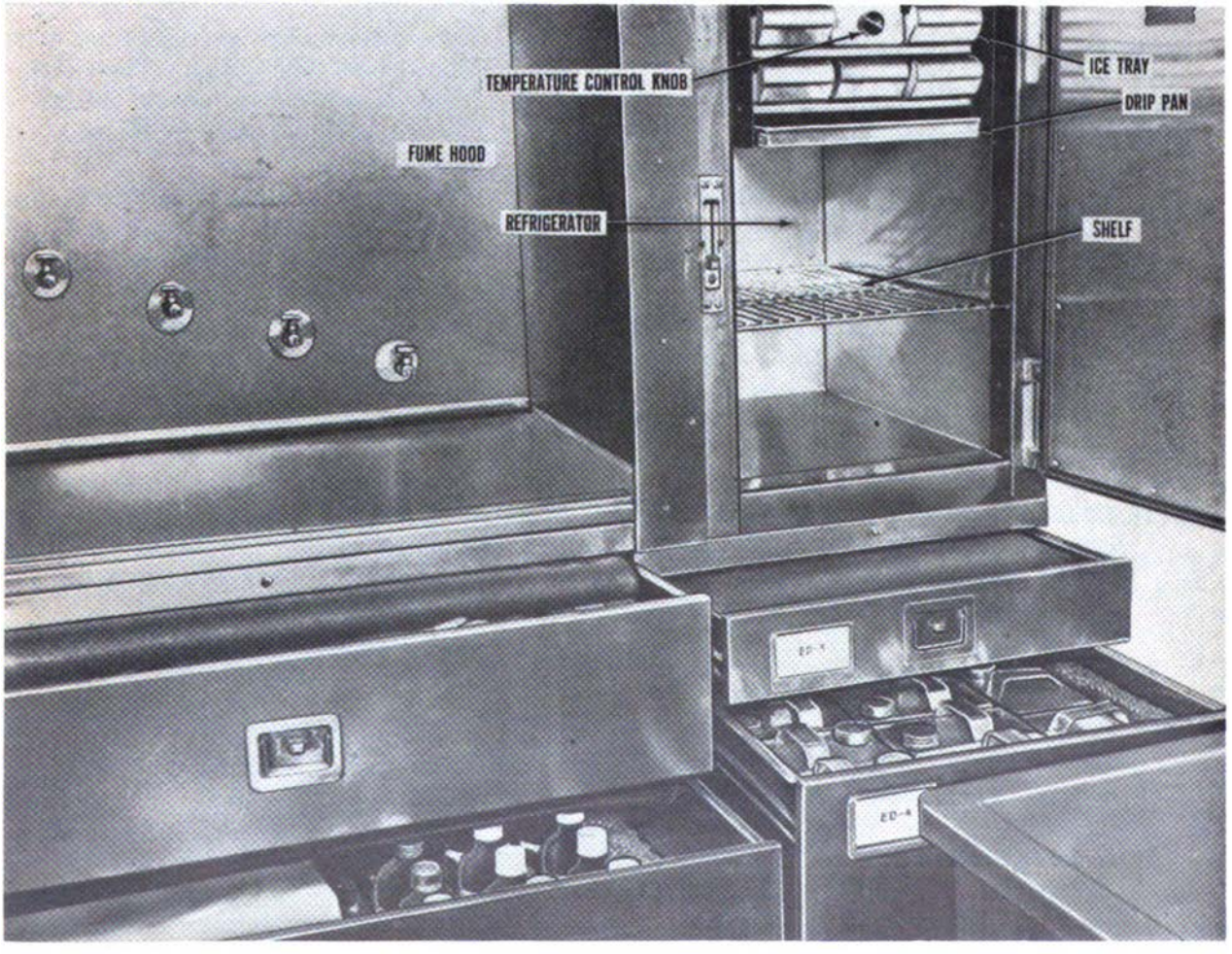


Figure 35. Refrigerator.

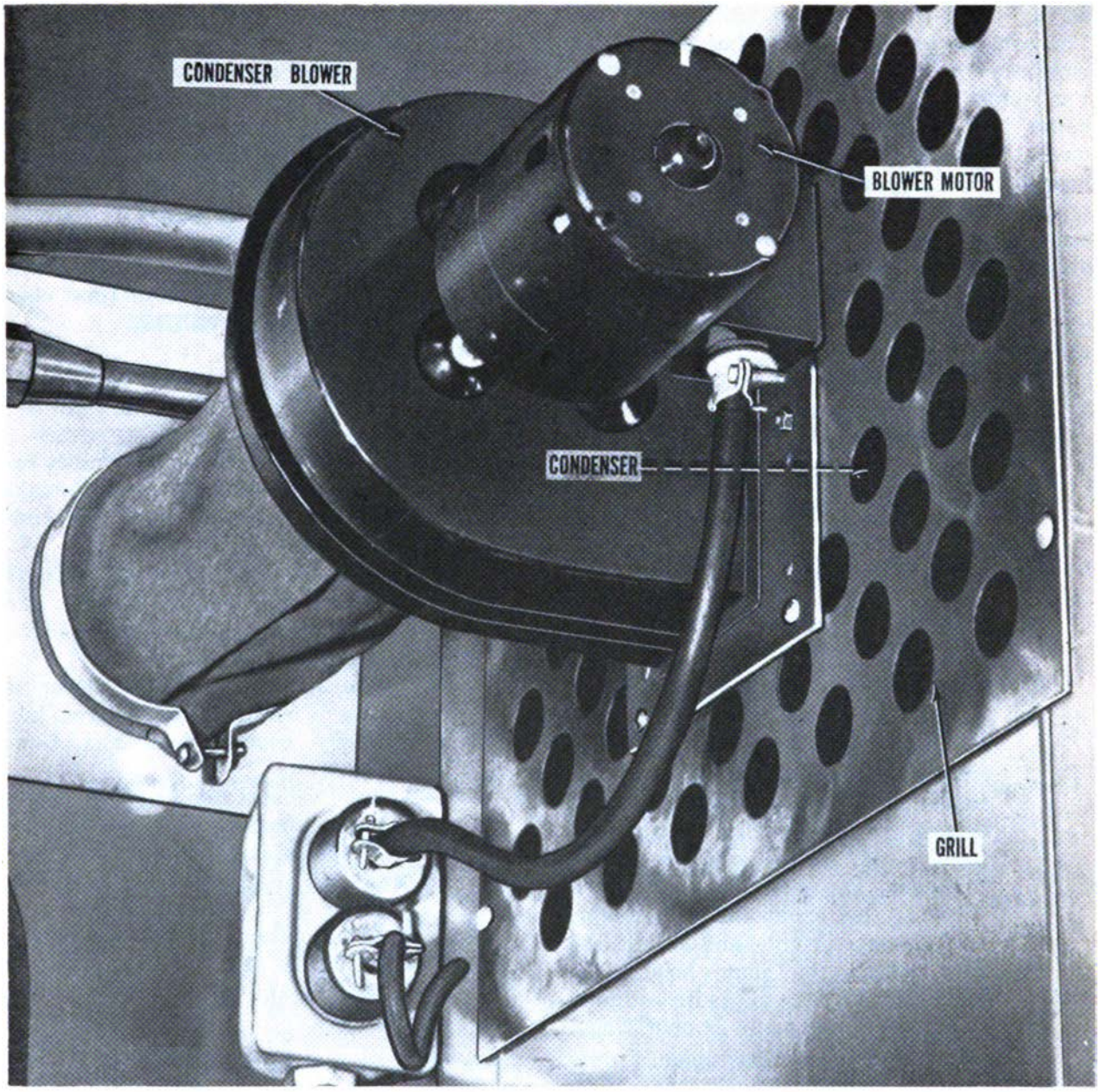


Figure 36. Condenser blower and motor.

Trouble	Possible cause	Remedy
		then operates, replace thermostat.
Condenser fan operates, unit fails to operate.	Relay circuit open.	Replace relay.
	Defective overload-protector relay.	Replace protector relay.
	Overload-protector relay tripped off.	Replace protector relay if it fails to operate after a 10-minute wait.
Condenser blower vibrates, is excessively noisy, heats.	Dirty fan blades.	Clean fan blades.
	Loose mountings.	Tighten mountings.
	Defective motor.	Replace motor.

37. Exhaust Blower and Ducts

a. Description. The exhaust blower-motor unit is located within the utility compartment

at the top of the fume-hood cabinet (fig. 37). The exhaust blower removes fumes from the laboratory compartment, drawing fumes directly into the fume hood by means of an exhaust duct along the ceiling of the compartment. Fumes are then removed from the fume hood by the exhaust-blower intake duct at the top of the fume hood and discharged from the semitrailer through the exhaust duct in the utility compartment and the exhaust hatch on the left side of the trailer (fig. 4). The exhaust duct along the ceiling is provided with exhaust intakes and hand-operated intake panels. The fume-hood cabinet is provided with three sliding Plexiglas doors, with intake ports and sliding panels at base of each door.

b. Data.

Exhaust motor-blower:

Manufacturer	ILG Electric Ventilating Co.
Type	E, single-phase, capacitor, 115/230 volts, 60 cycles, 2 plus 1 amperes, 1,750 r. p. m.
Ventilating capacity.	10 complete changes of air per hour.

c. Controls and Instruments.

(1) *Electrical controls.* Operation of the exhaust-blower fan is controlled by circuit-breaker switch 17 and the fume-hood fan ON–OFF toggle switch located on cabinet BD at the left front corner of the laboratory compartment. The upper left hand switch operates the exhaust-blower motor, and the upper right hand switch, the light within the fume hood. The warning light near the switches lights when the blower motor is operating.

(2) *Exhaust intakes.* The exhaust duct along the ceiling of the laboratory compartment contains exhaust intakes equipped with sliding panels.

(3) *Intake ports.* At the bases of the three sliding doors of the fume hood are intake ports equipped with sliding panels.

(4) *Exhaust hatch.* The exhaust hatch located on the left of the semitrailer (fig. 4) must be open when the blower is operating.

d. Operation.

(1) Open the exhaust hatch.

(2) Make sure circuit breaker switch 17 is closed.

(3) Push the exhaust-blower toggle switch to the ON position.

(4) To shut down exhaust blower, push exhaust-blower toggle switch on cabinet BD to OFF position; push fume-hood light switch to OFF position; close exhaust-blower hatch on left outside of semitrailer. If unit is not to be used for a period of time, open circuit breaker switch 17.

e. Maintenance.

(1) *Lubrication.* Lubrication of this unit is not required.

(2) *Before-operation service.*

(*a*) Check electrical connections to exhaust-blower motor; check to make sure that exhaust blower is mounted securely.

(*b*) Check to make sure that panels to exhaust intakes and ports, and fume-hood doors operate properly.

(3) *During-operation service.*

(*a*) Note whether exhaust blower is properly removing fumes from laboratory compartment and fume hood.

(*b*) Check exhaust blower for excessive noise, vibration, or overheating.

(4) *After-operation service.* Check and correct all deficiencies noted during operation of the equipment.

(5) *Troubleshooting.* The operator should be guided by the following chart in diagnosing and correcting operating difficulties.

Trouble	Possible cause	Remedy
Blower motor fails to run.	Defective wiring or loose connection.	Repair or replace wiring; tighten connection.
	Defective motor	Replace motor.
Blower and motor vibrate excessively, operate noisily, or overheat.	Excessive dirt or grease on blower blades.	Clean blower blades.
	Damaged bearings or bent shaft.	Replace motor.
	Loose mounting bolts.	Tighten bolts.
Blower fails to exhaust fumes.	Ducts obstructed	Remove obstruction.

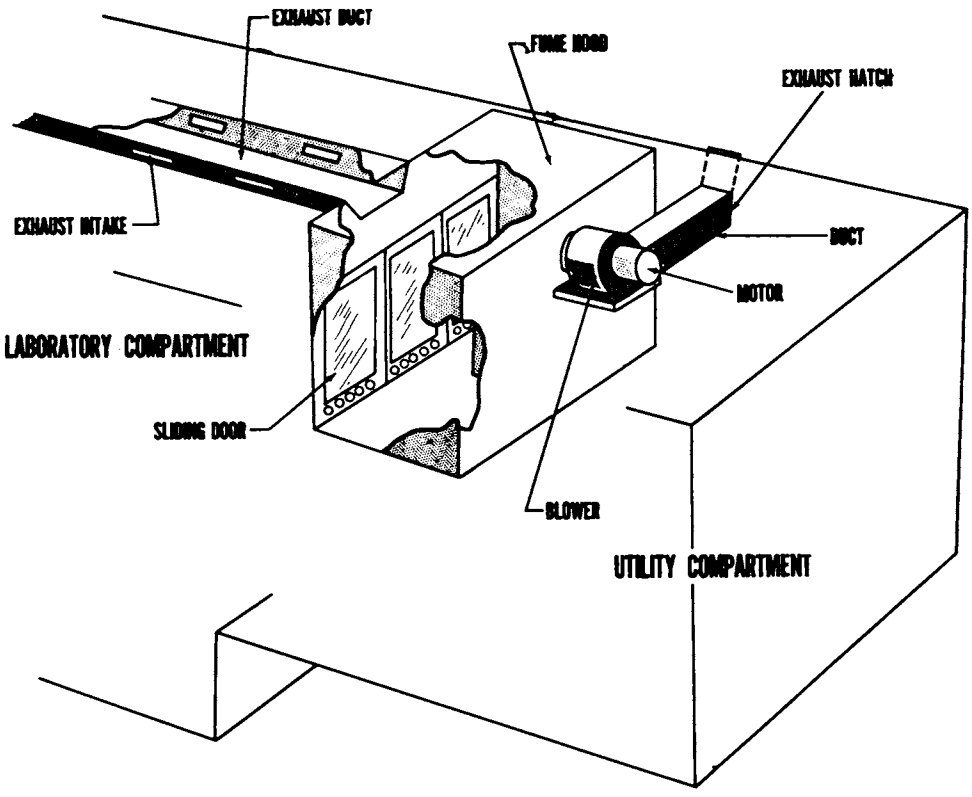


Figure 37. Exhaust blower and ducts.

38. Compressed-Gas Cylinders

a. Oxygen Cylinder.

(1) *Description.* The steel oxygen cylinder is located in the left rear corner of the rear compartment. The 220–240 cubic-foot-capacity cylinder is in an upright position, with its base resting in a circular receptacle and the cylinder body secured to the semitrailer by a metal band. The cylinder valve is connected to a pressure regulator (fig. 38), which is connected to the oxygen line running to the laboratory compartment.

(2) *Controls and Instruments.*

(*a*) *Cylinder valve.* The cylinder is equipped with a valve which controls flow of oxygen from the cylinder.

(*b*) *Pressure regulator.* The pressure-regulator inlet is connected to the cylinder-valve outlet, and the pressure-regulator outlet is connected to the oxygen line. The pressure regulator reduces pressure of compressed oxygen from cylinder pressure to desired working pressure (fig. 38).

(*c*) *Gages.* The gages on the pressure regulator indicate compressed-oxygen pressure within the cylinder, and working pressure of oxygen in the oxygen line.

(*d*) *Oxygen outlet valve.* An oxygen outlet valve is located on the partition wall above the oxidation-stability bath.

(3) *Operation.*

(*a*) Remove valve protection cap from cylinder.

(*b*) Remove outlet-connection cap from valve outlet connection.

(*c*) Open cylinder valve one-quarter turn counterclockwise and close immediately to clear the valve of particles of dust or dirt that might enter pressure regulator.

(*d*) Attach pressure regulator to cylinder-valve outlet and oxygen line.

(*e*) Turn pressure-regulator adjusting screw counterclockwise until pressure-regulator valve is fully open.

(*f*) Slowly open cylinder valve to full-open position.

(*g*) Turn pressure-regulator adjusting screw clockwise until desired working pressure is reached.

(*h*) To shut down, close cylinder valve. If pressure regulator is to be removed, release all oxygen from regulator and disconnect. Replace outlet-connection cap and valve protection cap.

(4) *Maintenance.*

(*a*) *Before-operation service.* Check to make sure that cylinder is undamaged, that connection threads are clean and undamaged, and that all connections are tight.

(*b*) *During-operation service.*

1. Check to make certain that proper cylinder and working pressures are being maintained.

2. Check for leaking valves, connections, and line.

(*c*) *After-operation service.*

1. Check all leaks in oxygen line and as required repair or replace defective components.

2. If pressure regulator is defective, replace pressure regulator; if cylinder or cylinder valve is defective, replace entire cylinder.

3. If cylinder is empty, disconnect pressure regulator, unfasten cylinder clamp, remove cylinder from compartment, open cylinder valve until positive that cylinder is entirely empty, close valve, replace outlet-connection cap, replace valve protection cap, and turn in cylinder to issuing agency.

(*d*) *Troubleshooting.* No repairs to defective cylinder or valve should be attempted by laboratory personnel. In event of leaking or blocked oxygen line, repair or replace the line. Replace entire cylinder, if cylinder or cylinder valve is defective. Replace pressure regulator, if defective.

(*e*) *Lubrication.* Do not lubricate cylinder valve or pressure regulator.

b. Propane Cylinder.

(1) *Description.* The steel propane cylinder is located on the left rear-wheel well cover in the forward left corner of the rear compartment. The 100-pound-capacity cylinder is in an upright position, with its base resting in a circular receptacle and the cylinder body secured to the semitrailer by a metal band. The cylinder valve is connected to a pressure regulator, which is connected to a propane line running to the laboratory compartment.

(2) *Operation and maintenance.* Operation and maintenance instructions for the propane cylinder are the same as those for the oxygen cylinder.

c. Freon Cylinder.

(1) *Description.* The steel Freon cylinder is located within the rear compartment on the left rear-wheel well cover. The 25-pound-capacity cylinder is securely supported in an upright position in a tube which is mounted on the left rear-wheel cover.

(2) *Control.* The Freon cylinder is equipped with a cylinder valve to control flow of Freon from the cylinder.

(3) *Operation.*

(*a*) Remove Freon cylinder from support.

(*b*) Remove valve protection cap.

(*c*) Remove outlet-connection cover.

(*d*) Connect cylinder-valve outlet to charging valve of refrigerator or air conditioner, whichever is to be charged.

(*e*) Slowly open Freon-cylinder valve.

(*f*) Close cylinder valve immediately after unit being charged is completely charged, or if Freon cylinder empties.

(*g*) Disconnect cylinder from unit being charged.

(*h*) Replace outlet-connection cover and valve protection cap.

(*i*) If not empty, replace cylinder in support in rear compartment. If empty, turn in for recharging.

(4) *Maintenance.* Maintenance instructions for the Freon cylinder are the same as those for the oxygen cylinder.

d. Carbon Dioxide Cylinder.

(1) *Description.* The steel carbon dioxide cylinder is located at the left rear wall of the rear compartment. The 50-pound-capacity cylinder is in an upright position with its base resting in a receptacle on the semitrailer floor; the cylinder body is secured to the semitrailer by means of a metal band.

(2) *Control.* Flow of carbon dioxide from the cylinder is controlled by the cylinder valve.

(3) *Operation.* For operating instructions, refer to paragraph 57*b*.

(4) *Maintenance.* Maintenance instructions for the carbon-dioxide cylinder are the same as those for the oxygen cylinder.

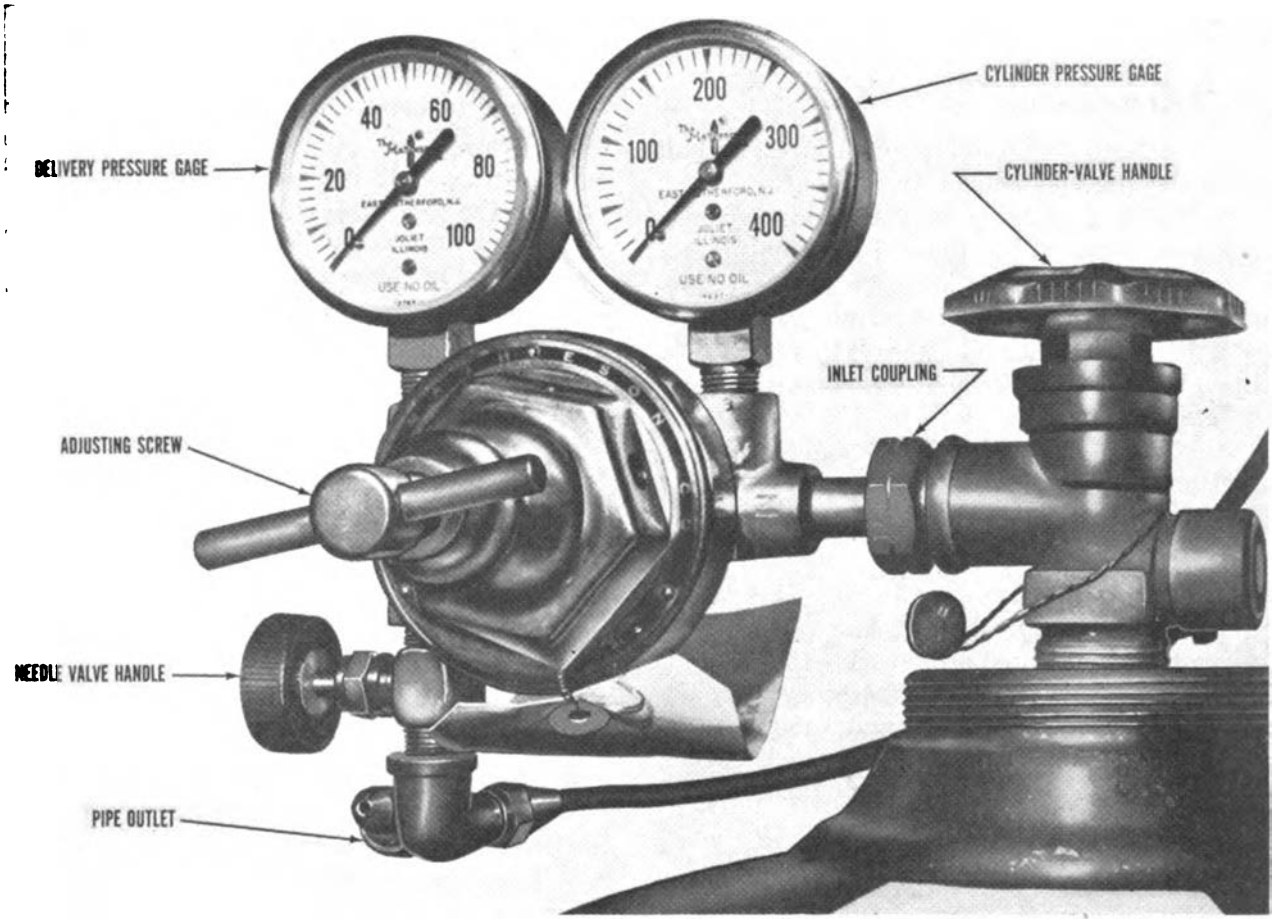


Figure 38. Pressure regulator and gages.

CHAPTER 4
LABORATORY APPARATUS

Section I. GENERAL

39. Test References

To perform required test procedures, consult the following applicable references:

a. ASTM Standards on Petroleum Products and Lubricants (With Related Information).

b. ASTM Manual on Measurement and Sampling of Petroleum and Petroleum Products.

c. Federal Standard No. 791, Lubricants, Liquid Fuels, and Related Products; Methods of Testing.

d. New and Revised TAG Manual for Inspectors of Petroleum.

40. Layout

All testing apparatus and equipment except the knock engine are stored below workbenches, permanently mounted atop workbenches, or attached to the walls in the laboratory compartment. Numbered drawers and cabinets (fig. 39) are installed beneath the workbenches. Along the left side of the compartment are 19 drawers and 1 cabinet. Along the right side are 3 drawers and 6 cabinets. At the front, beneath the fume hood and refrigerator, are 4 drawers. Small apparatus such as pipettes, thermometers, glassware (fig. 40), and chemicals (fig. 41), are stored in drawers. Bulky apparatus such as the analytical balance, typewriter, and spot-testing kit (fig. 42), and miscellaneous equipment such as brushes, sampling devices, and drum-plug wrenches (fig. 43), are stored in cabinets. For inventory purposes, each drawer and cabinet should be provided with a list of its contents. Chemicals are also stored in the utility compartment. To determine storage location of apparatus or equipment, refer to appendix II. To locate chemicals, refer to appendix III.

41. General Laboratory Procedure

To provide for safety of personnel and all equipment, and to insure accurate test results, observe the following rules.

a. Keep fire extinguishers properly charged and located in the semitrailer.

b. Use equipment only for purposes for which intended.

c. Make certain apparatus is properly assembled and firmly positioned before starting a testing procedure.

d. Discard oily rags in covered metal containers. Never store them within drawers, cabinets, or compartments.

e. Predetermine hazards that may be involved before starting any test procedure.

f. Immediately wipe up any liquid that has spilled.

g. Stay alert, especially when performing tests requiring heating operations.

h. Do not use faulty rubber or copper tubing.

i. Never use cracked or broken glassware, particularly when heating samples.

j. Keep sample containers clean and dry when not in use.

k. Keep sample containers stoppered or capped except when pouring out samples. Always replace same cork or stopper in container from which it was removed.

l. Keep all testing equipment clean and properly stored when not in use; clean testing equipment as soon after completing test procedures as possible. Do not allow liquids used in making a test to dry out in testing equipment. Never use equipment in which liquid from a previous test has dried without first cleaning thoroughly.

m. Plainly mark all containers to show contents.

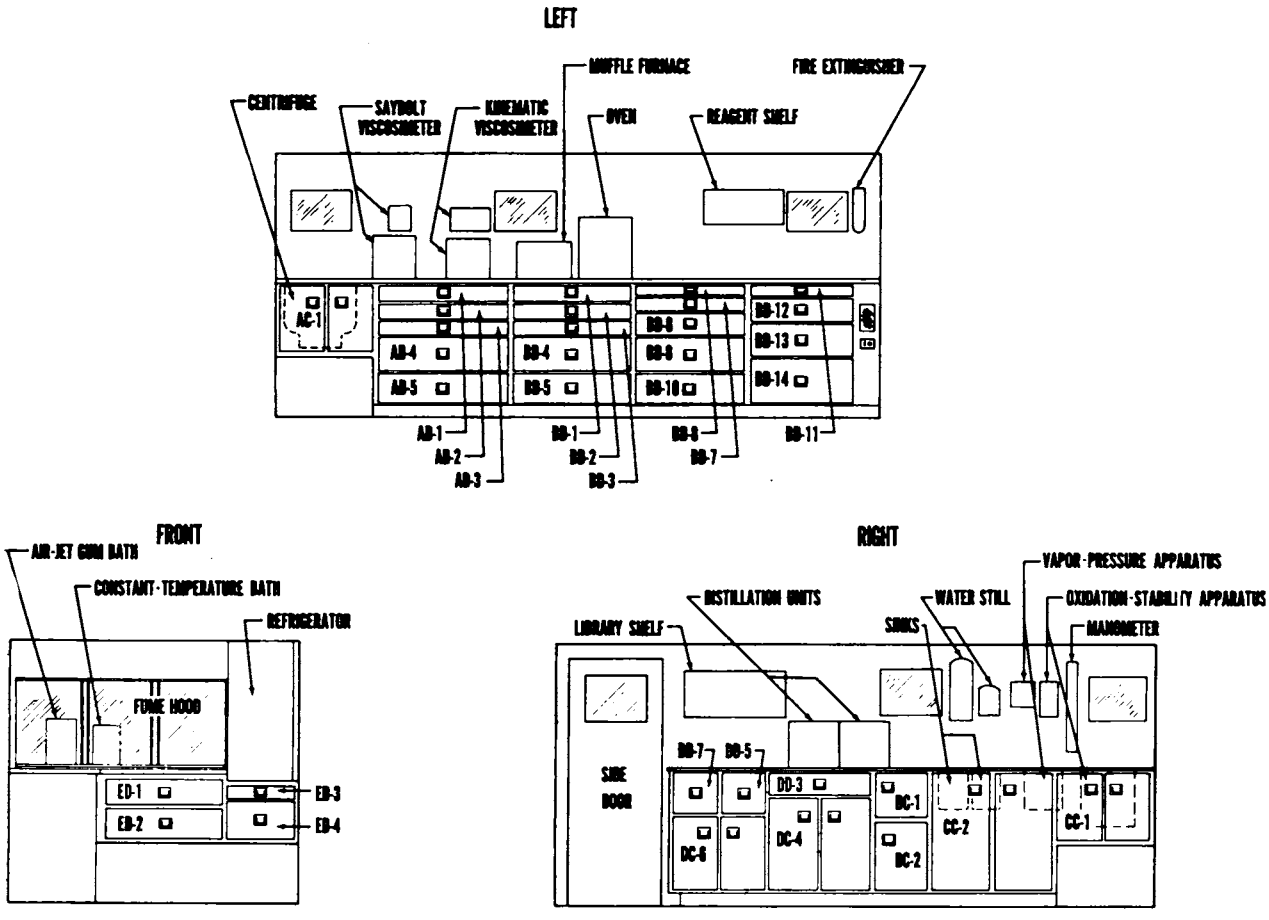


Figure 39. Laboratory compartment drawers and cabinets.

n. Never use solvents near an open flame. Never heat solvents.

o. Cover hot samples while they are cooling.

p. Handle liquids carefully to avoid spills or splashes. If any part of the body is affected by a spilled or splashed liquid, wash with water as soon as possible.

q. When boring holes in corks, hold the cork so that the hands cannot be injured if the cork breaks. Hold the cork against a solid surface.

r. Never attempt to stop a centrifuge with the hands.

s. Keep samples of volatile products as cool as possible.

t. Cool hot oils before discarding. Pouring hot oil into drains or receptacles may result in a flash fire, or may cause serious burns as a result of splattering.

u. Never clean flash cups by dipping into naphthas.

v. Handle compressed gas cylinders with care as all compressed gases are under high pressure. Flammable and explosive gases must be handled with particular care. Compressed-gas cylinders must never be allowed to come in contact with fire, sparks, or electrical circuits, as explosions may result. As compressed-gas cylinders are made of steel, such explosions have the same destructive effect as a bomb burst.

w. Fill distillation flasks at least 6 feet away from a flame when handling products having vapor pressures of less than 12 pounds.

x. Extinguish burner flame or cut off heater before removing the distillate receiver upon completion of a distillation.

y. Make certain that laboratory compartment is adequately ventilated and that all fumes are being properly exhausted.

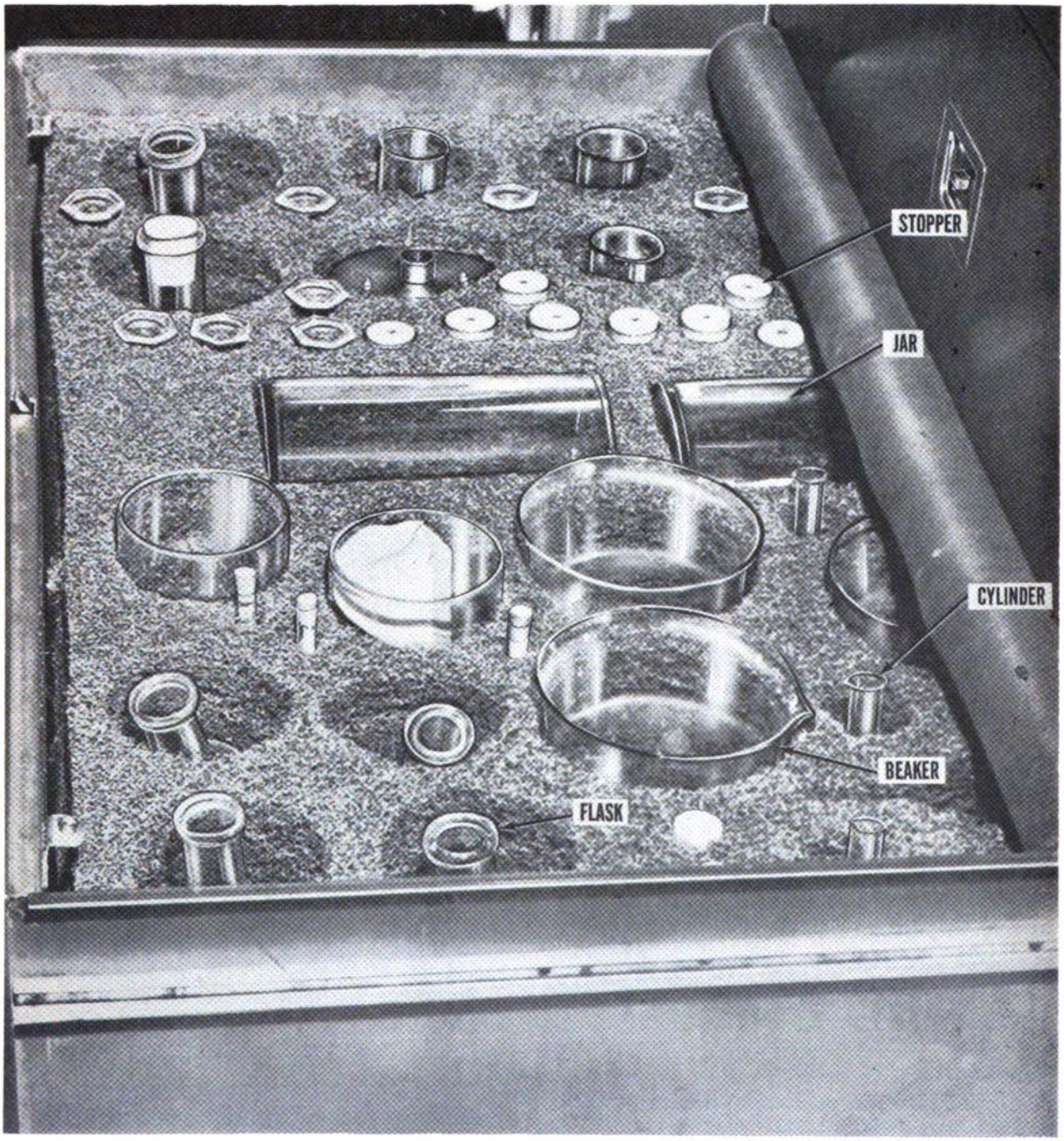


Figure 40. Glassware drawer.

Figure 41. Chemical drawers.

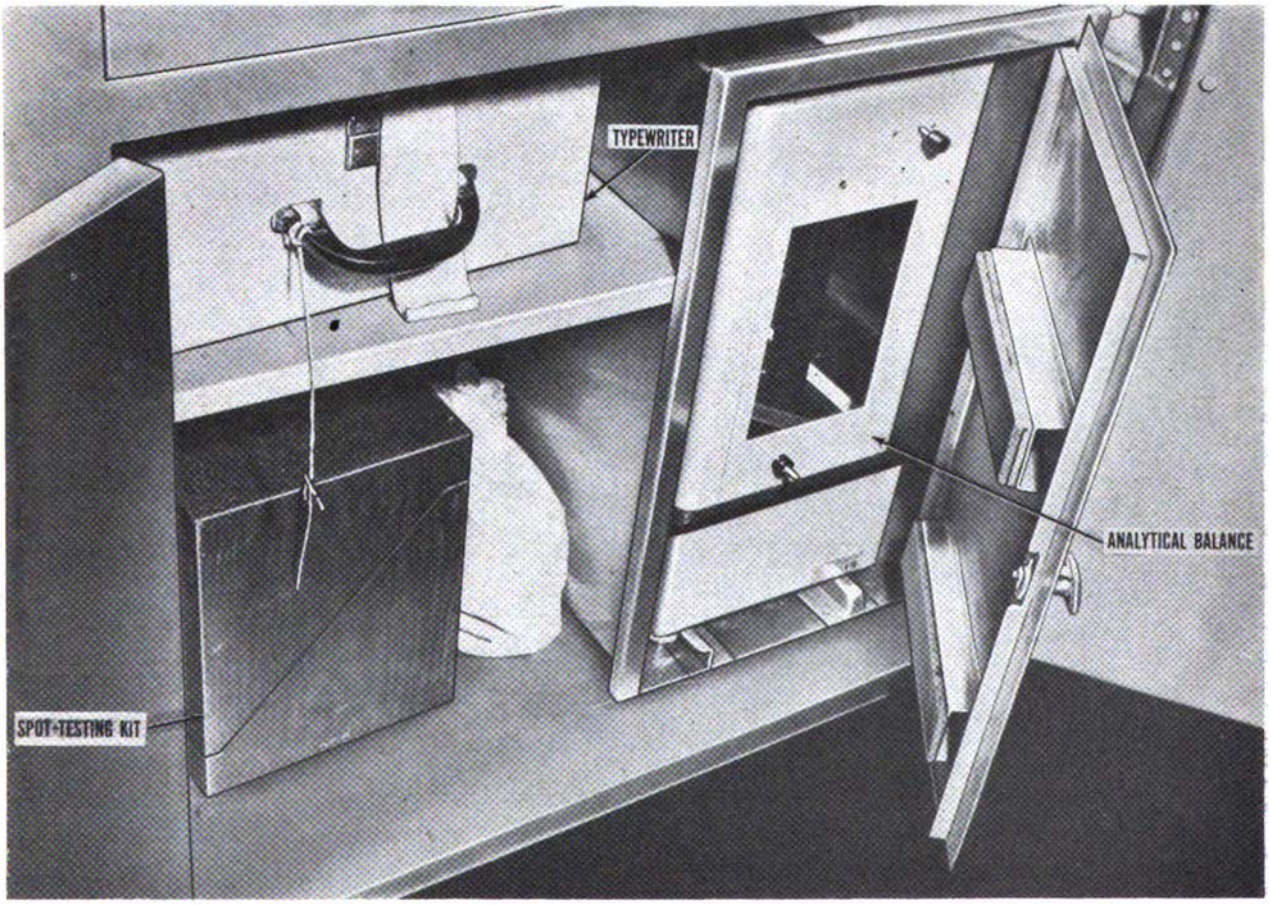


Figure 42. Storage cabinet for bulky apparatus.

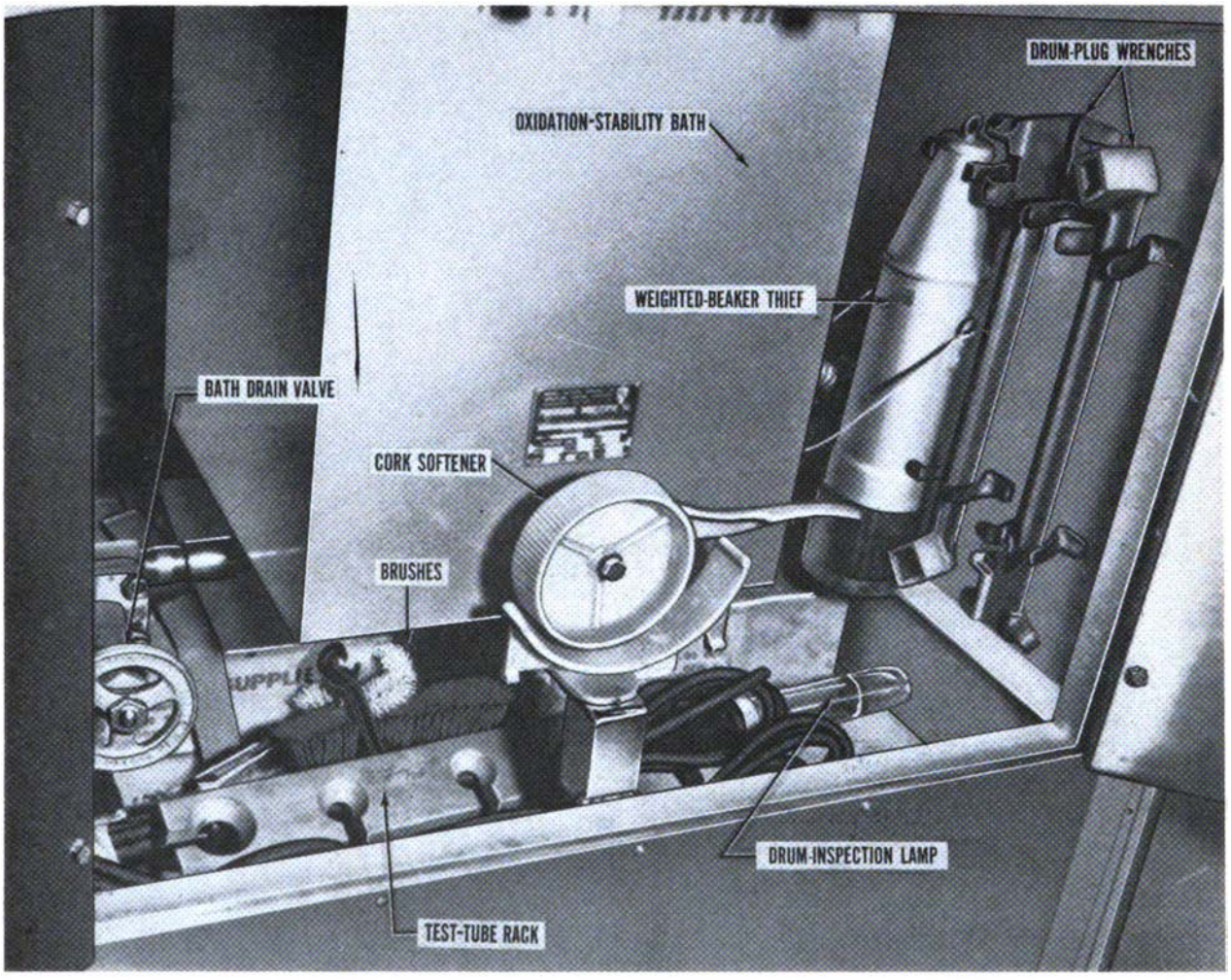


Figure 43. Storage cabinet for miscellaneous equipment.

Section II. OPERATING PROCEDURES

42. Centrifuge

a. Description. The centrifuge (fig. 44) is located in cabinet AC–1. The unit is equipped with a 4-place, 100-milliliter pear-shaped-tube head, four 100-milliliter pear-shaped-tube alumin shields, and eight 100-milliliter graduated centrifuge tubes. An electric motor with grease-sealed ball bearings, mounted inside the base, spins the head at speeds which are regulated by a built-in rheostat control. Circuit breaker 13 controls current to the centerifuge.

b. Operation. Before starting centrifuge, place tube containing sample in centrifuge and close cover. To start centrifuge, move lever at base from OFF position to position 1 for speed of 650 r. p. m., to position 2 for speed of 1,000 r. p. m., and to position 3 for speed of 1,700 r. p. m. To stop centrifuge, move lever back to OFF position. Never stop centrifuge by using hands.

c. Cleaning. Use clean cloth to clean interior and exterior of centrifuge. Use suitable solvent and mild soap-and-water solution for cleaning centrifuge tubes. Rinse tubes with clear water, and air-dry.

43. Saybolt Viscosimeter

a. Description. The Saybolt viscosimeter, used for determining viscosity of lubricating oils, is located above drawer AD–1. The Saybolt apparatus includes a 2-tube-capacity constant-temperature oil bath equipped with a 660-

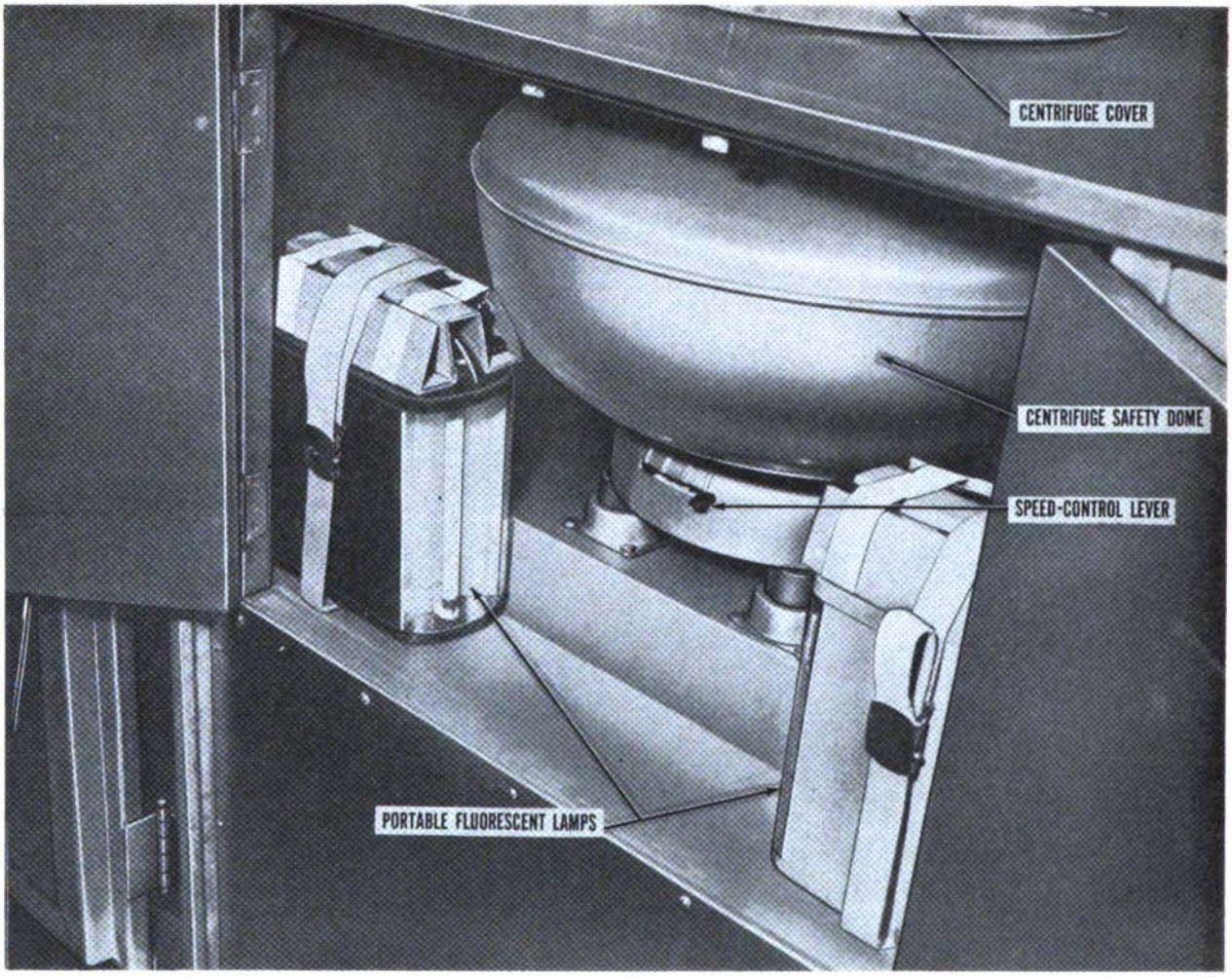


Figure 44. Centrifuge.

watt heater and two 60-watt heaters mounted in the bath, and an induction-type motor stirrer; 2 stainless-steel viscosity oil tubes; 4 universal tips and 2 furol tips; 6 receiving flasks; 2 sets of 6 thermometers each, 1 set graduated in Fahrenheit degrees and the other in Centigrade degrees; a withdrawal pipette; thermostat guard; strainer with 100-mesh replaceable wire gauze; tube-cleaning plunger; special oil for filling bath; a control box, mounted on the laboratory wall, equipped with 3 toggle-type ON-OFF switches; and a mercury-to-mercury thermoregulator. Circuit breaker switch 12 controls current to the Saybolt viscosimeter apparatus.

b. Operation.

(1) Insert oil tubes. Oil tubes may be inserted without removing top of bath. Place one ⅛-inch lead washer inside bath and one washer outside bath. Before tightening oil-tube locknut, shift tube so that it is exactly centered in bath-cover opening, and tighten securely with wrench.

(2) Fill thermoregulator U-tube with mercury (drawer BD–12) making sure that no air bubbles remain in the filled tube. Place the filled thermoregulator down in the top center opening of the bath, keeping regulating screw to the rear. Make sure thermoregulator is positioned securely.

(3) Fill bath with special oil (cabinet CC–2). As the oil expands on heating, the bath need not be filled to the overflowing point at the start. Before starting tests, make sure that oil level is up to overflow point.

(4) Push toggle of line switch on control box to ON position. Push toggle of switch marked QUICK on control box to ON position. This switch controls the 60-watt and the 660-watt heaters. When the QUICK switch is turned on, both the red warning and clear pilot lights flash on at the same time. A relay, controlling both heaters, prevents bath from exceeding set temperature. When required temperature is reached, turn off QUICK switch to obtain necessary close temperature control.

(5) If a heat temperature of above 190° F. is desired, push toggle of switch marked CONTINUOUS to ON position.

(6) When temperatures of below 100° F. are required, pass air or, if necessary, cold tap water through cooling coil. To regulate flow of water, place a needle valve in intake line. Connect inlet to lower hose connection at right rear of bath, connect upper hose connection to drain.

(7) To drain bath, attach hose to nipple at lower end of overflow tube. Lift bath cover and unscrew overflow tube, allowing oil to drain quickly.

(8) For detailed descriptions of test procedures using the Saybolt viscosimeter, consult applicable petroleum testing references.

c. Servicing.

(1) *Lubricating.* Oil stirrer motor every 1,000 hours of use applying light lubricating oil (LO).

(2) *Cleaning.* Clean exterior of bath using clean damp cloth. When required, clean bath interior after completely draining oil, using suitable solvent to remove remaining oil. Wash bath with mild soap-and-water solution and rinse thoroughly with clear water. Air-dry or use clean lintless cloth. Clean the capillary tube of the thermoregulator, when required, by pushing a cotton-covered wire through the tube, making sure that no trace of oil contaminates either mercury or tube.

44. Kinematic Viscosity Apparatus

a. Description. The kinematic viscosimeter (fig. 45), used for determining the kinematic viscosity of petroleum products, is located above drawer AD–1. The apparatus includes a constant-temperature bath consisting of a Pyrex glass jar and a stainless-steel insulating jacket at the top of which are housed stirrer and motor, terminals of two 300-watt heaters and a 600-watt heater, and a mercury thermoregulator. The bath accommodates 6 capillary-type viscosimeter tubes. The bath is connected electrically to a relay control box, which houses a temperature-control knob, heater switches, and pilot light, mounted on the laboratory wall above the apparatus. Circuit breaker switch 11 controls current to the apparatus.

b. Operation.

(1) Fill bath with oil (Primol D S/N 6505–034–7755) to ½ inch of the cap. Secure cover by adjusting and tightening the three eccentric lugs projecting from the underside of the cover.

(2) Adjust thermoregulator to approximate control point (*c* below), if required, and insert it into bath through hole provided in cover. Connect thermoregulator to outlet directly below motor and insert 8-prong plug into relay control box.

(3) Place suitable thermometer into thermometer well.

(4) Push line-switch toggle on relay box to ON position. Make sure that heater units are completely immersed in bath liquid. When line switch is turned on, stirrer starts operating and pilot light glows.

(5) Push auxiliary-heater-switch toggles No. 1 (300-watt heater) and No. 2 (600-watt heater) to ON position to bring bath quickly to required temperature. When pilot light goes off, push switches No. 1 and No. 2 to OFF position.

(6) When pilot light glows again, adjust the controlled heater by turning temperature-control knob as required to minimize overshoot above desired control point. The temperature-control knob regulates a 300-watt heater.

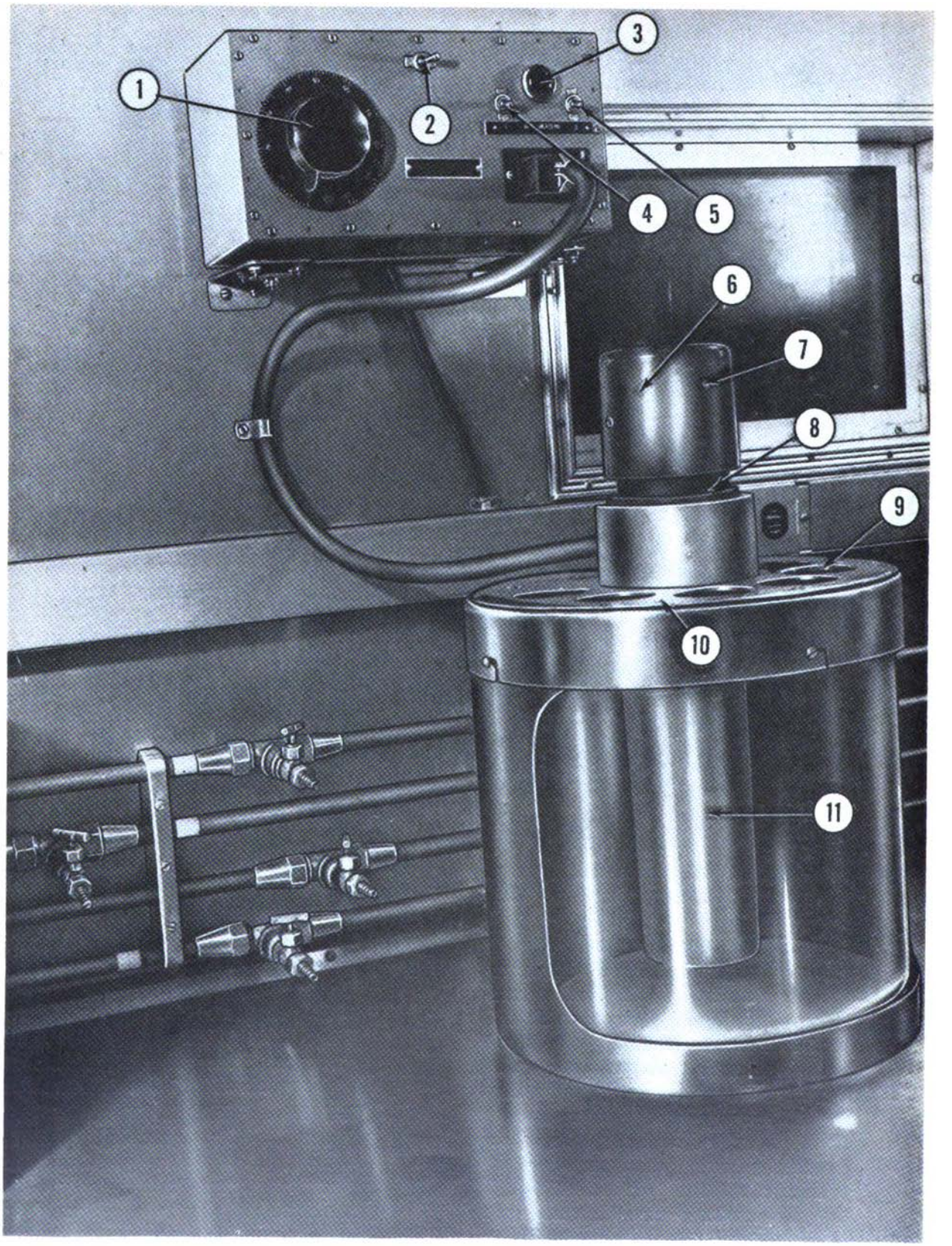


Figure 45. Kinematic viscosimeter.

1 Temperature-control knob
2 ON–OFF switch
3 Warning light
4 Auxiliary-heater switch No. 1
5 Auxiliary-heater switch No. 2
6 Stirrer motor
7 Lubrication point
8 Lubrication point
9 Opening for kinematic viscosity pipette
10 Thermometer opening
11 Heating element

Figure 45—Continued.

(7) For detailed descriptions of test procedures using the kinematic viscosimeter, consult applicable petroleum testing references.

c. Servicing.

(1) *Lubricating.* Oil stirrer motor every 1,000 hours of use, applying light lubricating oil (LO).

(2) *Cleaning.* Clean interior and exterior of bath using clean damp cloth.

(3) *Adjusting thermoregulator.*

(*a*) Remove thermoregulator from bath. Turn the magnet ring knob until contact wire is out of capillary tube. Turn thermoregulator from vertical position to an angle permitting free mercury to run through hole in cup.

(*b*) Invert thermoregulator so that hole in cup is at top.

(*c*) Turn thermoregulator to an angle allowing free mercury to fill cup and, while holding in this position, place thermoregulator in a bath adjusted at approximately 5° above desired control point. After about 2 minutes, return thermoregulator to vertical position, allowing all excess mercury to return to mercury reservoir.

(*d*) Turn magnet ring knob of thermoregulator for setting temperature approximately 10° F. from the primary control point. If a lower temperature than original setting is required, heat thermoregulator until mercury in the capillary rises to the cup to prevent mercury column from separating.

45. Muffle Furnace

a. Description. The muffle furnace (fig. 46) is located above drawer BD–1. The furnace is used for heat-treating, precipitate-drying, ashing, igniting, and fusing. It has a continuous operating temperature range of from 100° to 1,800° F., and intermittent heating as high as 2,000° F. will not damage the muffle winding or refractories. The furnace consists essentially of a muffle chamber with drop door and steel tray, and a base housing a temperature gage (pyrometer) showing both Fahrenheit and Centigrade scales, percentage timer, pilot light, and ON-OFF toggle switch. Circuit breaker switch 9 controls current to the furnace.

b. Operation.

(1) Place toggle switch in ON position.

(2) Set percentage timer. The timer operates so that heat is on for a set percentage of 1 minute and off the remaining part. For example, with the timer set at 20, the heat is on 20 percent of 1 minute and off 80 percent; a setting at 60 controls temperature at approximately 1,800° F. For quick heat-up, set timer at 100 which provides continuous heating, but make sure to turn back timer when pyrometer shows temperature reading at 1,800° to prevent burning out of heaters, refractories, etc., caused by excessive temperatures.

c. Cleaning. Clean steel tray and chamber interior, using a clean cloth and mild soap-and-water solution.

46. Oven

a. Description. The utility oven (fig. 47) is located above drawer BD–1. Producing heat ranging from 35° to 180° C., it is used for baking, drying, conditioning, and preheating. The cabinet-type, gravity-convection oven is equipped with hydraulic, snap-action thermostat, two adjustable latticed metal shelves, hinged door with safety latch, adjustable ventilator, pilot lamp, ON-OFF toggle switch, and a thermometer ranging from 0° to 200° C. Circuit breaker switch 10 controls current to the oven.

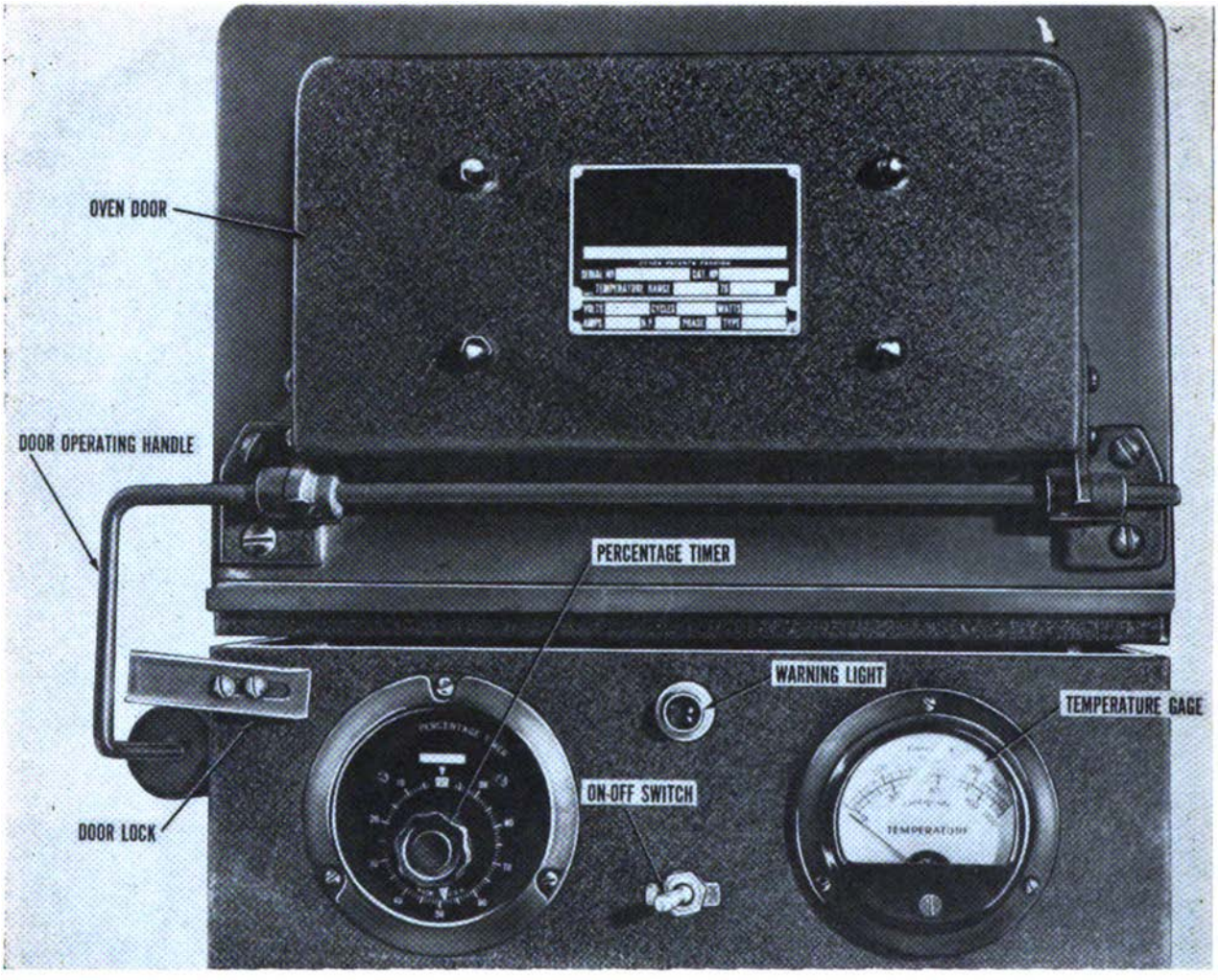


Figure 46. Muffle furnace.

b. Operation.

(1) Insert thermometer through hole in center of exhaust-vent shutter in top of oven, and open vent shutter. Make sure that thermometer bulb extends as far into heating chamber as possible to insure correct temperature reading.

(2) In loading oven, whenever possible, use only one shelf and leave ample space between objects for proper air circulation and maximum heat transfer. Never place materials on oven floor or below lowest shelf position. Shelves should not be overloaded, and should never be loaded from wall to wall.

(3) Always leave shutter in exhaust vent at least one-fourth open. As oven operates by gravity convection, air circulation is vertical. Air enters through opening in oven bottom, passes over the heater, and then through perforations of heater plate into cabinet where it passes through exhaust vent. By opening shutter, air movement within oven is increased, and more fresh air introduced.

(4) Place toggle switch in ON position.

(5) As reference points on temperature-control knob do not correspond with temperature settings, temperature readings must be taken from the thermometer. To raise temperature, turn temperature-control knob clockwise until pilot lamp indicates heaters are on. To lower temperature, turn knob counterclockwise. When turning

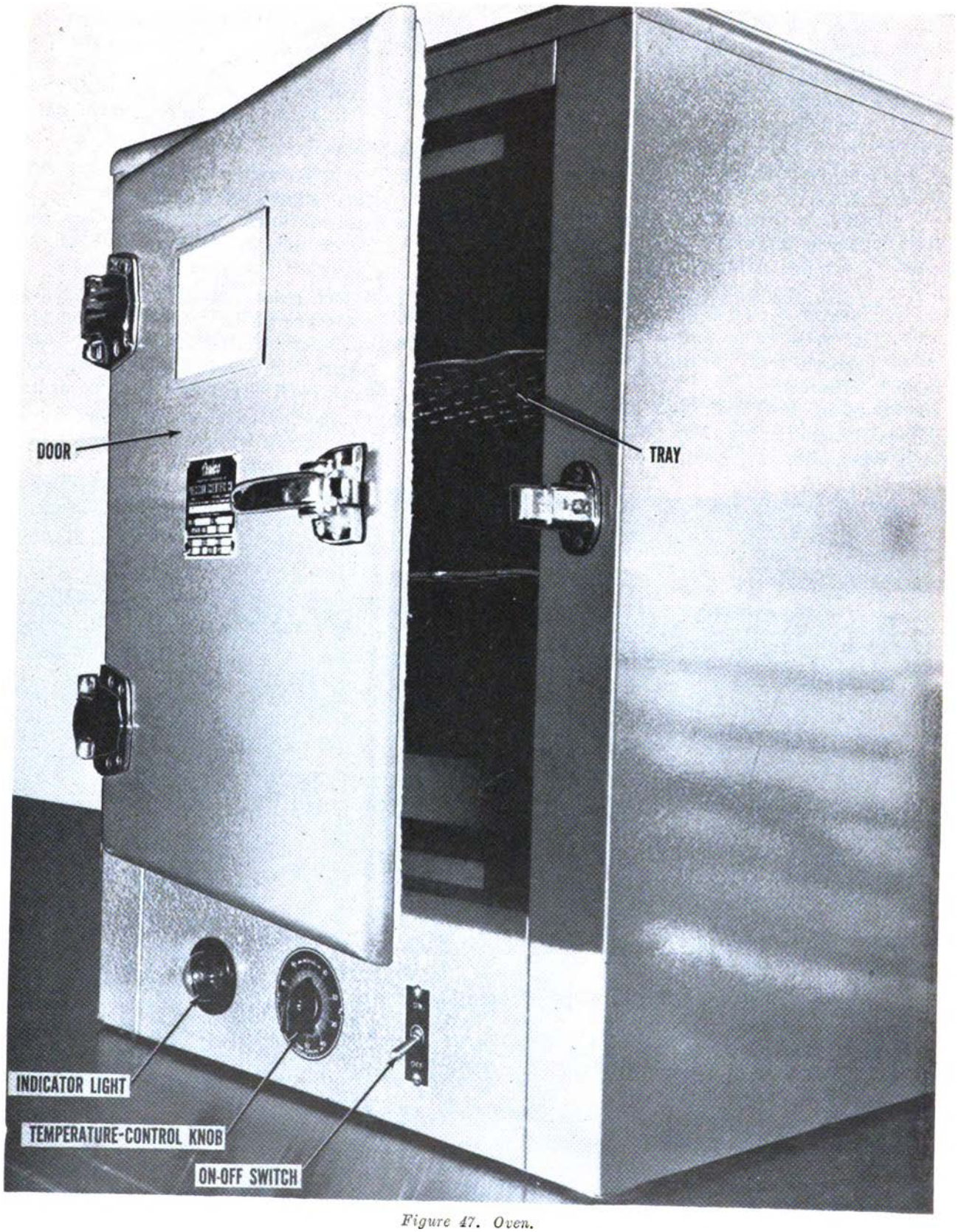


Figure 47. Oven.

temperature-control knob clockwise, it is necessary to back off slightly to take up lost motion in thermostat mechanism.

(6) When oven has reached desired temperature, turn temperature-control knob counterclockwise until heat shuts off, as indicated by pilot lamp going out.

(7) Before final temperature adjustment can be made, allow about an hour for oven heat to stabilize. If, after elapsed time, temperature is not at desired degree, turn temperature-control knob to raise or lower temperature as required until desired temperature is attained.

c. Cleaning. Use clean cloth and mild soap-and-water solution to clean interior and exterior when oven has cooled.

47. Air-Jet Gum Bath

a. Description. The air-jet gum bath (fig. 48), used to determine preformed gum in petroleum products, is located in the fume-hood cabinet. The apparatus includes a double-unit gum bath, metal reflux condenser, thermometer (30° to 400° F.), airflow gage and regulating valve, a 3-heat switch, and 8 beakers. Circuit breaker switch 14 controls current to the bath.

b. Operation.

(1) Using a solution of 97 percent ethylene glycol and 3 percent water, fill bath through reflux-condenser entrance tube to within 1 inch of the top.

(2) Attach reflux condenser to bath using union provided. Connect hose connection marked INLET to cold-water supply line, and hose connection marked OUTLET to a suitable drain.

(3) Couple flow-gage assembly directly to bath fitting without using any intermediate pipes or connections.

(4) Turn heater switch to high position until desired temperature is reached, then change switch position to medium

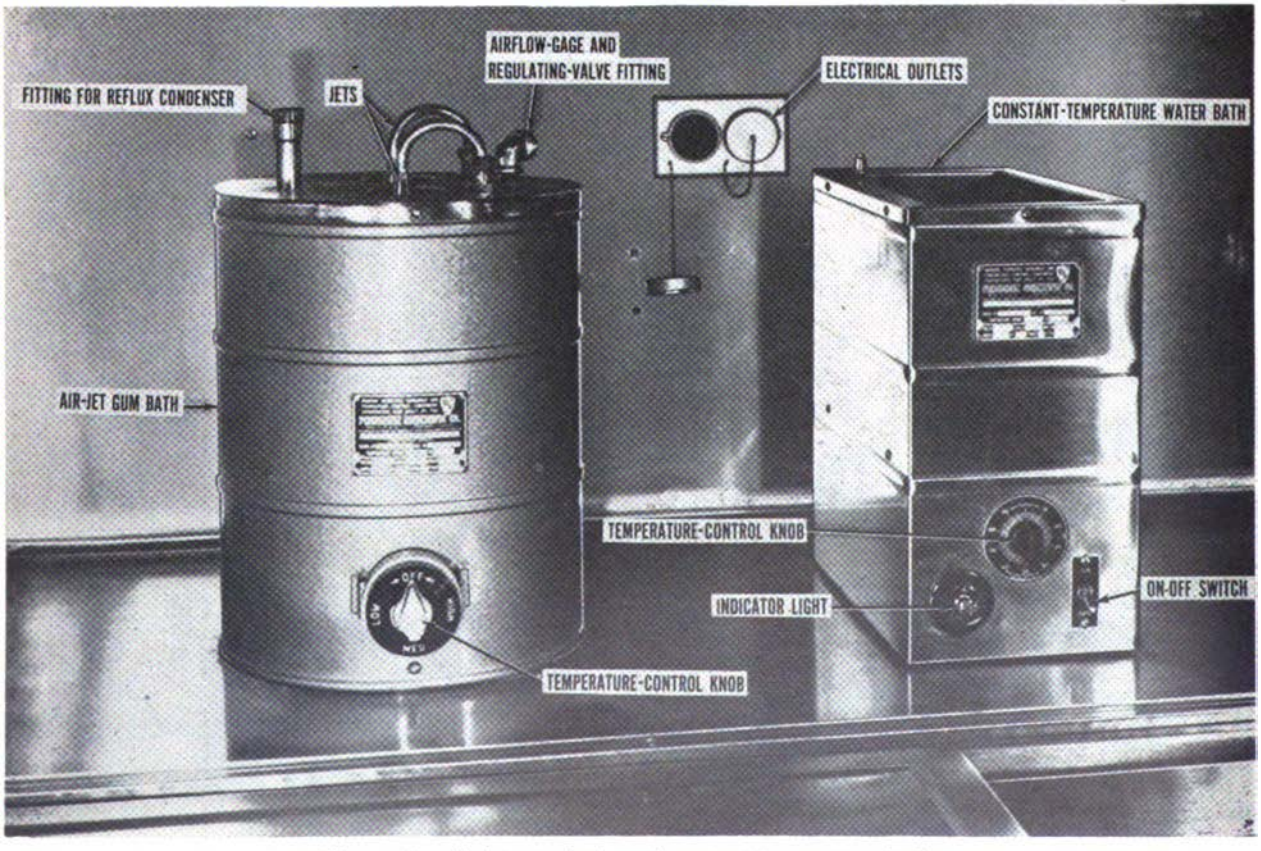


Figure 48. Air-jet gum bath, and constant-temperature bath.

or low as necessary for maintaining temperature.

(5) When solution in bath has reached prescribed operating temperature, attach a hose from compressed-air outlet to airflow inlet of bath and turn on compressed-air valve.

(6) When bath is operating, it may be necessary to adjust the flow of cooling water to eliminate vapors escaping through the top of the condenser.

(7) To control airflow into bath, adjust air regulator by turning adjusting screw clockwise to increase flow; counterclockwise to decrease flow. The flow gage is calibrated in pounds and ounces corresponding to the flow of air in liters per second. The gage reading is equivalent to an airflow of 1 liter per second with a tolerance of plus or minus 15 percent, in accordance with ASTM standards. The normal reading of 1 liter per second is indicated by black graduations on the flow gage; the tolerances by red graduations.

(8) For detailed descriptions of test procedures using the air-jet gum bath, consult applicable petroleum testing references.

c. Cleaning. Use clean cloth and mild soap-and-water solution to clean exterior of bath.

48. Constant-Temperature Water Bath

a. Description. The constant-temperature water bath (fig. 48), used to maintain water at constant temperature for test procedures, is located in the fume-hood cabinet. The bath is constructed of stainless steel and houses a 300-watt heater, thermostat, thermoregulator,

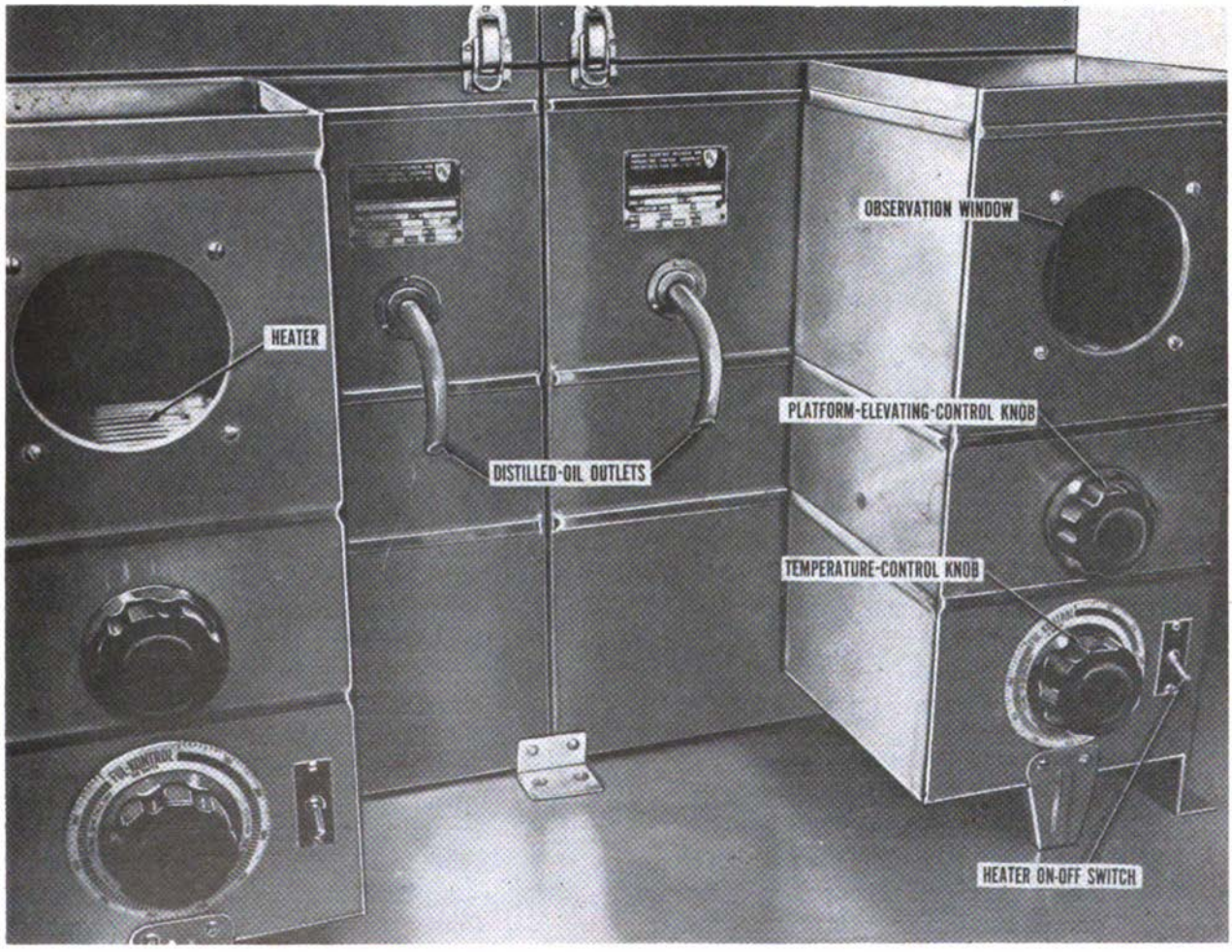


Figure 49. Distillation units.

microswitch, terminal leads, pilot lamp, and ON-OFF toggle switch. The bath is equipped with three ring covers, a thermometer (0° to 70° C., or 32° to 158° F.), and holder. The bath is used for heating and maintaining constant temperature of water from room temperature to a maximum temperature of 60° C. (140° F.). Circuit breaker switch 15 controls current to the water bath.

b. Operation.

(1) Fill bath with water to desired level.
(2) Insert suitable thermometer in space provided at top of bath.
(3) Push toggle switch to ON position.
(4) Set temperature-control knob for desired temperature. After determining reference point, adjust knob to specific temperature required.

c. Cleaning. Use clean damp cloth to clean bath exterior.

49. Distillation Units

a. Description. Two petroleum distillation units (fig. 49), used for distillation of petroleum products, are located above drawers DD–3 and DC–1. Each unit consists of a shield assembly and a condenser assembly. The shield and condenser exteriors are constructed of stainless steel; the condenser interior of copper insulated with a 1-inch thickness of fiberglass. The ice-refrigerated condenser is equipped with a drain and overflow outlet, and distilled-oil outlet. The shield incloses a 750-watt heater with autotransformer, 2 porcelain refractory blocks, observation window, an elevating device to allow proper alinement of distillation flask to condenser tube, a temperature-control assembly, and an ON-OFF toggle switch. A wood block is provided for supporting cooling jar and graduate. Circuit breaker switch 3 controls current to the distillation units.

b. Operation.

(1) Push toggle switch to ON position.
(2) Turn temperature-control knob clockwise to increase temperature; counterclockwise to decrease temperature.
(3) To operate elevating control, turn knob clockwise to raise platform; counterclockwise to lower platform. Total vertical adjustment is ¾ inch.
(4) Consult applicable petroleum testing references for detailed descriptions of test procedures in which petroleum distillation units are used.

c. Cleaning. Use clean cloth and mild soap-and-water solution to clean interior and exterior of distillation units.

50. Water Still and Storage Tank

a. Description. The water still and distilled-water storage tank are mounted above the sinks on the right wall of the laboratory compartment (fig. 50). The water still is used to distill water for use in test procedures. The still consists of a heater section, containing a 1,200-watt heating element; a boiler section, directly above the heating element; and a condenser section at the top. Circuit breaker switch 4 controls current to the heater. The still is designed to operate so that the water circulates through the condenser before passing into the boiler section where it is vaporized. To insure that an even flow of raw water is maintained, a special uniflow constant-head cup is provided with the still. The cup, along with its mounting rod and a hose Y-fitting, is stored in drawer BD–12. The still has a rated capacity of one-half gallon of distilled water per hour.

b. Operation.

(1) Use mounting rod and two right-angle clamps to install uniflow cup at a level higher than the raw-water inlet nipple. Secure the lower clamp to the upper mounting bracket on the still. Position the upper clamp so that it can be raised or lowered, as required, on the mounting rod.
(2) Connect a hose from water-outlet valve on wall to middle uniflow cup nipple marked INLET. Connect a hose from cup nipple marked OUT to main branch of Y-fitting. Connect a hose from cup nipple marked APP to raw-water inlet of still. Connect a hose from overflow nipple at bottom of constant-level cup on the still to a branch of the Y-fitting. Connect a hose from a branch of Y-fitting, allowing free end to hang into sink for drainage.
(3) Insert a thermometer, with range including 150° to 200° F., into the constant-level cup.
(4) Open water-outlet valve to admit water into system. Adjust valve so

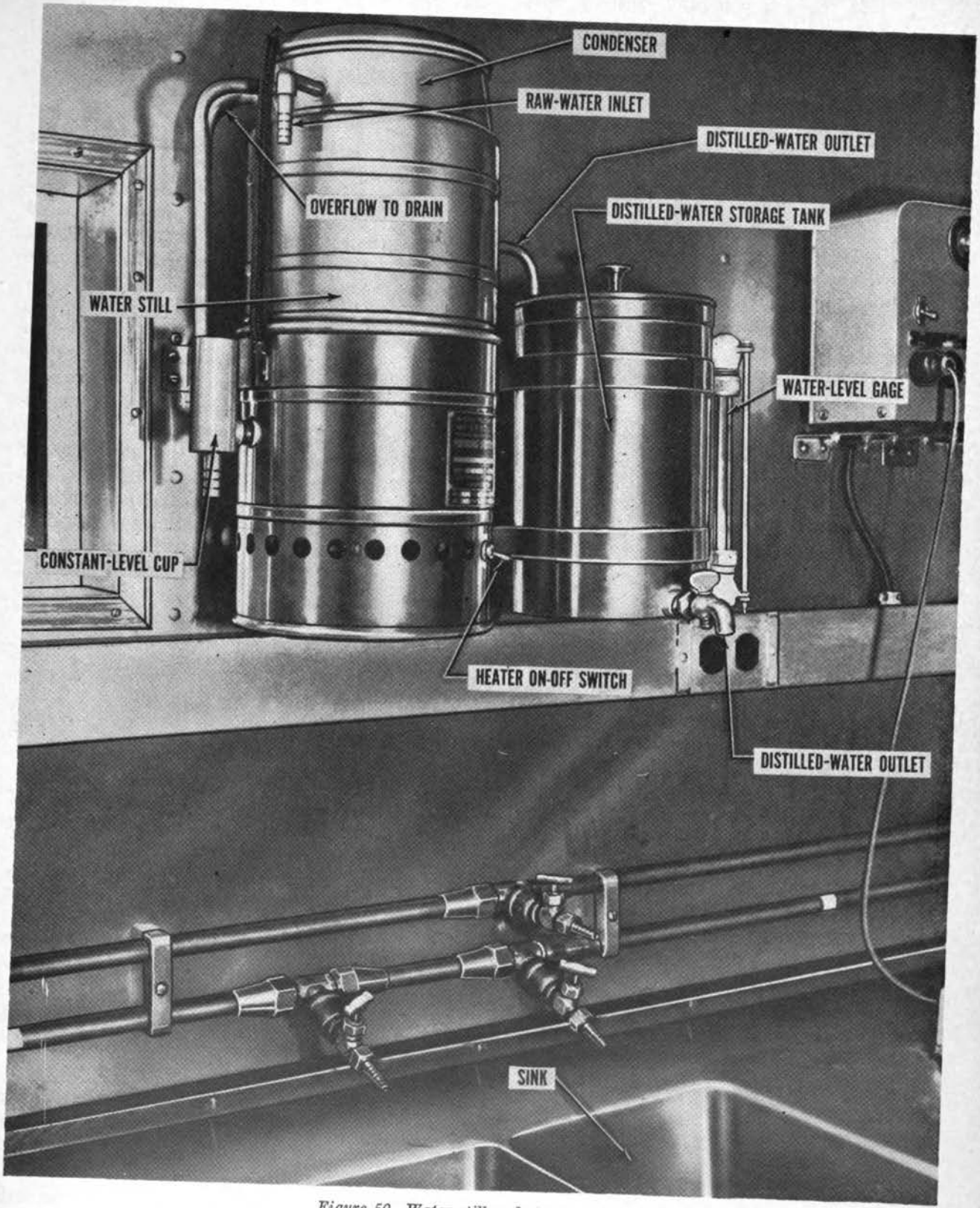


Figure 50. Water still and storage tank.

that there is constant overflow from the uniflow cup overflow and from the constant-level cup overflow. The rate of waterflow may be regulated by moving uniflow cup up or down on the mounting rod.

(5) After water has circulated for at least 5 minutes, make sure that circuit breaker switch 4 is closed, and push heater toggle switch to ON position.

(6) Observe thermometer as water heats. Temperature of water in the constant-level cup must be maintained between 170° and 180° F. To increase temperature, decrease water supply; to decrease temperature, increase water supply.

Note. Never reduce supply of water to a point where waterflow from overflow lines is interrupted.

(7) Observe water still closely during operation to assure that proper temperature is being maintained and that overflow is present from both the uniflow cup and the constant-level cup.

(8) When the storage tank is full, as indicated in the sight glass, push heater toggle switch to OFF position, and close water valve.

c. Servicing.

(1) *Cleaning.* Remove dome cover of still after daily use, and wipe away accumulated soft sludge. If sludge has hardened into a crust, leave a dilute (about 10 percent) solution of acetic acid overnight in evaporator. After this treatment make sure that no distilled water produced is utilized before operating still for about 2 hours to remove all traces of acid.

(2) *Replacing heater element.*

(*a*) Remove the three screws on outside of still that hold bottom insulation plate in place.

(*b*) Remove wires from element terminals.

(*c*) Unscrew nuts holding element in place and life element out of top of boiling chamber.

(*d*) Replace with new element. Replace packing and reassemble.

51. Reid Vapor-Pressure Apparatus

a. Description. The Reid vapor-pressure apparatus (fig. 51), used to determine vapor pressure of volatile petroleum products, is mounted in cabinets CC–1 and CC–2. The apparatus consists of items required for the immersion of 3 Reid vapor-pressure bombs in a constant-temperature bath (100° F. ± 0.2° F.) and includes heating units and sensitive controls for automatic maintenance of required temperature. Components include a flush-mounted, stainless-steel, constant-temperature bath, at the top of which are mounted a 1/30-horsepower motor, for stirring bath water; thermometer; 500-watt "low-lag" immersion heater, controlled by a mercury-to-mercury thermoregulator and sealed contact relay; and brackets for suspending bombs. An overflow standpipe and drain is screwed into the bath bottom. In the housing below the bath working chamber are mounted a relay, pilot light, and ON-OFF toggle switch. A control box containing the motor and heater switches is mounted on the laboratory wall above the apparatus. Circuit breaker switch 5 controls current to the control box.

b. Operation.

(1) Make sure that drain valve in cabinet under bath is closed. Fill bath to level of overflow pipe with water to which a solution of 10 parts per million of copper-sulfate has been added to minimize algae growth.

(2) Push toggle switch on bath to ON position thereby energizing heater and stirrer-motor circuits.

Note. Never turn on switch unless bath is filled with water, as heaters will burn out if not immersed.

(3) Proceed with test as prescribed by appropriate ASTM or Federal standard procedures.

(4) To drain bath, open drain valve and allow all water to draw off.

c. Servicing.

(1) *Lubricating.* Through oil cap of stirrer motor, apply several drops of light lubricating oil (LO) every 1,000 hours.

(2) *Cleaning.* Wipe all components with clean damp cloth.

(3) *Setting thermoregulator.*

(*a*) Before making a definite temperature setting, inspect regulator closely, observing for presence of gas bubbles in lower mercury chamber or in the two capillary columns. If bubbles or separation of mercury in columns exist, heat bulb gently until bubbles are driven up into the expansion chamber. Cool slowly in a vertical position allowing mercury to recede slowly to form solid columns without bubbles or separations.

(*b*) To attain desired operating temperature of regulator, immerse regulator so that bulb is completely submerged into a suitable bath provided with thermometer to measure temperature of water. The mercury will rise within columns and touch contact points. If mercury columns fail to rise to contact point at bottom of expansion chamber, remove regulator from bath and gently heat bulb until expansion chamber is filled. Turn regulator to heat each side evenly thereby preventing excessive rise in one column over the other. Turn regulator to horizontal position so that tip of expansion chamber is in surplus mercury, and allow bulb to cool in this position for approximately 5 minutes. The mercury will recede within the columns.

(*c*) To avoid cracking, slowly replace regulator in bath allowing it to remain for several minutes to push excess mercury out of top of expansion chamber.

(*d*) Proceed as described in (*b*) above, allowing mercury columns to reach contact point.

(*e*) Check bath temperature to make sure it is at temperature desired for thermoregulator setting and allow

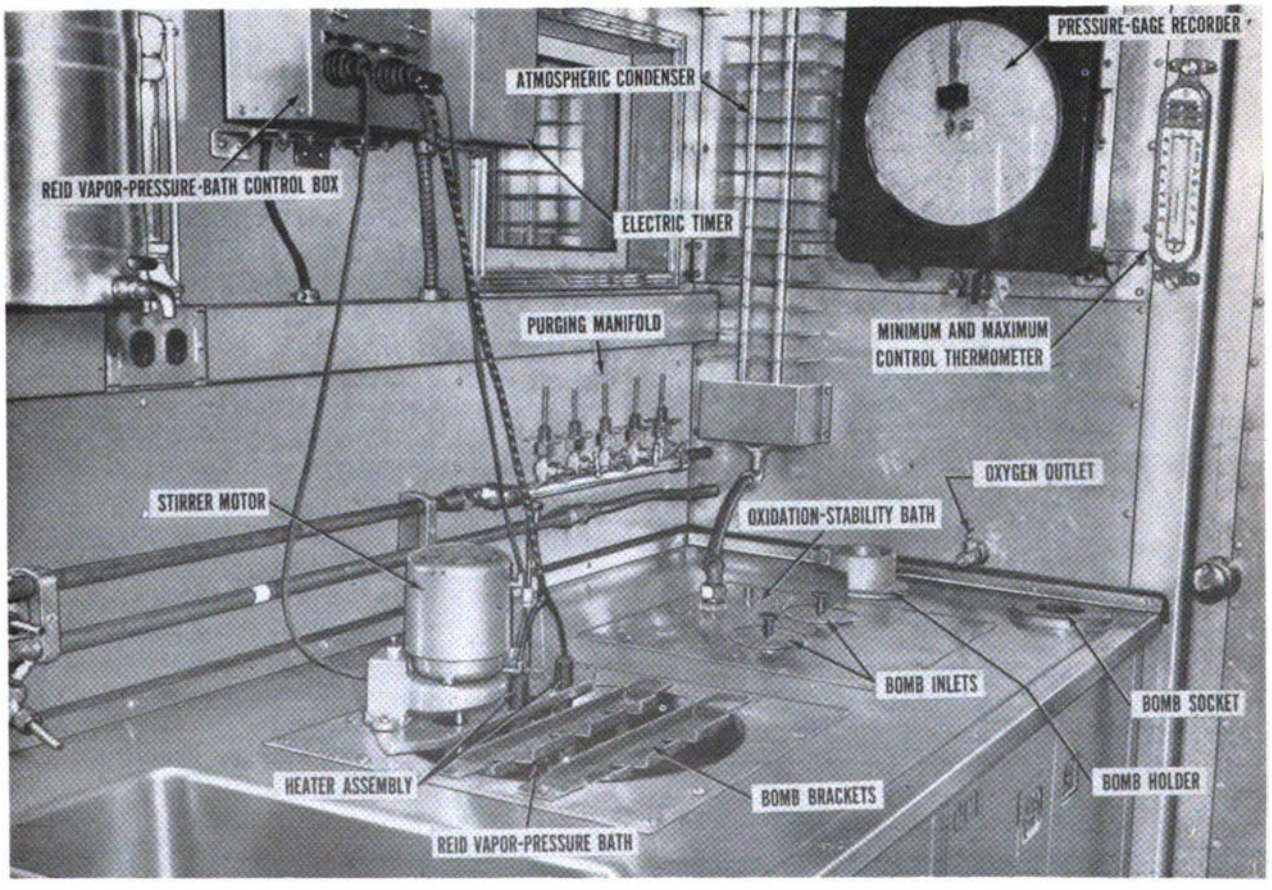


Figure 51. Reid vapor-pressure bath apparatus and oxidation-stability bath.

regulator to stabilize for 2 or 3 minutes in the bath.

(*f*) Remove regulator from bath and quickly tip expansion chamber down. Tap regulator against the palm of the hand forcing mercury into expansion chamber away from contact point thereby allowing columns to recede without drawing additional mercury from the expansion chamber.

(*g*) To complete setting, gently heat bulb in the inverted position so that all surplus mercury is forced out of the expansion chamber.

(4) *Checking setting.*

(*a*) Immerse regulator in bath at a lower temperature than which the regulator has been set. Place a standard thermometer close to the regulator and slowly bring bath up to temperature. When temperature reading on the thermometer reaches temperature for which the regulator presumably has been set, the mercury columns should part. If columns do not part at this temperature, or have parted before, the regulator must be reset. If the columns have parted before the temperature has been attained, it indicates that the regulator is set to control at a lower temperature than that desired. If the columns part after the temperature on the thermometer has been attained, it indicates that the regulator is set to control at a higher temperature than that desired.

(*b*) If after checking, regulator does not control properly, reset thermoregulator as described in (3) above.

52. Manometer

a. Description. The manometer (fig. 52) is mounted on the left wall of the laboratory compartment. Of well-type design, the manometer consists of a glass column supported within a frame and connected at the bottom by a U-shaped tube to the manometer fluid reservoir. Calibrated in inches of mercury, the manometer scale has a range of 20 inches of mercury. The manometer is equipped with high-pressure (HP) connection, low-pressure (LP) connection, fill plug, drain plug, vent plug, and zero-scale adjustment knot.

b. Operation. The manometer is used for testing accuracy of pressure gages and measuring high pressure (pressure above atmosphere, or gage pressure), vacuum pressure (pressure below atmosphere), or pressure differential. After completion of appropriate line connections, the indicating fluid rises in the column until a static balance is established, thus permitting direct reading of results from the scale behind the column. To connect lines to manometer, proceed as applicable—

(1) To measure pressure higher than atmospheric, connect line to high-pressure (HP) connection on fluid reservoir.

(2) To measure vacuum, connect line to low-pressure (LP) connection at top of indicating column.

(3) To measure a differential pressure, connect line with higher pressure to high-pressure (HP) connection, and line with lower pressure to low-pressure (LP) connection.

53. Oxidation-Stability-of-Gasoline Apparatus

a. Description. The oxidation (gum)-stability-of-gasoline test apparatus (fig. 51), used to determine gum stability of gasoline in storage, consists of an electrically heated oxidation-stability bath with a 2-bomb capacity and 3-heat switch. It is provided with a wall-mounted atmospheric condenser; two stainless-steel bombs, each provided with composition gaskets, needle valve, and Pyrex glass liner; a wall-mounted 2-pen-type pressure-recording gage with electric clock mechanism, and a range of from 0 to 200 pounds in 2-pound divisions, recording charts, and ink set; two 5-foot lengths of flexible metal tubing with a coupler at each end for connection between bomb and recorder; a wall-mounted electric timer (fig. 53); and a table socket to accommodate bomb when tightening bomb cap. Circuit breaker 8 controls current to the apparatus.

b. Operation.

(1) *Timer.* Raise timer cover. Turn time-set screw clockwise until dial is set at desired position as indicated by white

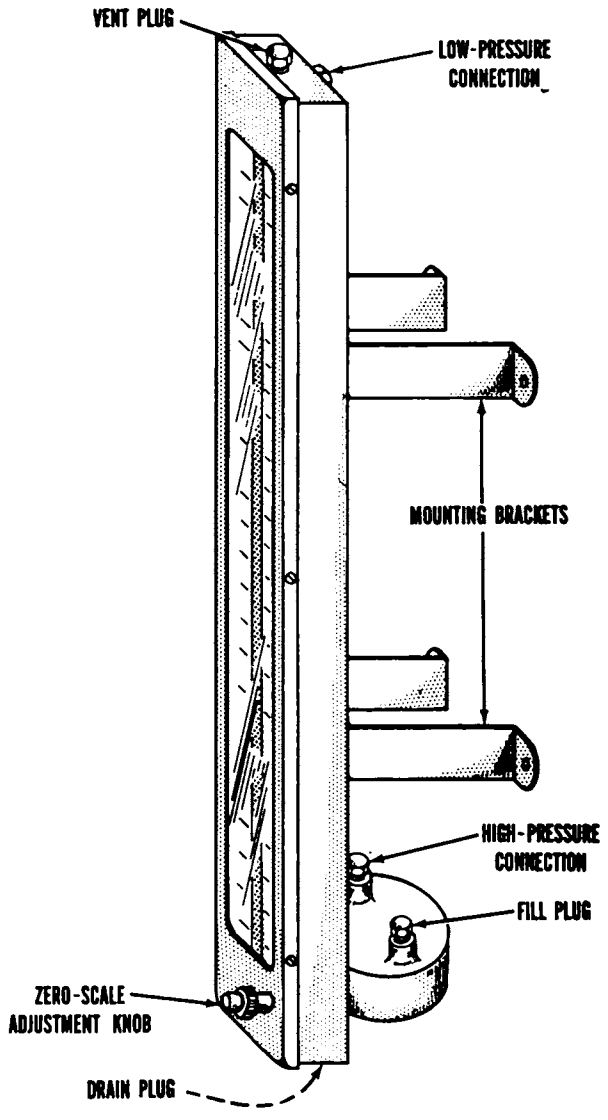


Figure 52. Manometer.

pointer. Set the four time indicators along dial rim so that at desired time intervals they will trip ratchet above dial.

(2) *Recorder.* To insert new chart, raise pens from chart by turning pen lifter. Turn chart knob to release fingers so that chart can be slipped over knob. Remove old chart, if present, and insert new chart. Retighten knob and set pens so that chart travels freely.

(3) *ON-OFF switch.* After inserting bombs in bath push toggle switch on right side of timer to ON position to turn on timer-controlled electric heater of bath. For detailed description of test procedure refer to applicable petroleum testing references.

c. *Servicing.*

(1) *Cleaning.* Detailed instructions for cleaning apparatus are described in applicable ASTM or Federal specification oxidation-stability test procedures. Clean recorder pens when clogged, using either carbon tetrachloride or alcohol.

(2) *Calibrating recorder.* Recorder has been carefully calibrated at the factory. Before making any adjustments, compare reading on chart with that

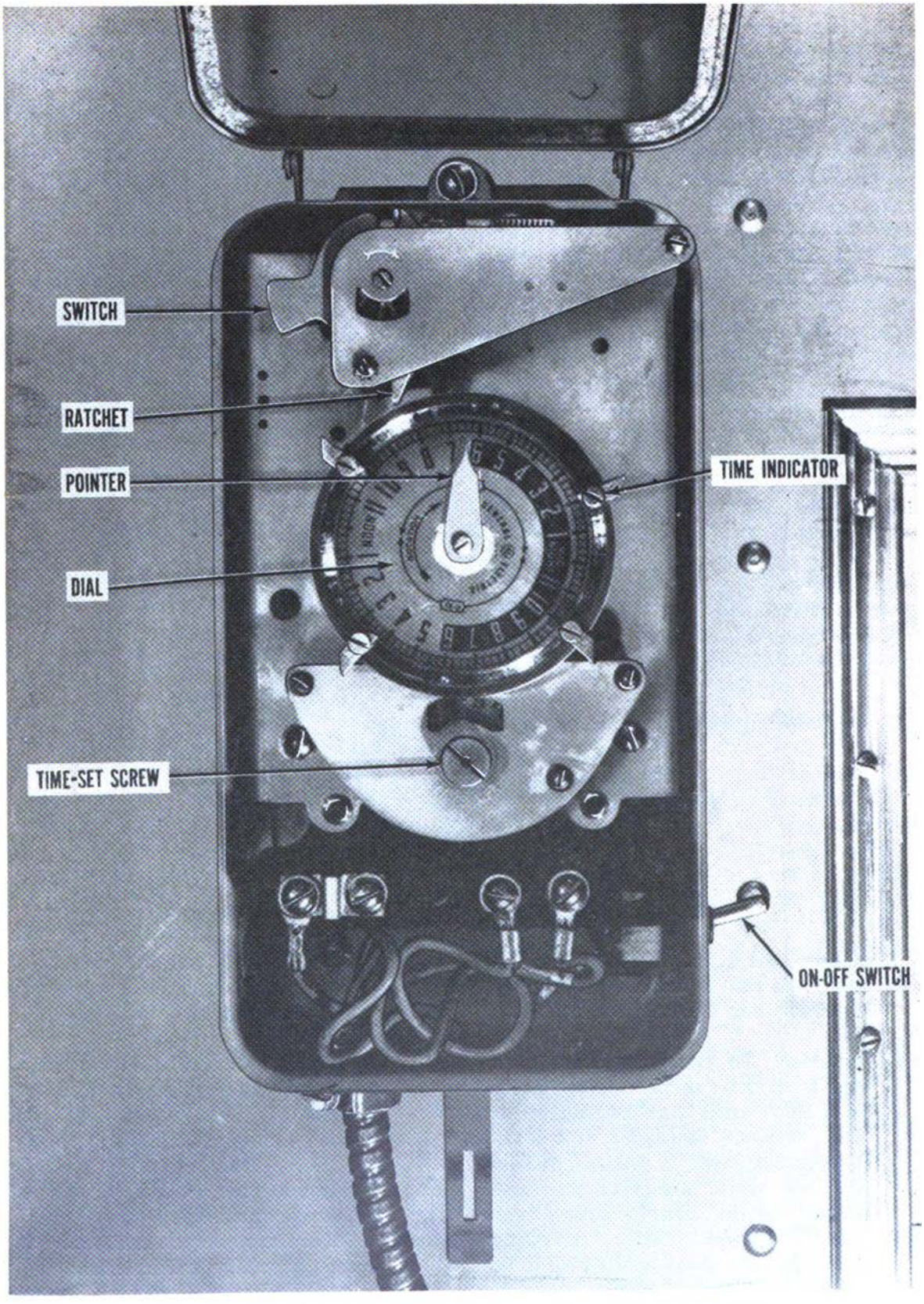


Figure 53. Electric timer (cover raised) for oxidation-stability test apparatus.

of a test thermometer of assured accuracy. Place the bulb of the standard thermometer alongside the recorder bulb in a liquid bath which is stirred vigorously. Check after temperature has been held constant for about 5 minutes. Before making test see that recorder bulb is located above or below the recorder case, the same distance as that marked on the nameplate attached to case. If recorder readings do not check with thermometer, correct by turning micrometer screw at right hand side of pen arm for only slight correction. Major adjustments should not be attempted.

54. Cloud-and-Pour-Point Test Apparatus

a. Description. The cloud-and-pour-point test apparatus, used to determine the temperature at which paraffin wax begins to separate from oil, and lowest temperature at which oil will flow, consists of a double-walled cooling bath accommodating four glass test jars which are retained in copper jackets suspended from a rod screwed into the bath bottom. Each jacket is provided with a cork disk and a pair of cork rings for insulating the glass test jar from the metal jacket. The assembly of four jackets may be raised or lowered on the rod support to vary depth of jackets in the cooling medium (dry ice and acetone; dry ice and gasoline), in accordance with the standard test procedure. The bath is equipped with a drain plug near the bottom, and a cover provided with openings to admit passage of test jars and thermometers. Both bath and cover are fitted with handles. The test apparatus includes 5 ASTM high-range thermometers (−36° to 120° F.) and cork stoppers. Bath apparatus is located in cabinet DC–1, test jars in drawer AD–5, and thermometers in drawer BD–6.

b. Operation. No special instructions are required for operating cloud-and-pour-point test apparatus. Complete details for performing test are described in appropriate ASTM or Federal standard test procedures.

c. Cleaning. Use suitable solvent for removing oil from glass test jars. Wash with soap and water, rinsing with clear water, and air-drying. Use clean damp cloth for cleaning bath exterior.

55. Penetrometer

a. Description. The penetrometer (fig. 54) is stored in cabinet DC–6, and is used to measure penetration of grease with a penetration cone. The penetrometer is provided with a dial for measuring depth of penetration up to 38 millimeters on a single sweep of the dial needle, stainless-steel plunger bearings, preliminary setting and fine-pitch micrometer adjustments, clutch, ASTM 2.5-gram needle, and a 50-gram weight.

b. Operation.

(1) Level instrument carefully before using.

(2) Insert cone into chuck, and tighten securely.

(3) Set dial needle to zero by pulling up depth gage as high as it will go. If the needle does not stop exactly at zero, loosen needle locknut and reset needle to zero. Be sure to tighten needle locknut securely.

(4) Add weights to test rod as required. In adding weights to make up the required test load, note that weight of test rod itself is 47.5 grams. When the specified load for grease penetrations with a grease cone, for example, is 150 grams, no weights need be added, as the combined weight of the cone (102.5 grams) and test rod (47.5 grams) makes up the required load as specified by ASTM.

(5) Place prepared sample to be tested in position on penetrometer table.

(6) Adjust height of penetrometer to bring the point of the penetrating instrument (cone) exactly into contact with surface of sample, as follows:

(*a*) *Coarse adjustment.* Grasp mechanism bracket (3, fig. 54) and loosen both upper lock screw (4) and coarse adjustment knob (6). Raise or lower as required to move penetrometer to approximate position for test; then tighten coarse adjustment knob.

(*b*) *Micrometer adjustment.* With upper lock screw loosened, make final contact adjustment by means of micrometer adjusting knob (5). Tighten upper lock screw.

(7) Release test rod (11), allowing penetrating instrument (cone) to descend into sample. To do this, release clutch spring (10) and hold in its released position during specified time required for test, using a stopwatch for noting time.

(8) Observe dial reading. To read depth of penetration, push down depth gage (1) gently as far as it will go. The dial (12) reading indicates depth of penetration in tenths of millimeters. For example, if dial needle rests at the fourth mark past the 270 point, penetration depth is 274 tenths millimeters, or 27.4 millimeters. On depths greater than 38 millimeters, the dial needle makes more than one complete revolution to a maximum of depth of 39 millimeters on a single reading.

(9) Return dial needle to zero as indicated in (3) above. If original zero setting has been accurate, dial needle will return exactly to zero, and subsequent readings will check against standard gage blocks.

(10) For detailed descriptions of test procedures using penetrometer, consult applicable petroleum testing references.

c. Servicing.

(1) *Lubricating.* Lubricate stem, adjusting and locking screws, depth gage and needle gears, and clutch mechanism as often as required, using light lubricating oil (LO).

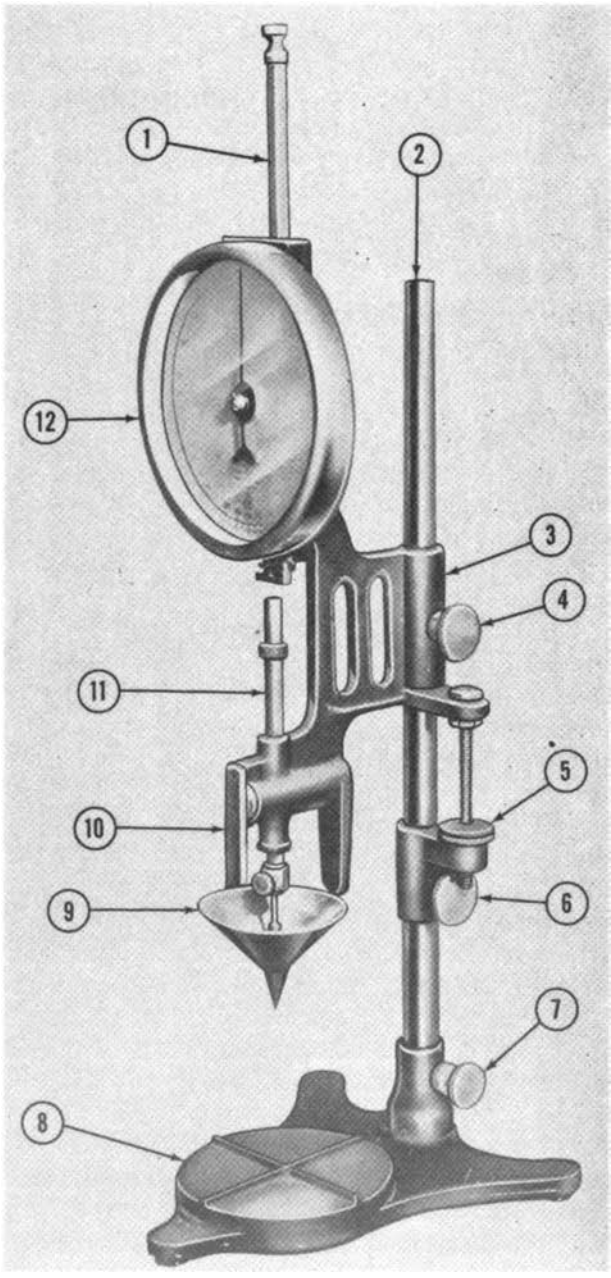
(2) *Cleaning.* Remove test product with solvent. Air-dry or wipe dry with clean, lintless cloth. Use mild soap and water if necessary, and dry thoroughly to prevent rust.

56. Flash-Point Testers

The mobile laboratory is furnished with apparatus for performing three standard flash-point tests on petroleum products.

a. Description.

(1) *Cleveland flash tester.* The Cleveland flash-point test apparatus consists of the following items located in cabinet DC–4: a 750-watt heater with rheostat and dial control, permanently mounted test-flame burner, pivot-post thermometer holder, and refractory top which includes a heat-resistant board, cast-iron plate, and test-flame bead. An open flash cup, located in drawer BD–13, test-flame arm, located



1	Depth gage	7	Lower lock screw
2	Stem	8	Table
3	Mechanism bracket	9	Penetrating cone
4	Upper lock screw	10	Clutch spring
5	Micrometer adjusting knob	11	Test rod
6	Coarse adjustment knob	12	Dial

Figure 54. Penetrometer.

in drawer ED–1, and thermometers complete the test apparatus.

(2) *Pensky-Martens flash tester.* The Pensky-Martens flash-point test apparatus is located in cabinet CC–2, except for the stirrer and motor, stored in drawer BD–14. The apparatus consists of an electric heater with 3-heat switch, controlling rheostat, pilot lamp, stirrer and motor, a closed flash cup mounted in air bath, shutter, test-flame burner, pilot burner, and thermometers.

(3) *Tag flash tester.* The Tag closed-cup flash test apparatus, located in drawer BD–13, consists of a test cup with a lid on which are mounted a thermometer and test flame burner, water bath, alcohol burner, and thermometers. Wicks for the burner are stored in drawer AD–2.

b. Operation. Complete instructions for operating each type of flash test apparatus are described in pertinent ASTM or Federal standard test procedures. No special instructions are required.

c. Servicing.

(1) *Lubricating.* Oil the stirrer motors every 1,000 hours of use, applying light lubricating oil (LO). Oil moving parts of Pensky-Martens tester top as often as needed, applying light lubricating oil (LO).

(2) *Cleaning.* Never use gasoline or naphtha for cleaning flash cups. Use kerosene or gas oil as cleaning agents.

57. Dry-Ice Machine

a. Description. The dry-ice (solidified carbon dioxide) machine is stored in cabinet AC–1. The machine is capable of molding from 60 to 70 3-ounce cakes or disks of dry ice from a 50-pound carbon dioxide gas cylinder. The dry ice is used primarily for cooling cloud-and-pour-point test baths and wherever required for application of low temperatures. The dry-ice machine is equipped with a hinged cover and safety valves, and is provided with strainer, tubes, and connecters for attachment to the gas cylinder.

b. Operation.

(1) Invert a full 50-pound carbon dioxide gas cylinder so that valve is at lower end, or lay cylinder on its side with valve at least 4 inches lower than the base of the dry-ice machine. Connect one end of tubing to cylinder and the other to valve on side of machine, using fiber washers attached.

(2) Close cover of ice machine, engaging handle securely. Close gas-control valve on side of machine. Open cylinder valve.

(3) Open gas-control valve slightly until gas can be heard entering machine and hold open for about 10 seconds or until safety valve on top of machine discharges, or cover is raised by safety valve on cover hinge, indicating that cavity is filled with dry ice. It is normal for excess gas to escape on the sides and bottom of the machine while ice cake is being formed.

(4) Close gas-control valve and remove dry-ice disk.

c. Servicing.

(1) *Cleaning.* Use clean damp cloth for cleaning interior and exterior of machine.

(2) *Adjusting.* Safety valves are factory set and should not be adjusted.

58. Modified CFR Knock-Testing Engine

The modified CFR (Coordinating Fuel Research) knock-testing engine (figs. 55 and 56) is supported by a platform mounted on the right wheel well and extending to the rear wall of the rear compartment. The modified knock engine replaces standard engines normally used for performing either the "research method" or the "motor method" test for determining knock characteristics of motor fuels. The modified knock engine includes changes in design due to space limitations within the mobile laboratory. This paragraph describes differences between the modified knock engine and the standard knock engine, and includes instructions for adapting the engine to perform each test. For complete description of engine and test instructions, refer to the ASTM Manual of Engine Test Methods for Rating Fuels.

a. Modifications. The knock engine furnished the mobile laboratory differs from the standard knock engine in the following modifications:

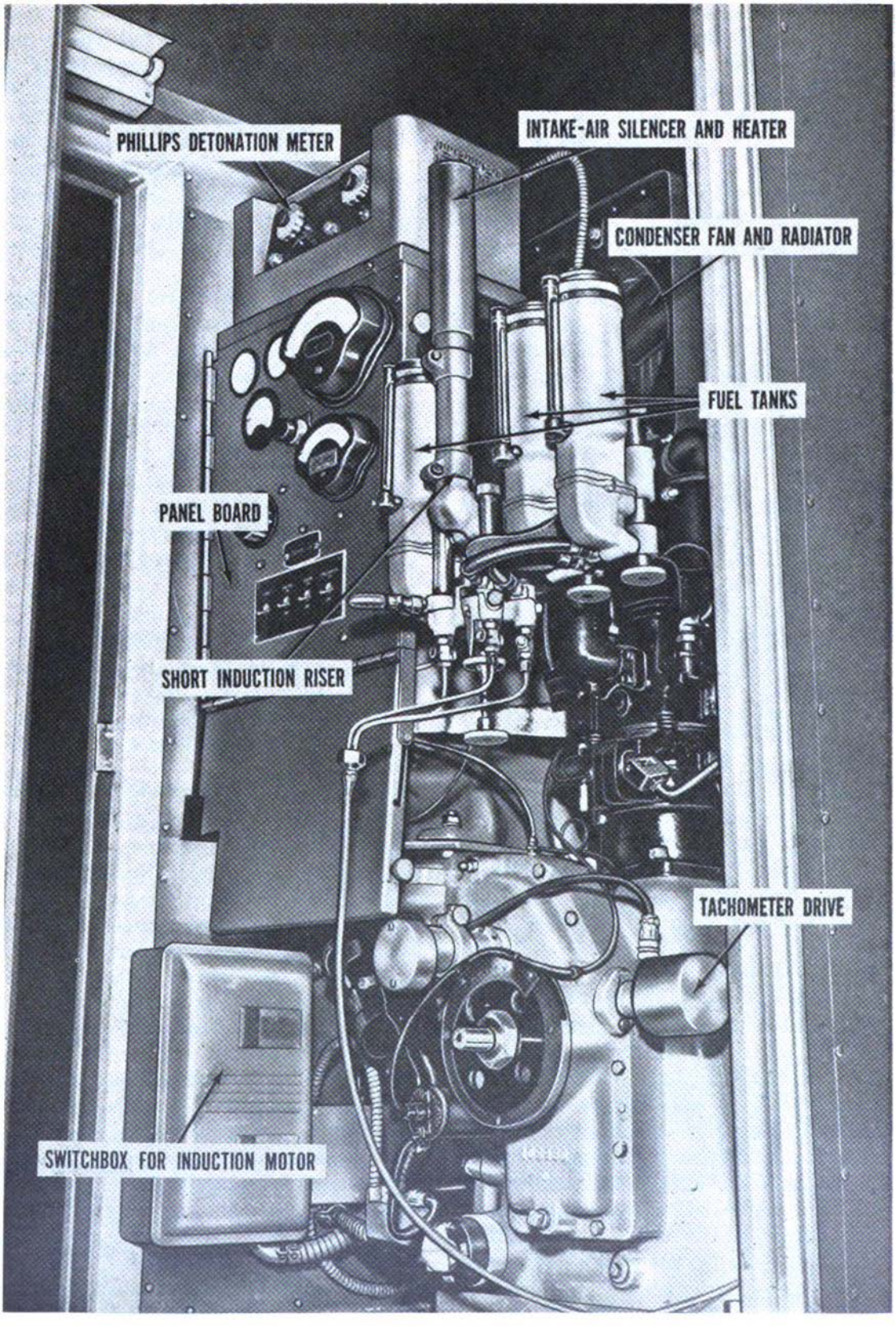


Figure 55. Modified knock engine (overall view).

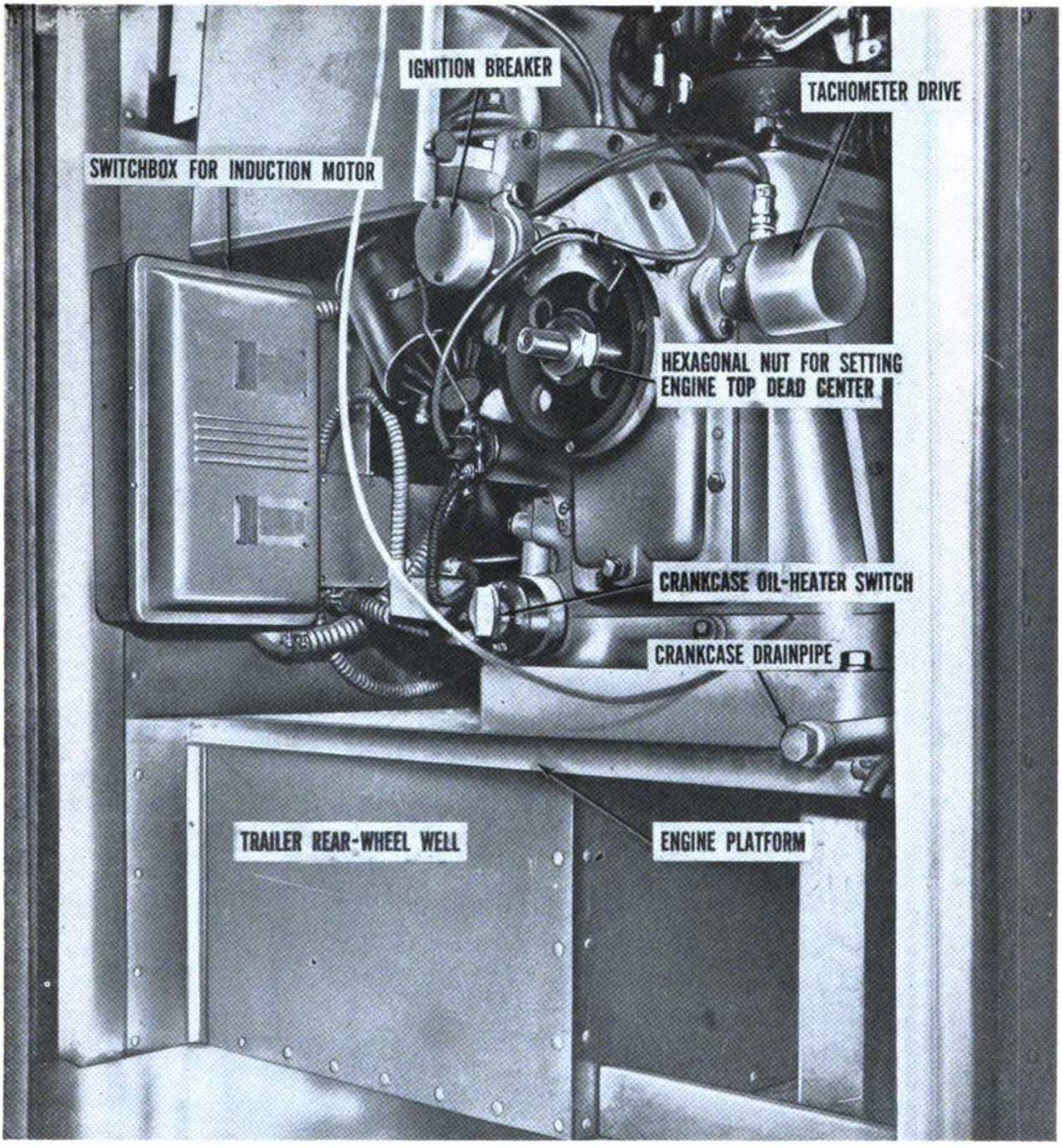


Figure 56. Modified knock engine, lower section.

(1) *Panel board.* The panel board (fig. 57), redesigned to be one-half the size of the standard panel board, is mounted on a swivel to permit easy access to its rear. The board is equipped with standard oil-pressure and oil-temperature gages, knock-meter, and control switches for starting, ignition, oil heater, and knock-meter. Mounted on the side of the panel board is a 110-volt receptacle for connecting one of the two intake heaters, i.e., intake-air heater for research method or intake-mixture heater for motor method. Temperature of the intake heater is governed by a

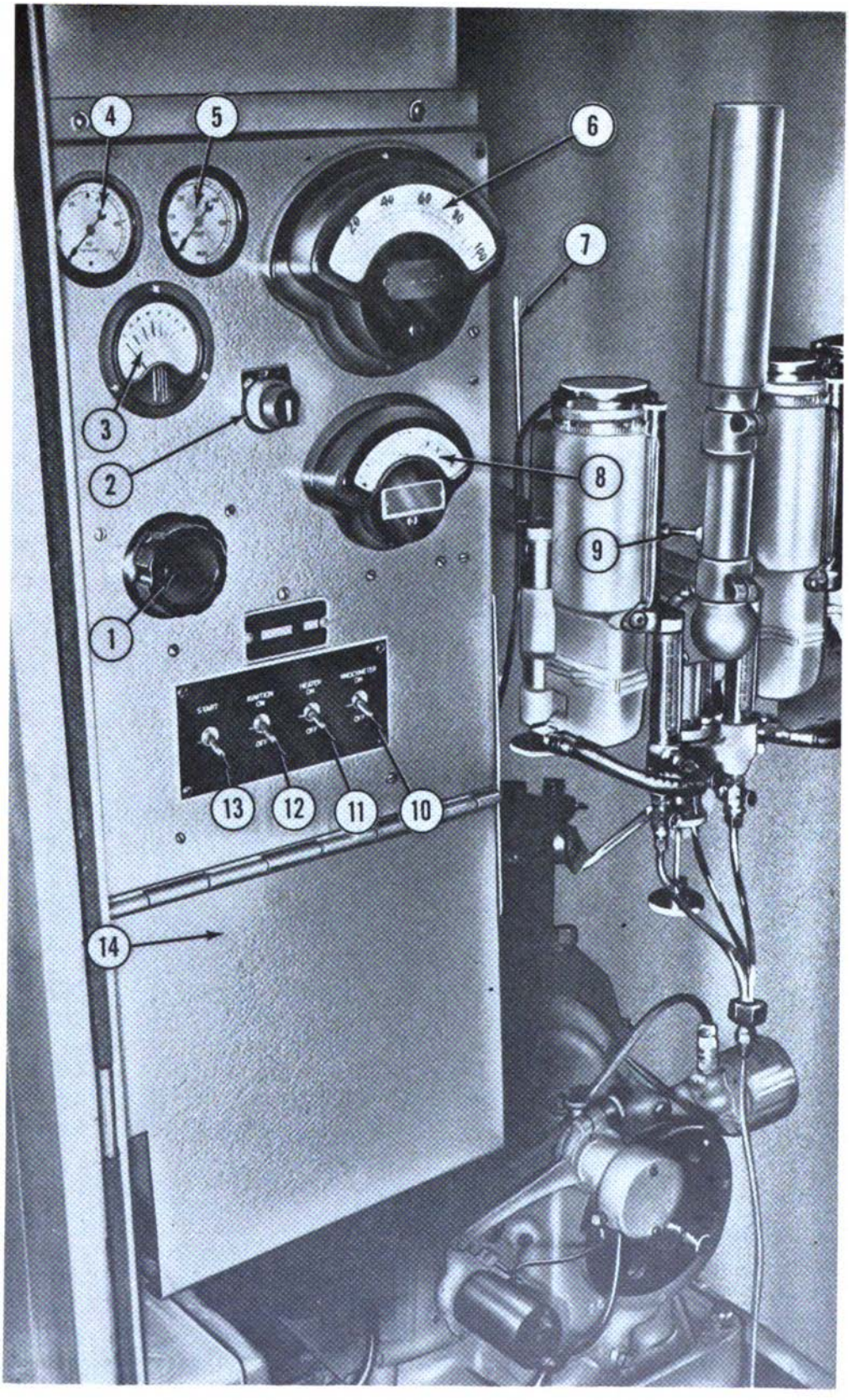


Figure 57. Modified-knock-engine control panel board.

1 Intake-heater current-control knob
2 Speed-selector switch
3 Intake-heater current ammeter
4 Oil-pressure gage
5 Oil-temperature gage
6 Knockmeter
7 Intake-manifold thermometer
8 Tachometer
9 Air-intake thermometer
10 Knockmeter switch
11 Intake-manifold-heater switch
12 Ignition switch
13 Starting switch
14 Writing desk, in lowered position

Figure 57—Continued.

Variac rheostat, fitted with a control knob. An ammeter, located above the control knob, registers heater current in amperes. The speed-selector switch, which has LOW, STOP, and HIGH positions, controls the speed at which the synchronous 2-speed motor operates. A tachometer is located beside the speed-selector switch. The tachometer generator is attached to the engine on the right side above the crankcase. Attached to the bottom of the panel board is a hinged rectangular panel, which, when swung into a horizontal position and locked, forms a small writing desk.

(2) *Cooling and ventilation.* The modified-engine cooling system utilizes a condensing radiator and fan in place of the standard water-cooled condenser. The exhaust hatch for the condenser fan opens from the outside of the trailer (fig. 58). The crankcase oil-breather pipe has been redesigned to extend directly out the side of the trailer.

(3) *Electrical system.* The wiring diagram for the modified knock engine is shown in figure 59. Three-phase 220-volt current, used to drive the synchronous 2-speed electric motor, is furnished to the unit through circuit breaker switch 6. A power pack rectifies the 110-volt alternating current to 110-volt direct current for the ignition circuit.

(4) *Exhaust, fuel supply, and induction systems.* The modified knock engine is equipped with a short rigid exhaust manifold coupled to the vertical 6-inch muffler that has been substituted for the standard exhaust surge tank. The muffler is clamped to the coolant reservoir, which in turn is connected by hose to the condenser. The exhaust opens directly into the atmosphere through the exhaust hatch (fig. 58). As the ice tower has been eliminated, humidity control of intake air is not possible. In its place is a short induction riser to which is attached a short intake-air silencer (fig. 55) of the type used on the cetane method engine. An intake-air heater is attached to the silencer for the research test method. The intake-manifold thermometer is placed so that it may be read from the front of the engine.

(5) *Knock-intensity instruments.* The modified knock engine is equipped with a Phillips detonation meter (model 501–A) and, in place of the bouncing pin, a Lane-Wells pickup.

(6) *Crankcase and lubricants.* The crankcase drainpipe (fig. 56) has been lengthened and brought to the front of the engine to facilitate drainage.

(7) *Power-absorption unit.* The synchronous 2-speed, 220-volt, 3-phase induction motor has been modified and mounted on the body of the engine, and equipped with a special starter-relay box.

b. Operations. Before starting operations, open the three hatches on the outside of the trailer and close circuit breaker switches 6 and 29. At the end of each day's operation, to prevent warping and entrance of foreign matter into combustion chamber, turn the flywheel to the top dead center of the compression stroke by turning the hexagonal nut on the front of the engine with a wrench until the mark on the flywheel is directly opposite the top-dead-center mark on the engine body. Complete procedures for performing the knock tests using the two different methods are described in the ASTM knock-engine manual. Procedures for adapting the engine for each test follow:

(1) *Adapting engine to perform research-method test.*

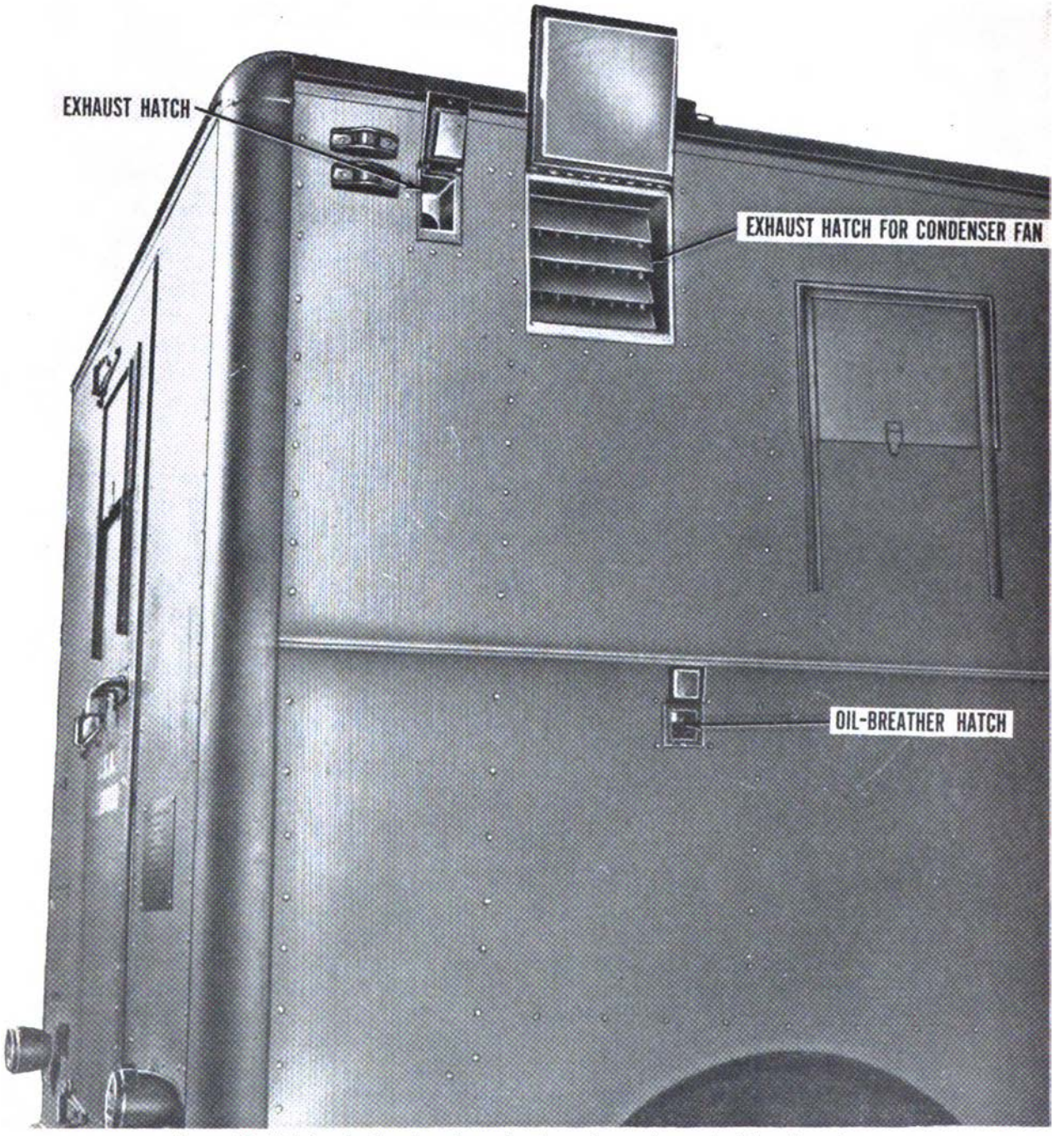


Figure 58. Hatches for knock-engine exhaust, condenser fan, and oil-breather pipe.

(*a*) Unplug mixture-heater cord from receptacle.

(*b*) Remove carburetor and mixture heater from cylinder head. Disconnect heater from carburetor.

(*c*) Make sure carburetor venturi is of proper size for altitude in which operating.

(*d*) Replace carburetor, tightening it directly to the cylinder head.

(*e*) Remove motor-method metering jets and install jets required for research method.

(*f*) Adjust spark advance for research method.

(*g*) Install intake heater on air silencer.

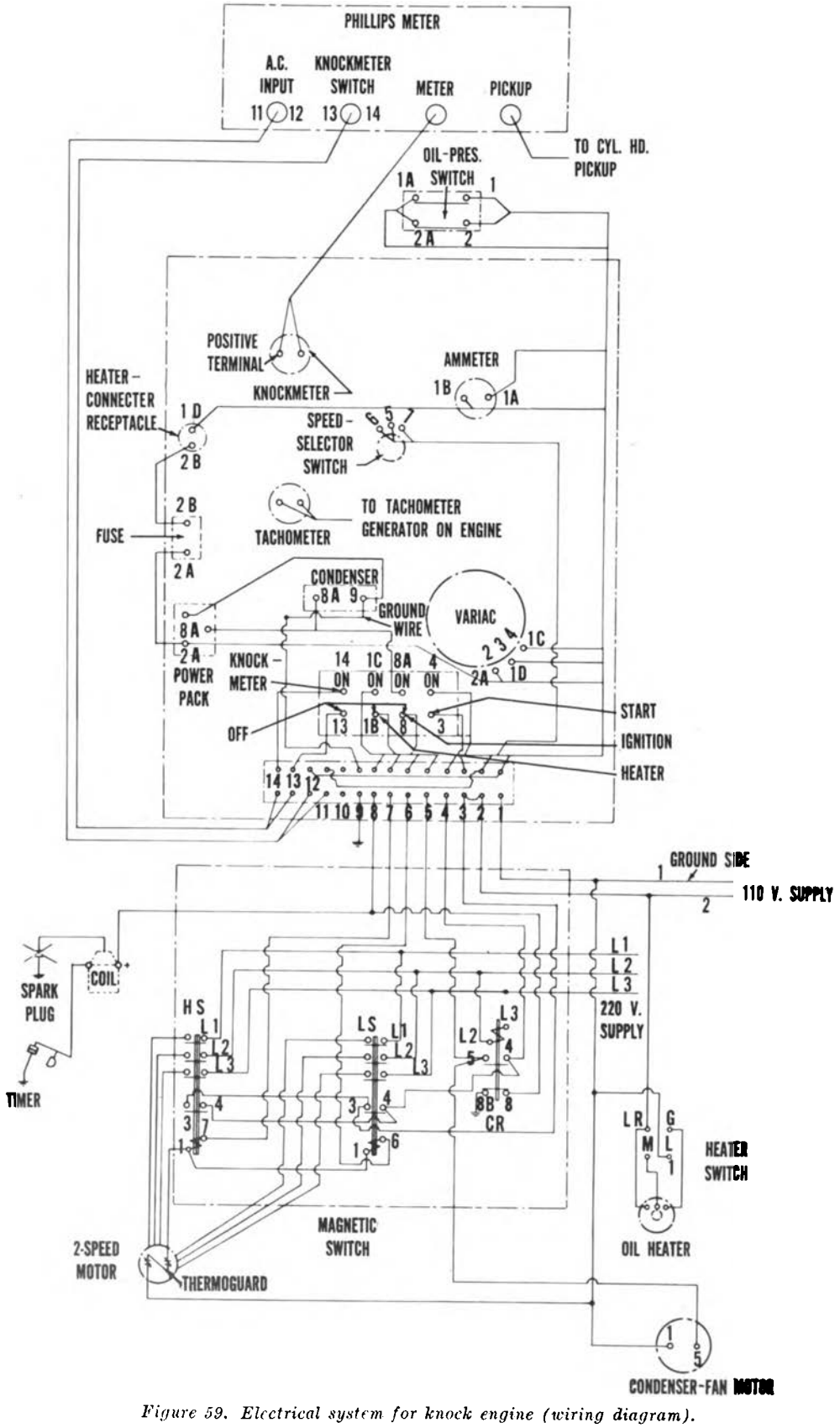


Figure 59. Electrical system for knock engine (wiring diagram).

Plug heater into receptacle on side of panel board.

(*h*) Turn speed-selector switch to LOW.

(2) *Adapting engine to perform motor-method test.*

(*a*) Unplug and remove intake-air heater.

(*b*) Remove carburetor from cylinder head.

(*c*) Install mixture heater to cylinder head.

(*d*) Make sure venturi is proper size for motor method.

(*e*) Install carburetor to inlet flange of mixture heater.

(*f*) Remove research-method jets and install motor-method jets.

(*g*) Adjust spark advance for motor method.

(*h*) Connect heater plug to receptacle on side of panel board.

(*i*) Turn speed-selector switch to HIGH.

c. Maintenance. For complete maintenance instructions, refer to ASTM knock-engine manual.

59. Aniline-Point Apparatus

a. Description. The aniline-point apparatus, for determining aniline point of petroleum products, consists of a cover with U-tube, belt-driven stirrers for bath liquid and sample, and cooling coil; a glass bath jar; a 115-volt, 50–60-cycle stirrer motor; electric heater; 2 thermometers; stand and support rod; and clamp for stirrer motor. The apparatus is stored in cabinet DC–2 and drawers AD–4, AD–5, BD–3, and BD–1.

b. Operation.

(1) Place glass bath jar on electric heater and fill jar with bath liquid.

(2) Immerse cover assembly into bath liquid.

(3) Place sample in U-tube and insert prescribed ASTM aniline-point thermometer into U-tube.

(4) Insert bath thermometer into proper opening.

(5) Clamp stirrer motor to rod and connect drive belt to motor and stirrers.

(6) Turn on electric heater and stirrers and connect rubber tubing from cooling coil to water or oxygen outlet, whichever is to be used for cooling liquid bath.

(7) Refer to appropriate ASTM procedures or Federal standard for complete instructions for performing test.

c. Cleaning. Clean the glass bath jar with suitable solvent, wash with soap and water, rinse, and air-dry. Disassemble cover units and clean with suitable solvent, wash with soap and water and rinse. Air-dry glass equipment, and wipe metal equipment dry with a clean cloth.

d. Lubrication. Oil stirrer motor after 1,000 hours of operation with light lubricating oil (LO).

60. Asphalt-Softening-Point Apparatus

a. Description. The asphalt-softening-point apparatus, for determining the softening point of bituminous products, consists of a Pyrex beaker, 2 straight form rings, 2 hardened-steel balls, and a brass cover which fits a 600-milliliter beaker. From the brass cover are suspended 2 shelves spaced exactly 1 inch apart. The upper shelf has 3 openings, 2 for rings and 1 for thermometer. The apparatus is stored in drawer AD–5.

b. Operation.

(1) Clamp a support ring to a support rod and cover with wire gauze.

(2) Fill Pyrex beaker to a depth of not less than 9 centimeters with prescribed solution, and place on support ring.

(3) Place brass cover with shelves, rings, specimen, and balls on the beaker.

(4) Insert prescribed ASTM thermometer through center hole of cover and upper shelf, and support with a thermometer clamp attached to the support rod.

(5) Heat the solution with a gas burner placed under the beaker.

(6) Refer to appropriate ASTM procedures or Federal standard for complete instructions for performing the test.

c. Cleaning. Use suitable solvent for removing bituminous material from apparatus. Wash with soap and water, rinse, air-dry glass equipment, and wipe brass and steel equipment dry with a clean cloth.

61. Crankcase-Dilution Apparatus

a. Description. The crankcase-dilution apparatus, for determining dilution of crankcase oils, consists of stand with support rod, ring, clamp, burner, boiling flask, condenser, and trap. Apparatus is stored in drawer BD–7.

b. Operation.

(1) Set up support rod and stand, and attach ring and clamps.
(2) Place oil to be tested in boiling flask, and set flask on ring.
(3) Connect trap to flask and to the condenser.
(4) Connect two rubber tubes to the condenser. Connect one tube to a cold-water supply valve, and connect the other hose to cold-water return valve.
(5) Place burner under the boiling flask, and circulate water through the condenser.
(6) Refer to appropriate ASTM procedures or Federal standard for complete directions for determination of dilution of crankcase oils.

c. Cleaning. Remove all oil from glass parts with a suitable solvent, wash with soap and water, rinse, and air-dry.

62. Grease-Dropping-Point Apparatus

a. Description. The grease-dropping-point apparatus, for use in determining the dropping point of lubricating grease, consists of a chrome-plated brass cup; test tube with indentions to support the cup inside th tube; 2 ASTM thermometers; a 400-milliliter beaker; a 115-volt, ac, 500-watt-capacity rheostat heater, with support-rod clamp attached; support rod; clamp for stirrer motor; 115-volt ac, stirrer motor with stirrer; 2 corks; and a chrome-plated rod for forming grease film in the cup. Apparatus is stored in drawer BD–3.

b. Operation.

(1) Fill beaker to prescribed level with oil, and place on heater.
(2) Insert one of the thermometers in a cork and place cork in the holder, which is to rest on beaker. Adjust thermometer so that it will be one-eighth inch above bottom of grease cup when thermometer is in the tube and tube is connected to the cork.
(3) Insert the other thermometer in a cork, and place cork in the holder. Adjust thermometer so that bulb will be in oil bath at same level as thermometer bulb in test tube.
(4) Place sample in cup with rod, insert cup in the test tube, attach test tube to proper cork, and place the assembled thermometers and test tube in oil bath.
(5) Place support rod in clamp at rear of heater, and attach stirrer motor to support rod, with stirrer suspended in the oil bath.
(6) Plug in heater and stirrer motor to electrical outlets.
(7) Refer to appropriate ASTM procedures or Federal standard for complete directions for determining the dropping point of grease.

c. Cleaning. Use suitable solvent for removing oil and grease from the apparatus. Wash with soap and water and rinse. Air-dry glass equipment and wipe metal equipment dry with a clean cloth.

d. Lubrication. Oil stirrer motor after 1,000 hours of operation with light lubricating oil (LO).

63. Gravitometer

a. Description. The Fisher-Davidson gravitometer is used for determining the specific gravities of small quantities of liquids. The assembly consists of a metal support stand with thermometer, level, graduated scale with cursor, leveling knobs, rubber suction device, and clips for attaching the L-tube and Z-tube. The gravitometer is stored in cabinet DC–6.

b. Operation. Complete directions for operation of the gravitometer and for determining specific gravities of liquids are stamped on a metal plate attached to the front of the metal support.

c. Cleaning. Wipe metal support stand with a clean cloth. Clean glass L-tube and Z-tube with suitable solvent, wash with soap and water, rinse, and air-dry. After L-tube and Z-tube are dry attach them to the metal stand of the graviotometer.

64. Steam-Emulsion Apparatus

a. Description. The steam-emulsion apparatus is used for approximate evaluation of re-

sistance of lubricating oils to emulsify. The apparatus consists of 2 tripods, 2 Pyrex glass jars, supports for the emulsion tube and thermometer, bent-glass steam lines, rubber tubing connections, 3 pinch clamps, rectangular support, 2 burners, Pyrex flask, 2 thermometers (0° to 220° F.) with 2° graduations, one thermometer (30° to 230° F.) with 1° graduations for oil container, and 1 graduated Pyrex emulsion tube. Apparatus is stored in drawers AD–2, BD–7, BD–9, BD–10, and BD–11, and cabinet CC–2.

b. Operation. Complete directions for assembling the apparatus and testing the steam emulsion of lubricating oils are described in the appropriate ASTM procedures or Federal standard.

c. Cleaning. Remove oils with suitable solvent, wash with soap and water, rinse, and air-dry all glass equipment.

65. Sulfur-Determination Apparatus, Lamp Method

a. Description. The sulfur-determination apparatus, lamp method, consists of glass flask, burner, chimney, absorber, spray trap, and a metal base. Apparatus is stored in drawer DD–5.

b. Operation. Complete directions for preparation of apparatus and sample, and testing for sulfur in liquid petroleum products by lamp method, are described in the appropriate ASTM procedures or Federal standard.

c. Cleaning. Use suitable solvent to remove all oils from glass equipment. Wash with soap and water, rinse, and air-dry.

66. Sulfur-Determination Apparatus, Bomb Method

a. Description. The sulfur-determination apparatus, bomb method, consists of a double-valve self-sealing bomb, water jacket, bench socket, oxygen connection, ignition unit, sample cup, fuse wire, and support for bomb cover. The apparatus operates on 115 volts, 60 cycles, ac. The apparatus is located in drawers BD–7, BD–13, and ED–1, and cabinets CC–2 and DC–6.

b. Operation. Complete directions for preparation of sample and bomb, and testing for sulfur in petroleum products, are described in the appropriate ASTM procedures.

c. Cleaning. Remove all grease and residue with suitable solvent, wash with soap and water, rinse, and wipe dry with a clean cloth.

67. Tetraethyllead Apparatus

a. Description. The tetraethyllead apparatus, for the determination of tetraethyllead in gasoline, consists of a 500-milliliter boiling flask, with heating tube wound with 250-watt nichrome coil; Hopkins reflux condenser; 70-milliliter thistle tube; 400-milliliter beaker; 50-milliliter pipette, calibrated for gasoline delivery; horseshoe base, with 2 support rods; 2 extension clamps and 2 clamp holders; and a 25-ohm, 2-ampere-capacity rheostat. Apparatus is stored in drawers AD–4, BD–7, BD–9, ED–1, and ED–2, and cabinets CC–2, and DC–2.

b. Operation. Complete directions for preparing sample and apparatus, and for testing for tetraethyllead in gasoline, are described in appropriate ASTM procedures or Federal standard.

c. Cleaning. Clean all glassware with a suitable solvent, wash with soap and water, rinse, and air-dry. Clean all metal equipment and wipe dry with a clean cloth.

68. Tetraethyllead Determination Kit

a. Description. The Hellige portable TEL laboratory, for the determination of tetraethyllead in gasoline, consists of a wooden carrying case containing a pocket comparator housing with magnifying prism attachment; two color disks; a square Pyrex glass precision tube; a Pyrex glass extraction vessel; a mechanical pipetting attachment; three pipettes; a 50-milliliter Pyrex Erlenmeyer flask; a 50-milliliter graduated cylinder; a thermometer; an alcohol lamp; an 8-ounce bottle of iodine reagent; two 16-ounce bottles of sulfite ammonia reagent; an 8-ounce bottle of assayed dithizone reagent; and two 16-ounce bottles of distilled water. The tetraethyllead determination kit is stored in cabinet DC–1.

b. Operation. Directions No. 850–I–012351, published by Hellige, Incorporated, and supplied with each kit, give complete instructions for testing for tetraethyllead using this equipment.

c. Cleaning. Upon the completion of a test, wash all glassware thoroughly with clean water, rinse with distilled water, and air-dry.

69. Water-Determination Apparatus

a. Description. The water-determination apparatus, for determination of water in petroleum products, consists of glass distilling flask, condenser, and distilling-tube receiver; and metal support and rod, ring, clamp, and gas burner. The apparatus is stored in drawers AD–1, AD–2, AD–5, and ED–1, and cabinet CC–2.

b. Operation.

(1) Set up stand and support, with ring and clamp attached.

(2) Place sample and solvent in flask, place flask on ring, connect trap to flask and condenser, and fasten condenser in clamp.

(3) Attach cold-water inlet and outlet rubber tubes to condenser.

(4) Refer to appropriate ASTM procedures or Federal standard for complete directions for preparation of apparatus and sample for determination of water in petroleum products.

c. Cleaning. Remove all oils and grease from glass equipment with suitable solvent, wash with soap and water, rinse, and air-dry.

CHAPTER 5
SHIPMENT, STORAGE, AND DEMOLITION

Section I. PREPARATION FOR STORAGE AND SHIPMENT

70. General Instructions

Preparation of the mobile petroleum laboratory is similar for domestic shipment or for limited storage. Preparation for shipment by rail includes blocking and bracing to secure the unit on the flatcar. The following instructions apply to the mobile petroleum laboratory which is ready for immediate use upon arrival and which will be stored for not more than 90 days.

a. Trailer.

(1) Lubricate trailer according to instructions on lubrication order (fig. 13).

(2) Clean all tires thoroughly. Wash off any grease, oil, or gasoline that comes in contact with tires. Do not store trailer on floors, cinders, or other surfaces that are soaked with grease or oil.

(3) Remove rust and corrosion appearing on any part of body or chassis. Paint wherever necessary to protect trailer against deterioration.

(4) Put trailer through an operation test similar to run-in test (par. 8) to assure proper performance of trailer.

(5) Make a systematic inspection just prior to shipment or storage, to make certain that all required steps have been taken. During limited storage, inspect every 48 hours.

b. Utility Equipment.

(1) Test utility equipment for loose components.

(2) Check fuel and water tanks to make sure they are empty.

c. Laboratory Apparatus.

(1) Be sure all components are fastened securely.

(2) Place masking tape over protruding components.

(3) Fix drawer-retaining bars in place.

(4) Lock fume-hood sliding doors to the left.

(5) Cover gage glasses and warning lamps with masking tape.

(6) Check fluorescent lamps and fixtures for looseness.

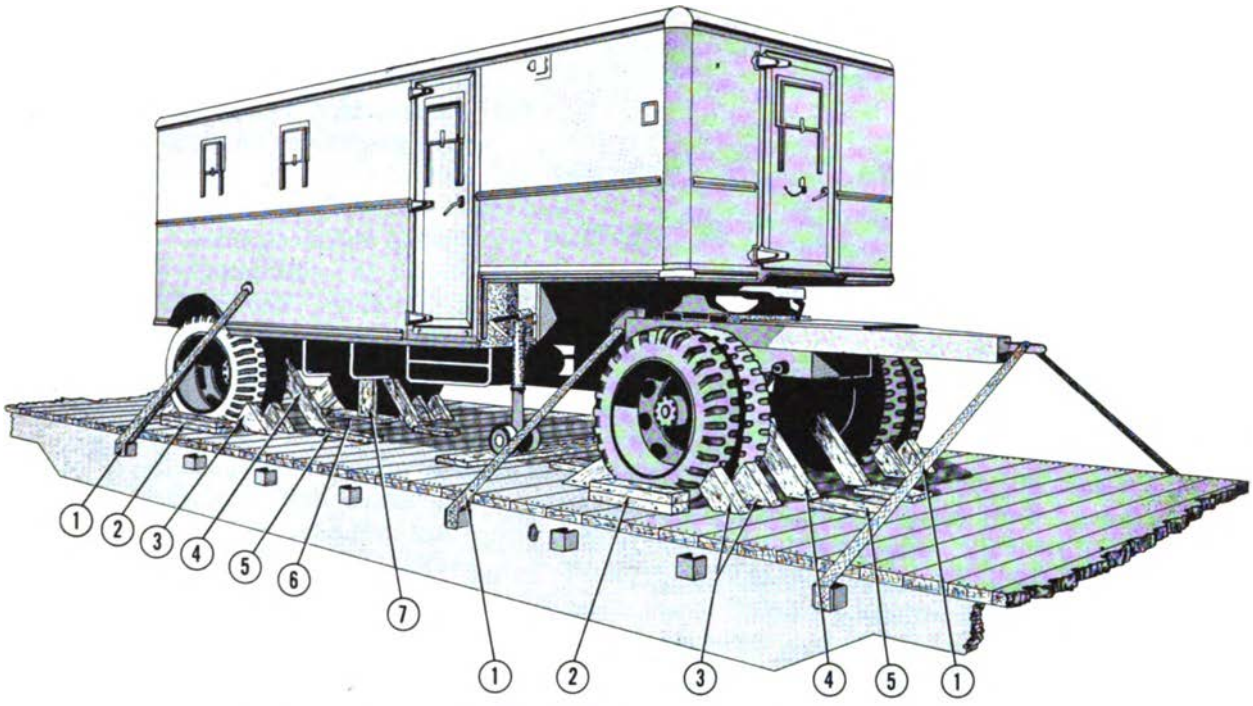
71. Loading and Blocking for Rail Shipment

Block and brace trailer on flatcar according to standard procedures (TB 9–OSSC–G). After loading trailer on flatcar, set handbrakes on dolly and trailer. For blocking and bracing dolly and semitrailer on flatcar, see figure 60 to identify braces, blocks, chocks, and other materials used in securing trailer.

a. Strapping (2 × 0.050 in. High-Tension Banding). Place 1 strap through each of the 2 lifting shackles, 1 through dolly ramp, and 1 through dolly lunette. Attach strap ends to stake pockets of flatcar (1, fig. 60). Four-strand No. 8 gage annealed steel wire may be substituted for metal holddown bands.

b. Side Cleats (2 × 4 × 18 in.). Place 2 cleats against outside face of each outer wheel (2, fig. 60). Place suitable cushioning material (waterproof paper, burlap) under lower cleat and between cleats and tires. The cushioning material must extend 2 inches above top cleats. Nail each lower cleat to flatcar floor with 5 twentypenny nails and each top cleat to lower cleat and flatcar floor with 5 twentypenny nails.

c. Chock Blocks (6 × 6 × 13 in.). Bevel both ends of blocks approximately 45°. Place 1 block against front and 1 rear of each wheel (3, fig. 60). Nail face of block to flatcar floor with 3



1 Strapping
2 Side cleats
3 Chock blocks
4 Diagonal braces
5 Diagonal brace cleats
6 Support base
7 Support

Figure 60. Securing semitrailer and dolly to flatcars.

sixtypenny nails and toenail outer face to flatcar floor with 1 sixtypenny nail.

d. Diagonal Braces (2 × 6 in.). Cut to proper length and place braces at front and rear of each axle (4, fig. 60). Shape one end to fit axle and bevel other end approximately 45°. Toenail to flatcar floor with 2 thirtypenny nails.

e. Diagonal Brace Cleats (2 × 4 × 16 in.). Place lengthwise of flatcar against each diagonal brace (5, fig. 60). Nail to flatcar floor with 6 twentypenny nails.

f. Support Bases (2 × 6 × 24 in.). Nail support bases lengthwise on flatcar floor under axles near each wheel (6, fig. 60). Use 8 twentypenny nails for fastening support bases to flatcar floor. Supports (7) will rest on these bases.

g. Supports (6 × 6 in.). Cut to proper length and place under axle near each wheel, with bottom of support resting on support base (7, fig. 60). Nail each support to its base with 8 thirtypenny nails.

72. Oversea Shipment or Extended Storage

To insure safe transit and to protect the semitrailer against weather, shipping personnel should follow the principles and instructions described in TM 38–230.

Section II. DEMOLITION TO PREVENT ENEMY USE

73. General

Demolition should be carried out only upon orders of the commanding officer. If possible, demolition should be accomplished on an airstrip or road to obstruct enemy advance. Destruction should be as complete as available time, equipment, and personnel allow. If thorough demolition of all parts cannot be com-

pleted, destroy the most important parts. Adequate safety precautions must be taken to protect personnel involved in demolition.

74. Detailed Procedures

a. Laboratory Compartment.

(1) Smash all apparatus and glassware.
(2) Break and bend copper tubing. Smash needle valves.
(3) Smash control boxes, cut wiring, and smash control panel.
(4) Remove chemicals from drawers and cabinets, and pour out. Smash containers.
(5) Demolish drawers, cabinets, fume hood, and refrigerator, using any readily available heavy object.
(6) Remove and discharge contents of fire extinguishers outside of trailer.

b. Utility and Rear Compartments.

(1) Smash heater, vacuum pump, air compressor, water pump, air conditioner, refrigerator condenser, knock-testing engine, and all electric motors.
(2) Bend and break all copper tubing.
(3) Puncture water and fuel tanks.
(4) Smash valves, breaker switchboxes, and electrical conduits. Cut all exposed wire.
(5) Immediately before leaving trailer, open gas valves on all bottled-gas cylinders.

c. Trailer and Dolly.

(1) Deflate and slash tires.
(2) Smash the taillights, reflectors, electrical plugs, cables, sockets, hoses, jacks, valves, couplings, brakes, shock absorbers, pintles, windows, and doors, using any readily available heavy object.
(3) If available, pour gasoline or oil over the entire unit and ignite by incendiary grenades, or by any other means available. Do not ignite semitrailer with matches if gas cylinder valves were opened prior to leaving trailer, as the escaping gases will make the trailer highly explosive.
(4) Fire on the trailer using rifle or machinegun fire, grenades, or rockets.
(5) Keep personnel a safe distance from trailer when trailer is being demolished by fire and gunfire.

APPENDIX I

REFERENCES

AR 700–2300–1	Motor Vehicles.
AR 700–8120–1	Safe Handling, Storing, Shipping, Use, and Disposal of Compressed Gas Cylinders.
AR 850–20	Precautions in Handling Gasoline.
DA Pam 310–1	Index of Administrative Publications.
DA Pam 310–2	Index of Blank Forms.
DA Pam 310–3	Index of Training Publications.
DA Pam 310–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310–7	Index of Tables of Organization and Equipment, Tables of Organization, Type Tables of Distribution, and Tables of Allowances.
DA Pam 310–25	Index of Supply Manuals; Corps of Engineers.
DA Pam 310–29	Index of Supply Manuals; Ordnance Corps.
DA Pam 310–30	Index of Supply Manuals; Quartermaster Corps.
ENG 3–17	Federal Class 17; Electrical Apparatus.
FM 10–37	Quartermaster Petroleum Depot Company.
TM 3–250	Storage and Shipment of Dangerous Chemicals.
TM 9–846	Trailer Converter Dollies: 6-Ton, 2-Wheel Trailer Converter Dolly M364 (Heil, Model D2); 8-Ton, 2-Wheel Trailer Converter Dolly (Fruehauf, Signal Corps Models K83 and K83A); and 10-Ton, 2-Wheel Trailer Converter Dolly M365 (Springfield Auto Works; Production Engineering).
TM 9–1799	Ordnance Maintenance: Fire Extinguisher.
TM 9–1827A	Ordnance Maintenance: Power Brake Systems (Bendix-Westinghouse).
TM 9–2851	Painting Instructions for Field Use.
TM 9–2855	Instruction Guide: Operation and Maintenance of Ordnance Materiel in Extreme Cold (0° to —65° F.).
TM 10–1101	Petroleum-Handling Operations.
TM 21–300	Driver Selection and Training.
TM 21–305	Driver's Manual.
TM 38–230	Preservation, Packaging, and Packing of Military Supplies and Equipment.

APPENDIX II

EQUIPMENT AND SUPPLY LISTING FOR QUARTERMASTER MOBILE PETROLEUM LABORATORY

Legend: NSNA—No stock number available.
P/M—Permanently mounted in laboratory.
P/A—Permanently attached to the mounted item to which it applies.
Letter and number designations indicate drawer or cabinet location.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
1	Aniline point apparatus, ASTM D611, S.I.L. 4-tube model, complete, less thermometer and heater, 115 v., 50–60 cycle, ac, Precision Scientific Co. 73478.	6630-359-9626	ea	1	AD-4, AD-5, BD-3, BD-14, DC-2.
2	Balance, analytical, Voland type, 340–D, notched beam, 200 gm. each pan, sensitivity 0.05 gm, with full load, w/visigram and built-in magnetic damper, Machlett & Sons No. 2-604.	6670-359-2199	ea	1	DC-4.
3	Balance, 3-beam scale, stainless steel, chemical dispensing, complete with weight, 1,610-gm. capacity, sensitivity 0.1 gm. Fisher Scientific Co. No. 2-033.	6670-494-3604	ea	1	BD-13.
4	Barometer, aneroid, 25 to 31 2n. range, w/o case	6685-255-9507	ea	1	BD-7.
5	Bath, constant temperature, utility, electrically heated, 10½ x 5 x 5 in. deep inside, 12¼ x 7 x 12¾ in. high outside, including thermometer, but no racks or cover, 300 w., 115 v., ac, Precision Scientific Co. No. 66602.	6640-359-9631	ea	1	P/M.
6	Bath jar, 4 tube, aniline point apparatus, glass	6630-359-9638	ea	2	AD-5.
7	Bath, kinematic viscosity, constant temperature, ASTM D 445, 6-tube capacity, electrically heated, complete, w/control box, less thermometers and viscosity pipettes, 115 v., ac or dc, Emil Greiner Co. No. G 19600.	6640-359-9635	ea (Thermometer holder). (Magneto set).	1 6 1	P/M. ED 1. BD 3.
8	Beads, glass, solid, 5 mm. dia., E. Machlett and Son No. G 41-550	6640-290-6548	lb	1	BD 7.
9	Beaker, Berzelius, Pyrex, tall form, w/o spout, 100-ml. capacity, Emil Greiner Co. No. G 1710.	6640-290-6817	ea	12	DD-3.
10	Beaker, Griffin, Pyrex, low form, w/spout, 100-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-290-6824	ea	6	DD-3.
11	Beaker, Griffin, Pyrex, low form, w/spout, 250-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-290-6825	ea	6	BD-9.
12	Beaker, Griffin, Pyrex, low form, with spout, 400-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-290-6826	ea	4 12	AD-4. DD-3.
13	Beaker, Griffin, Pyrex, low form, with spout, 600-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-290-6827	ea	6	DD-3.
14	Beaker, Griffin, Pyrex, low form, with spout, 1,000-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-00-6829	ea	6	AD-4.
15	Beaker, Griffin, Pyrex, low form, with spout, 2,000-ml. capacity, Fisher Scientific Co. No. 2-540.	6640-290-6830	ea	3	AD-5.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
16	Block, refractory, upper electric heater, Heat-Roc, 2¾ in. hole, Precision Scientific Co. No. 61836.	6640-359-9643	ea	2	CC-2.
17	Bomb, Reid vapor pressure, ASTM D323, immersion type, ¼ size, complete w/o gage.	6635-359-9657	ea	2	BD-14.
18	Borer, cork, nickel burnished steel, outside dia. 4.75 to 19 mm., set of 10, Fisher Scientific Co. No. 7-850.	6640-379-4603	set	1	BD-3.
19	Bottle, dropping, glass, ground in pipette stopper with rubber bulb, 60-ml. capacity, E. M. Sargent & Co. No. S-8755.	6640-290-6832	ea	6	BD-9.
20	Bottle, unsaturation, Stoddard, ASTM D 484, blue line exax, neck graduated from 0 to 100 percent in 2 percent divisions, w/ground-glass stopper, Fisher Scientific Co. No. 13-559.	6640-359-9663	ea	2	BD-10.
21	Bottle, washing, Pyrex, ring neck, 2-hole rubber stopper with bent-glass tubes, 500-ml. capacity, Fisher Scientific Co. No. 3-395.	6640-290-6833	ea	2	BD-9.
22	Bottle, washing, Pyrex, ring neck, wicker covered, 2-hole rubber stopper with bent glass tubes, 500-ml. capacity, Fisher Scientific Co. No. 3-401.	6640-00-6835	ea	2	BD-4.
23	Brush, dusting, bench, hair, length of brush part 8½ in., width of bristles 2½ in., overall length 13 in.	7920-244-0152	ea	1	CC-1.
24	Brush, flexible, metal shaft, wooden handle, for flask or bottle, length of bristle part 4 in., dia. of bristles 1¼ in., overall length 16 in.	7920-359-6186	ea	2	CC-1.
25	Brush, test tube, dia. of brush part 7/16 in., overall length 9 in	7920-244-0365	ea	2	CC-1.
26	Brush, test tube, dia. of brush part ¾ in., overall length 10 in	7920-234-9313	ea	2	CC-1.
27	Bulb, light, aniline point apparatus, 6-8 v., Precision Scientific Co.	6640-00-19290	ea	6	BD-3.
28	Bulb, pilot, wide base, Tag Saybolt viscosimeter, 110 v., ac	6635-359-9667	ea	6	BD-7.
29	Burette, straight stopcock, blue line exax, retested, 50-ml. capacity, Fisher Scientific Co. No. 3-699.	6640-290-6840	ea	5	BD-2.
30	Can, friction top, steel, rd., 2-lb. capacity	8110-248-9621	ea	8	Utility compt.
31	Can, screw cap, with fixed handle, steel, rectangular, 1-gal. capacity.	8110-222-3065	ea	12	Utility compt.
32	Carbon residue apparatus, Conradson, ASTM D 189, single unit, natural gas, complete, Precision Scientific Co. No. 73571.	6630-359-9706	ea	1	AD-3, BD-1, BD-13, ED-1.
33	Cement, DeKhotinsky, hard, 1-oz. stick	8040-272-7689	ea	1	BD-3.
34	Centrifuge, electric, ball bearing, 4-place head and aluminum shields for ASTM 100-ml. pear-shaped tubes, 115 v., ac, or dc Emil Greiner Co. No. G 4255.	6640-359-9708	ea	1	P/M.
35	Chamois, leather, sheepskin, untrimmed, Fed. KK-S-416A, type A, medium.	8330-257-2498	ea	4	ED-3.
36	Chart, kinematic viscosity, ASTM D 341, type C, size 20 x 16 in., high range 2 to 20,000,000 centistokes, temperature range minus 30° to plus 450° F., 25 charts to a pad.	7640-248-4490	pad	1	ED-3.
37	Chart, viscosity blending, size 16¾ x 11 in., 30 to 10,000 Saybolt seconds, 25 charts to a pad.	7640-248-4495	pad	2	ED-3.
38	Chart, viscosity temperature, ASTM D 431, type B, size 8½ x 11 in., range 33 to 100,000 Saybolt Universal seconds, temperature range 10° to 300° F., 50 charts to a pad.	7640-248-4497	pad	1	ED-3.
39	Chart, viscosity temperature, Esso type, size 24 x 18 in. graph paper, 25 charts to a pad.	7640-248-4498	pad	1	ED-3.
40	Clamp, burette, round jar, single, Armco iron, jaw opening ½ to 1¼ in., overall length 6⅜ in., Precision Scientific Co. No. 7420.	6640-359-9714	ea	2	BD-3.
41	Clamp, extension, round jaw, stainless steel, jaw opening ½ to 1¼ in., overall length 8 in., Precision Scientific Co. No. 7524.	6640-494-2489	ea	4	BD-3.
42	Clamp holder, fixed, castaloy, for rods to 11/16 in., dia., Fisher Scientific Co. No. 5-756.	6640-494-3634	ea	4	BD-3.
43	Clamp, pinchcock, rubber tubing, heavy duty, 2-jaw spring-cylinder type, castaloy, Fisher Scientific Co. No. 5-849-B.	6640-290-6796	ea	4	BD-1.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
44	Cloud and pour point apparatus, ASTM D 97, 4 unit, metal, complete with ASTM high-range thermometers, glass test jars and stoppers, Precision Scientific Co. 74515.	6635-359-9730	ea	1	DC-1.
45	Comparator, color, for petroleum oils, portable, with 2 sample tubes, 2 disks with 13 color units total, Emil Greiner Co. No. G 17550.	6635-359-2217	ea	1	BD-12.
46	Condenser, atmospheric	NSNA	ea	25	P/M.
47	Condenser, Friedrichs, Pyrex, standard taper 24/40 joint with drip tip at the bottom and an outer standard 24/40 joint at the vapor inlet, 350 mm. long, Fisher Scientific Co. No. 7-744-5.	6640-359-9731	ea	2	AD-3.
48	Condenser, Liebig, Pyrex, with inner tube sealed to jacket, length of jacket 400 ml. Emil Greiner Co. No. G 6365.	6640-359-9734	ea	1	ED-1.
49	Cone, grease penetration, ASTM, brass body, hardened steel tip and stem. Precision Scientific Co. No. 73526.	6640-359-2218	ea	2	BD-3.
50	Copper strip, corrosion, polished, for ASTM D 130, pkg. of 25, Precision Scientific Co. No. 74916.	6640-359-9741	pkg	4	BD-3.
51	Cork press, rotary, for corks 5 mm. to 32 mm., Fisher Scientific Co. No. 7-880.	6640-494-3727	ea	1	CC-1.
52	Cork, test tube, grease dripping point apparatus, C. J. Tagliabue Corp. No. 55805D.	6640-375-1707	set	6	BD-3.
53	Cover, beaker, watch glass form, glass, dia. 75 mm., Fisher Scientific Co. No. 2-610.	6640-290-6809	ea	6	ED-1.
54	Cover, beaker, watch glass form, glass, dia. 150 mm., Fisher Scientific Co. No. 2-610.	6640-290-6815	ea	6	AD-2.
55	Cover, glass cylinder, distillation apparatus, petroleum products, fibre square, Emil Greiner Co.	6640-255-9140	ea	6	BD-1.
56	Crankcase dilution apparatus, Pyrex glass parts only, with interchangeable joint No. 24/40 between trap, condenser and flask, Emil Greiner Co. No. 17784.	6635-359-9749	ea	1	BD-7.
57	Crucible, Coors, porcelain, high form, size No. 0, capacity 15 ml., dia. 35 mm., height 27 mm., Fisher Scientific Co. No. 7-965.	6640-290-6781	ea	6	AD-3.
58	Crucible, Coors, porcelain, high form, size No. 1, capacity 30 ml., dia. 41 mm., height 35 mm., Fisher Scientific Co. No. 7-965.	6640-290-6782	ea	6	DA-1.
59	Crucible, Coors, porcelain, high form, size No. 2, capacity 55 ml., dia. 52 mm., height 43 mm., Fisher Scientific Co. No. 7-965.	6640 290 6778	ea	6	DA-3.
60	Crucible, Gooch, Coors, porcelain, with perforated bottom, size No. 3, capacity 25 ml., dia. 36 mm., height 41 mm., Emil Greiner Co. No. G 6735.	6640 290 6793	ea	4	AD-3.
61	Crucible, Gooch, Coors, porcelain, with perforated bottom, size No. 4, capacity 35 ml., dia. 40 mm., height 47 mm., Emil Greiner Co. No. G 6735.	6640 290 6549	ea	8	AD-1.
62	Crucible holder, Walter, rubber, with glass stem, Fisher Scientific Co. No. 8-285.	6640 359 9753	ea	2	BD-12.
63	Cup, Cleveland, open flash point tester, forged brass, with attached handle.	6630 359 9757	ea	1	BD-13.
64	Cutter, glass tubing, 30 mm. maximum tube diameter	5110 00 19008 Not in QM system (deleted)	ea	2	BD-1.
65	Cylinder, graduated, single scale, glass, white line, 25-ml. capacity, Fisher Scientific Co. No. 8-550.	6640-290 6567	ea	4	AD-5.
66	Cylinder, graduated, single scale, glass, white line, 100-ml. capacity, Fisher Scientific Co. No. 8-550.	6640 290 6568	ea	6	BD-9.
67	Cylinder, graduated, single scale, Pyrex, Lifetime Red, 5-ml. capacity, Fisher Scientific Co. No. 8-552R.	6640 290 6569	ea	4	AD-5.
68	Cylinder, graduated, single scale, Pyrex, Lifetime Red, 10-ml. capacity, Fisher Scientific Co. No. 8-552R.	6640 290 6570	ea	4	AD-5.
69	Cylinder, graduated, single scale, Pyrex, 100 percent white line, approx. 200-ml. capacity.	6640 00 19097	ea	6	BD-12.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
70	Cylinder, hydrometer jar, glass, with pouring lip and base, inside height 200 mm., inside diameter 38 mm.	6630-244-4341	ea	4	AD-2.
71	Cylinder, hydrometer jar, Pyrex, inside height 250 mm., inside dia. 30 mm.	6630-244-4346	ea	4	BD-14.
72	Desiccator, aluminum, inside dia. 8 in., height inside 8 in., seven 1⅛ in. dia. holes in plate, with cover, Fisher Scientific Co. No. 8-594-B.	6640-290-6537	ea	1	DC-6.
73	Dish, corrosion and gum test, gasoline, copper, dia. 3½ in., Fisher Scientific Co. No. 13-403.	6640-359-9768	ea	6	AD-2.
74	Distillation apparatus, petroleum products, ASTM D 86 and D 216, front view, ice refrigerated, complete, less glassware, w/built-in 115 v., 50- to 60-cycle, 750-w., ac, Ful-Kontrol heater for each unit, 1 unit, left hand, Precision Scientific Co. No. 74731.	6640-00-19126	ea	1	P/A.
75	Distillation apparatus, petroleum products, ASTM D 86 and D 216, front view, ice refrigerated, complete, less glassware, with built-in 115-v., 50- to 60-cycle, 750-w., ac, Ful-Kontrol heater for each unit, 1 unit right hand, Precision Scientific Co. No. 74730.	6640-359-9772	ea	1	P/A.
76	Distilling receiver, crankcase dilution test, Pyrex, graduated from 0 to 12.5-ml., 0.1-ml. divisions, Emil Greiner Co. No. G 7507.	6640-359-9777	ea	4	AD-2.
77	Distilling receiver, Dean and Stark, Pyrex, blue line exax., graduated from 0 to 10-ml. in 0.1-ml. divisions, Emil Greiner Co. No. G 7517.	6640-359-9779	ea	3	AD-2.
78	Dry ice machine, Snowman, chrome plated, complete with strainer, tubes, and connectors, 3-oz. cake size, Precision Scientific Co. No. 74503.	4110-026-0413	ea	1	AC-1.
79	Extraction apparatus, Soxhlet, Pyrex, with interchangeable ground joints, complete with condenser, condenser tube, and flash, size B, Fisher Scientific Co. No. 9-556.	6640-359-9783	ea	2	BD-10.
80	File, hand, American pattern, round type, length heel to point 6 in., double cut, bastard face, JAN-F-1088, class 1, type E.	5110-234-6548	ea	1	BD-1.
81	Fire extinguisher, Kidde, model 2½ T 1, w/mounting bracket...	NSNA	ea	3	P/M.
82	Flash point tester, Cleveland, open cup, ASTM D 92, electrically heated, complete, auto-transformer Ful-Kontrol heater, 115-v., 50- to 60-cycles, 750-w., ac, Precision Scientific Co. No. 74580.	6630-359-9787	ea	1	BD-13, CC-2, DC-2, ED-1.
83	Flash point tester, Pensky Martens, closed cup, ASTM D 93, electrically heated, complete, 3-heat switch heater, 115-v., 50- to 60-cycles, ac, Emil Greiner Co. No. G-18200.	6630-359-9791	ea	1	CC-2.
84	Flash point tester, Tag, closed cup, ASTM D 56, complete w/alcohol lamp burner, Emil Greiner Co. No. G-18180.	6630-359-9792	ea	1	BD-13.
85	Flask, boiling, Pyrex, round bottom, short ring neck, 500-ml. capacity, Fisher Scientific Co. No. 10-065.	6640-290-6865	ea	2 3	AD-4. AD-5.
86	Flask, boiling, Pyrex, round bottom, short ring neck, 1,000-ml. capacity, Fisher Scientific Co. No. 10-065.	6640-290-6866	ea	2	AD-5.
87	Flask, distilling, Engler, ASTM, Pyrex, 100-ml. capacity, Emil Greiner Co. No. G-8705.	6640-359-9794	ea	8 2 2	BD-8. DD-3. BD-10.
88	Flask, distilling, Saybolt, ASTM, Pyrex, 250-ml. capacity, Emil Greiner Co. No. G-8725.	6640-359-9798	ea	8	BD-8.
89	Flask, Erlenmeyer, Pyrex, vial mouth, 250-ml. capacity, Fisher Scientific Co. No. 10-040.	6640-290-6937	ea	6	DB-10.
90	Flask, Erlenmeyer, Pyrex, vial mouth, 500-ml. capacity, Fisher Scientific Co. No. 10-040.	6640-290-6939	ea	6	AD-4.
91	Flask, Erlenmeyer, Pyrex, wide mouth, 250-ml. capacity, Fisher Scientific Co. No. 10-090.	6640-290-6872	ea	2	AD-4.
92	Flask, Erlenmeyer, Pyrex, wide mouth, 500-ml. capacity, Fisher Scientific Co. No. 10-090.	6640-290-6873	ea	2 4	AD-4. AD-5.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
93	Flask, filtering, Pyrex, with side tube, 500-ml. capacity, Fisher Scientific Co. No. 10–180.	6640–290–6945	ea	2	AD–4.
94	Flask, iodine, Pyrex, with standard taper stopper and mercury seal rim, 250-ml. capacity, Fisher Scientific Co. No. 10–094.	6640–290–6936	-------	------	----------
95	Flask, Saybolt viscosimeter, ASTM, Pyrex, 60-ml. capacity, Fisher Scientific Co. No. 10–235.	6640–359–9801	ea	6	BD–4.
96	Flask, volumetric, blue line exax., retested, with standard-taper glass stopper, 500-ml. capacity, Fisher Scientific Co. No. 10–204.	6640–290–6934	ea	2	BD–9.
97	Flask, volumetric, blue line exax., retested, with standard-taper glass stopper, 1,000-ml. capacity, Fisher Scientific Co. No. 10–204.	6640–290–6922	ea	3	BD–9.
98	Flexaframe, laboratory apparatus, aluminum alloy rods, Castaloy connectors, set 1, Fisher Scientific Co. No. 14–666–1.	6640–359–9802	ea	2	CC–1.
99	Foam test apparatus, crankcase oils, ASTM D 892, consisting of 1,000-ml. Pyrex cylinder, diffusion stone mounted on glass tube, calibrated manometer type flowmeter, minus 5° to plus 215° F. gravity thermometer and including Pyrex bath, 12 in. dia. x 18 in. high, with heating elements, thermoregulator and control box, 110 v., ac, Emil Greiner Co. No. G–18250 and No. G–18255, plus thermometer.	6640–255–9137	ea	1	BD–1, BD–4, BD–7, BD–11, BD–13, BD–14, CC–2, DC–2, DC–6, ED–1.
100	Forceps, blance weight, curved, corrosion-resisting steel, plastic tipped.	6670–494–3615	ea	1	BD–1.
101	Fume hood, canopy type, stainless steel, with blower, 56 in. x 24 in. x 30 in. high. Hood will be furnished with a condensation gutter and sliding front glass door. Suitable for evaporating of acids and other liquids.	NSNA	ea	1	P/M.
102	Funelaire, rubber, to fit the stem of funnels of from 3 to 6 in. dia. Fisher Scientific Co. No. 10–331.	6640–359–9810	ea	3	BD–1.
103	Funnel, filtering, Pyrex, long stem, dia. 50 mm., length of stem 150 mm., Central Scientific Co. No. 15056.	6640–290–6923	ea	4	AD–3.
104	Funnel, ribbed, Mooney Airvent, heavy molded glass, 1,000-ml. capacity, top dia. 175 mm., Fisher Scientific Co. No. 10–381.	6640–290–6913	ea	1	AD–5.
105	Funnel, separator, Pyrex, cylindrical, with standard-taper glass stopcock and stopper, 500-ml. capacity, Fisher Scientific Co. No. 10–412.	6640–290–6900	ea	2	AD–4.
106	Funnel, separator, Squibb, Pyrex pear shape, short stem, with standard-taper stopcock and stopper, 250-ml. capacity, E. Machlett and Son No. 37–260.	6640–290–6905	ea	3	DD–3.
107	Furnace, laboratory, muffle, electric, working chamber 9 in. wide x 4⅜ in. deep x 4 in. high, 115 v., ac, Precision Scientific Co. model No. TF.	6640–359–9814	ea	1	P/M.
108	Gage, pressure, dial indicating, single bourdon tube, rigid stem mounting, single connection, male, lower, ¼ in. SPT., 0 to 15 p. s. i., 2½-in. dial, nonadjustable pointer.	6685–254–5003	ea	3	BD–7.
109	Gage, pressure, dial indicating, single bourdon tube, rigid stem mounting, single connection, male, lower, ¼-in. SPT., 0 to 30 p. s. i., 2½-in. dial, nonadjustable pointer.	6685–255–9509	ea	2	BD–7.
110	Gage, pressure, double bourdon tube, surface, wall mounting, double connection, female, top ¼-in. NPT., 0 to 200 p. s. i., zero adjustment.	6685–255–8151	ea	1	DC–6.
111	Gas, carbon dioxide (50 lb. cylinder w/valve)	NSNA*	ea	1	Rear compartment.
112	Gas, Freon 12, 5-lb. container	NSNA*	ea	1	Rear compartment.
113	Gas, oxygen (220–240 cu. ft.) cylinder w/valve	NSNA*	ea	1	Rear compartment.
114	Gas, propane (100-lb. cylinder w/valve)	NSNA*	ea	1	Rear compartment.

*Initial issue only, resupply should be through Engineer requisitioning channels.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
115	Gasket, O-ring, for ¼ size Reid vapor pressure bomb	6635–359–9817	ea	48	BD–1.
116	Gasoline indicating paste, gage–0, 3-oz. tube	6630–359–9821	tube	12	BD–13.
117	Gloves, asbestos, 11 in. long, Fisher Scientific Co. No. I–460	0088–Q2–03008	pr	1	ED–3.
118	Gloves, rubber, men's, synthetic rubber, heavyweight, black, A, 20–130, type 1, size 9.	8415–266–8682	pr	2	ED–3.
119	Gravitometer, Fisher Scientific Co. No. 11–509	0088–Q9–00418	ea	1	DC–6.
120	Grease cup, grease dropping point apparatus, chrome-plated brass.	6635–359–9825	ea	1	BD–3.
121	Grease dropping point apparatus, ASTM D 566, complete, including electric heater and thermometer, 115 v., ac, Precision Scientific Co. No. 73455.	6635–359–9827	ea	1	BD–3.
122	Grease, laboratory, stopcock, "Cello-Grease", 1 oz. tube	9150–385–7624	tube	1	BD–1.
123	Grease worker, ASTM, hand operated, Emil Greiner Co. No. G–17735.	6635–359–9829	ea	1	CC–2.
124	Ground rod, joslyn copper steel core, Cat. No. J 8330	NSNA	ea	1	P/M.
125	Guard, thermometer, Saybolt viscosity, Precision Scientific Co. No. 74978.	6685–359–2224	ea	3	BD–3.
126	Gum content apparatus, gasoline, ASTM D 381, double unit, complete, less beakers, 115 v., 50–60 cycles, ac, Precision Scientific Co. No. 74775:	6630–359–9835	ea	1	P/M.
	Condenser			1	BD–4.
	Gage			1	BD–13.
	Thermometer			1	BD–11.
	Beaker			12	DD–3.
127	Gum stability apparatus, gasoline, ASTM D 525, 2-bomb capacity, complete, 115 v., Emil Greiner Co.:	6630–00–19028	ea	1	P/M.
	Bath, gum stability apparatus, gasoline, 2-bomb size, electrically heated, 3-heat switch, 115 v.			1	
	Bomb, gum stability apparatus, gasoline, corrosion-resisting steel, complete with 6 composition gaskets, needle valve, and Pyrex liner.			2	ED–1.
	Gage, pressure recording, 2-pen type, electric clock, range 0–200 lb. in 2 lb. divisions with 100 charts and ink set.			1	PA/ED–3, BD–12.
	Tubing, gum stability apparatus, gasoline, flexible metal, for connection between bomb and recorder, 1/16 in. inside dia., 5 ft. long, with coupling at each end.			2	BD–14.
128	Heater, electric, Autemp, thermostatically controlled, top dia. 6 in., 115 v., ac, Fisher Scientific Co. No. 11–467–1A.	6640–359–9839	ea	2	BD–7.
129	Heater, electric, Ful-Kontrol, auto-transformer, complete w/on–off switch, 2 rod holders and porcelain refractory block, 3⅛-in. hole, 115 v., 0 to 750 w., ac, Precision Scientific Co. No. 1600.	6640–359–9840	ea	4	DC–2.
130	Heater, electric, Ful-Kontrol, special for aniline point apparatus, with cord and plug connection and tap-off for 6- to 8-v. lamp bulb, 115 v., 50 to 60 cycles, 750 w., ac, Precision Scientific Co. No. 73477–7.	6640–359–9841	ea	1	DC–2.
131	Holder, watch, plastic, with start, stop, and reset button	6645–249–6877	ea	3	BD–12.
132	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 9° to 21° API, division 1/5°, thermometer scale 20° to 130° F., overall length 7½ in., Taylor Instrument Co. No. 22841, type 23A.	6630–265–7610	ea	1	AD–3.
133	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 19° to 31° API, division 1/5°, thermometer scale 20° to 130° F., overall length 7½ in., Taylor Instrument Co. No. 22843, type 23A.	6630–265–7611	ea	1	AD–3.
134	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 29° to 41° API, division 1/5°, thermometer scale 20° to 130° F., overall length 7½ in., Taylor Instrument Co. No. 22845, type 23A.	6630–265–7758	ea	1	AD–3.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
135	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 39° to 51° API, division 1/5°, thermometer scale 20° to 130° F., overall length 7½ in., Taylor Instrument Co. No. 28846, type 23A.	6630-265-7759	ea	1	AD-3.
136	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 49° to 61° API, division 1/5°, thermometer scale 0° to 110° F., overall length 7½ in., Taylor Instrument Co. No. 22847, type 23A.	6630-265-7764	ea	1	AD-3.
137	Hydrometer (thermo-hydrometer), graduated scale, API, thermometer, scale 59° to 71° API, division 1/5°, thermometer scale 0° to 110° F., overall length 7½ in., Taylor Instrument Co. No. 22848, type 23A.	6630-265-7765	ea	1	AD-3.
138	Ink, recording, instrument chart, blue, 2-oz. bottle	7510-221-0790	bot	1	BD-12.
139	Jar, cloud and pour test, glass, ASTM	6635-359-9867	ea	10	AD-5.
140	Jar, cylindrical, petroleum distillation, Pyrex, dia. 4⅝ in., height 9 in., Emil Greiner Co. No. G-14635.	6640-359-9870	ea	2	BD-10.
141	Jar, cylindrical, Pyrex, outside dia. 4 in., height 6 in., Fisher Scientific Co. No. 11-823.	6640-290-6685	ea	1	BD-5.
142	Kit, spot testing, complete, Precision Scientific Co. No. 5970	0088-Q9-02208	set	1	DC-4.
143	Label, paper, gummed, white, 2¾ in. long, 1 in. wide, red border, 60 to a box.	7510-238-8901	box	6	BD-7.
144	Lamp, electric, fluorescent, portable, battery-operated tubes, plexiglass globe.	6240-375-1062 No longer in QM system (deleted).	ea	2	AC-1.
145	Level and plumb, metal, size 2 x 3 in.	41-L-1295 Deleted from QM system Quartermaster stock number.	ea	1	BD-11.
146	Light, extension, with cable No. 18-2, 2 conductors, 20 ft. long, 25 w., lamp included w/guard.	6240-274-4021 No longer in QM system (deleted).	ea	2	CC-1.
147	Liner, bomb, gum stability apparatus, gasoline, Pyrex	6630-359-9873	ea	2	DD-3.
148	Manometer, U-tube, 100 p. s. i., base mounted, male connection, top ¼ in., 0.18 to 0 to 18, 0 to 90 cm. range.	6685-255-8050	ea	1	P/M.
149	Mortar, Coors, porcelain, with pour-out lip and porcelain pestle, 150 mm. dia., 82 mm. high, 400-ml. capacity, Central Scientific Co. No. 17381-E.	6640-359-9876	ea	1	BD-12.
150	Needle, penetrometer, stainless steel	6635-359-2230	ea	2	AD-5.
151	Orifice tip, Universal, Saybolt, viscosity, ASTM D 88, corrosion resisting steel.	6635-359-9878	ea	4	BD-3.
152	Oven, laboratory, utility, Thelco, electric, working chamber 11 in. wide x 11 in. deep x 11 in. high, range 35° to 180° C., 300 w., 115 v., ac, Precision Scientific Co. model No. 16.	6640-359-9880	ea	1	P/M.
153	Pan, Saybolt viscosimeter, with lip	6635-359-9881	ea	1	AD-3.
154	Paper, abrasive, 13¾ in. long, 9 in. wide, grade No. 000	5350-260-0745 No longer in QM system (deleted).	sh	10	ED-3.
155	Paper, abrasive, 13¾ in. long, 9 in. wide, grade No. 0	5350-260-0747 No longer in QM system (deleted).	sh	10	ED-3.
156	Paper and color chart, test, hydrogen ion, chart attached to dispenser containing two 15-ft. rolls paper, one roll 2 to 10 and one roll 1 to 11 pH range, Emil Greiner Co. No. G-12410.	6630-290-4116	ea	2	ED-1.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
157	Paper, filter, qualitative, unwashed, medium, 12½ cm. dia., 100 circles to a carton, Fisher Scientific Co. No. 9–805.	6640–252–5197	carton	1	BD–13.
158	Paper, filter, qualitative, unwashed, soft, 12½ cm. dia., 100 circles to a carton, Fisher Scientific Co. No. 9–825.	6640–252–5198	carton	1	BD–13.
159	Paper, filter, quantitative, double acid-washed, dense, 12½ cm. dia., 100 circles to carton, Fisher Scientific Co. No. 9–855.	6640–252–5199	carton	1	BD–13.
160	Paper, filter, quantitative, double acid-washed, medium, 12½ cm. dia., 100 circles to a carton, Fisher Scientific Co. No. 9–845.	6640–252–5202	carton	1	BD–13.
161	Paper, filter, quantitative, double acid-washed, thin, 12½ cm. dia., 100 circles to a carton, Fisher Scientific Co. No. 9–860.	6640–252–5205	carton	1	BD–13.
162	Penetrometer, portable, for field use, complete with one ASTM D–5 needle weighing 2.5 gm., and one 50 gm. weight, Precision Scientific Co. No. 73518.	6635–359–2231	ea	1	DC–6 (needle in AD–5).
163	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 50, range 0.8 to 3 centistokes, Cannon Instrument Co. No. 50 CO.	6640–359–9887	ea	2	AD–1.
164	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 100, range 3 to 10 centistokes, range 35 to 65 Saybolt sec., Cannon Instrument Co. No. 100 CO.	6640–359–9888	ea	2	AD–1.
165	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 200, range 10 to 70 centistokes, range 60 to 325 Saybolt sec., Cannon Instrument Co. No. 200 CO.	6640–359–9889	ea	2	AD–1.
166	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 300, range 25 to 175 centistokes, range 120 to 800 Saybolt sec., Cannon Instrument Co. No. 300 CO.	6640–359–9890	ea	2	AD–1.
167	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 400, range 120 to 850 centistokes, range 550 to 4,000 Saybolt sec., Cannon Instrument Co. No. 400 CO.	6640–359–9891	ea	2	AD–1.
168	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 500, range 800 to 6,500 centistokes, range 3,600 to 30,000 Saybolt sec., Cannon Instrument Co. No. 500 CO.	6640–359–9892	ea	2	AD–1.
169	Pipette, kinematic viscosity, Cannon-Fenske, opaque, calibrated ASTM No. 600, range 5,000 to 10,000 centistokes, Cannon Instrument Co. No. 600 CO.	6640–359–9893	ea	2	AD–1.
170	Pipette, transfer, precision, Normax, 2-ml. capacity, Central Scientific Co. No. 16360.	6640–290–6894	ea	2	BD–2.
171	Pipette, transfer, precision, Normax, 5-ml. capacity, Central Scientific Co. No. 16360.	6640–290–6895	ea	2	BD–2.
172	Pipette, transfer, precision, Normax, 10-ml. capacity, Central Scientific Co. No. 16360.	6640–290–6892	ea	2	BD–2.
173	Pipette, transfer, precision, Normax, 25-ml. capacity, Central Scientific Co. No. 16360.	6640–290–6893	ea	4	BD–2.
174	Pipette, transfer, precision, Normax, 50-ml. capacity, Central Scientific Co. No. 16360.	6640–290–6882	ea	2	BD–2.
175	Pipette, viscosity, with rubber aspirator bulb, Fisher Scientific Co. No. 13–585.	6640–494–2493	ea	1	AD–1.
176	Plumb bob, brass, conical, 20 oz. weight	5210–238–1734	ea	2	BD–14.
177	Refrigerator, electric, self contained	NSNA	ea	1	P/M.
178	Regulator, oxygen, 2 gage, 2½ in. dial, 0–200 lb., 0–3000 lb	6680–00–19007 No longer in QM system (deleted).	ea	1	Rear compartment.
179	Regulator, pressure, propane, 2-way throwover manifold, standard setting pressures, with two pigtails and wrench, ¾ in. female outlet 970, POL male inlet NPT. Bastian-Blessing Co. No. 4726A.	6680–00–19008 No longer in QM system (deleted).	ea	1	Rear compartment.
180	Ring, support, cast iron, w/clamp and thumb screw, center of ring 4½ in. from center of support rod, outside dia. of ring 3 in., Fisher Scientific Co. No. 14–050.	6640–290–6695	ea	4	BD–3.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
181	Ring, support, cast iron, w/clamp and thumb screw, center of ring 4½ in. from center of support rod, outside dia. of ring 4 in., Fisher Scientific Co. No. 14–050.	6640–290–6696	ea	4	BD–1.
182	Ring, support, cast iron, w/clamp and thumb screw, center of ring 4½ in. from center of support rod, outside dia. of ring 5 in., Fisher Scientific Co. No. 14–050.	6640–290–6697	ea	4	BD–1.
183	Ring, support, cast iron, w/clamp and thumb screw, center of ring 4½ in. from center of support rod, outside dia. of ring 6 in., Fisher Scientific Co. No. 14–050.	6640–290–6698	ea	4	BD–3.
184	Rod, grease dropping point apparatus, chrome plated, 1/16 in. dia., 6 in. long.	6635–360–1061	ea	1	BD–3.
185	Roll, absorbent cotton, sterilized, 1-lb. roll, Fisher Scientific Co. No. 7–890.	6510–359–9746	ea	1	DC–4.
186	Sampler, petroleum products, ASTM D–270, weighted copper beaker, 1-qt. capacity, 16 in. high, dia. of neck ¾ in., Precision Scientific Co. No. 74856.	6640–359–9944	ea	1	CC–1.
187	Sampler, petroleum products, Tulsa, single chain trip, w/suspension chain, size 12 in., E. Machlett & Son No. 69–928.	6640–359–9946	ea	1	CC–2.
188	Scissors, general surgical, nickel-plated steel, straight, both points sharp, 4½ in. Fisher Scientific Co. No. 8–945.	6515–246–6453	ea	1	BD–1.
189	Scriber, diamond point, straight, w/threaded end, w/rd., bakelite handle, length 5 in.	5120–254–4586	ea	2	BD–3.
190	Sediment apparatus, fuel oil, extraction method, ASTM D 473, consisting of 1-liter Pyrex Erlenmeyer flask, Alundum thimble, thimble support and condenser, Emil Greiner Co. G–19145.	6635–359–9947	ea	1	BD–12.
191	Sharpener, cork borer, brass cone, tool steel blade, 190 mm. long, for borers up to 22 mm. dia.	5345–093–5562	ea	1	BD–1.
192	Shield, safety, Victor	NSNA	ea	1	ED–3.
193	Slide rule, log-log duplex type, metal, 10-in. long scale, w/case	6675–240–1890	ea	2	BD–11.
194	Softening point apparatus, asphalt, ASTM D 36, shelf type, complete w/burner, Precision Scientific Co. consisting of:	6635–00–19003	ea	1	AD–5 (cover only).
	4—Beaker, Griffin, Pyrex, low form, w/spout, 600-ml. capacity.				BD–10.
	2—Ring, softening point apparatus, asphalt, shelf type, straight form, D–36.				BD–1.
	2—Ring, ball retaining, softening point apparatus, asphalt, shelf type, for straight form ring, D–36.				BD–1.
	1 pkg.—Ball, steel, ASTM, softening point apparatus, asphalt, pkg. of 12.				BD–1.
	1—Support stand, laboratory apparatus, rectangular base, cast iron, w/steel rod, size of base 6½ x 11 in., length of rod 36 in.				CC–2.
	1—Ring, support, softening point apparatus, asphalt short shank, cast iron, w/clamp and thumb screw.				BD–1.
	2—Thermometer, bituminous softening point, range 30° to 180° F., division 1/2°, total immersion, total length 15 in., ASTM designation D61, E1.				BD–6.
	2—Thermometer, bituminous softening point, high, range 85° to 392° F., divisions 1°, total immersion, total length 15 in., ASTM designation E28, E1.				BD–6.
	1—Clamp, thermometer and stem, spring for thermometer mounted on rotating arm.				BD–1.
	1—Wire gauze square, iron, with asbestos center, size of square 6 x 6 in.				BD–1.
195	Solder, tin alloy, wire, acid cored, 0.162 in. dia., Fed. QQ–S–571B composition SN 60.	3375–254–8439	lb	1	BD–1.
196	Soldering iron, electric, ½ lb., wedge shape tip, dia. of tip 7/16 in., 44 w., ac, dc.	3375–257–4969	ea	1	BD–10.
197	Sponge, natural, unbleached, avg. perimeter 22 in.	7920–255–7637	ea	1	DC–4.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
198	Steam emulsion apparatus, lubricating oils, ASTM D 157, gas heated, complete, including two burners.	6635-359-9961	ea	1	AD-2, BD-7, BD-9, BD-10, BD-11, CC-2.
199	Still, water, Midget, electrically heated, ½ gal. per hr capacity, 115 v., 1,200 w., Precision Scientific Co. No. 2004.	6640-359-9964	ea	1	P/M.
200	Stirrer, electric, variable speed, direct worm drive, 115 v., ac or dc, Fisher Scientific Co. No. 14-499.	6640-359-9969	ea	1	BD-14.
201	Stone, gas diffuser, foam test apparatus, crankcase oils, spherical, fused crystalline alumina grain, 1 in. dia., attached to glass air inlet tube.	6635-359-9975	ea	1	AD-1.
202	Stopper, bottle, cork, w/std. taper, reg. length, sizes 1 to 20, assorted, 144 per bag.	8125-359-9743	bag	3	CC-2.
203	Stopper, bottle, rubber, 5 assorted sizes, 5-lb. box	8125-132-9016	box	1	BD-12.
204	Stopwatch, 1/5 sec. to 60 sec., 30 min. register	6645-254-8399	ea	4	BD-11.
205	Strainer, Saybolt, viscosimeter, 100 mesh	6635-359-9982	ea	1	ED-1.
206	Stretcher, rubber tubing and bulbs, nickel-plated metal, overall length 6 in., Fisher Scientific Co. No. 14-195.	6640-359-9983	ea	3	BD-1.
207	Sulfur apparatus, petroleum products, Parr oxygen bomb, electric-ignition type, ASTM D 129, single valve, complete, including ignition unit, 115 v., 60 cycles, ac, Emil Greiner Co. G-19250.	6630-359-9984	ea	1	BD-7, BD-13, CC-2, DC-6, ED-1.
208	Sulfur determination apparatus, petroleum oils, ASTM D 90, lamp method, Pyrex, standard-taper joints, complete, including lamp assembly and metal base, Emil Greiner Co. G-19320 W/G 19322.	6630-290-6686	ea	3	DD-5.
209	Support, funnel, wood, 4-place, w/clamp, E. H. Sargent & Co. No. S-78815.	6640-359-9987	ea	1	CC-1.
210	Support stand, laboratory apparatus, rectangular base, cast iron, w/steel rod, size of base 6 x 9 in., length of rod 24 in., Fisher Scientific Co. No. 14-670.	6640-290-6718	ea	4	CC-2.
211	Swab, condenser tube, petroleum distillation apparatus, Precision Scientific Co. No. 76018.	6640-359-9995	ea	1	CC-1.
212	Tape, oil gaging, innage, steel, heavy duty, ½ in. wide, 50 ft. long, marked feet, inches, and eighths, w/reel and locking handle, w/o bob, Lufkin Rule Co. No. 1293S.	5210-359-6571	ea	2	BD-14.
213	Tetraethyllead apparatus, ASTM D-526, complete, Pyrex glassware, w/interchangeable ground joints, Emil Greiner Co. G-19390.	6630-360-0007	ea	2	AD-4, BD-7, BD-9, CC-2, DC-2, ED-1, ED-2.
214	Tetraethyllead determination testing kit, gasoline, complete, Helige, Inc. 850-LA.	6630-360-0008	ea	1	DC-1.
215	Thermometer, max. and min. six's pattern, range −40° F. to 120° F., Taylor Instrument 5448.	0088-Q2-69158	ea	1	P/M.
216	Thermometer, self-indicating, liquid in glass, aniline point, mercury actuating medium, range −38° to 42° C., division 1/5°, immersion 51 mm., length 15 in.	6685-247-3758	ea	2	BD-6.
217	Thermometer, self-indicating, liquid in glass, aniline point, mercury actuating medium, range 25° to 105° C., division 1/5°, immersion 51 mm., length 15 in.	6685-247-3757	ea	4	BD-6 (2), BD-11 (2).
218	Thermometer, self-indicating, liquid in glass, aniline point, mercury actuating medium, range 90° to 170° C., division 1/5°, immersion 51 mm., length 15 in.	6685-247-3753	ea	4	BD-6 (2), BD-11 (2).
219	Thermometer, self-indicating, liquid in glass, bituminous softening point, mercury actuating medium, range 85° to 392° F., division 1°, total immersion, length 15 in.	6685-247-3751	ea	2	BD-6.
220	Thermometer, self-indicating, liquid in glass, cloud and pour, mercury actuating medium, range −36° to −120° F., division 2°, immersion 4½ in., length 8¾ in.	6685-247-3737	ea	6	BD-6.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
221	Thermometer, self-indicating, liquid in glass, cloud and pour, toluol actuating medium, range −112° to −70° F., division 2°, immersion 3 in., length 9 in.	6685–245–9521	ea	6	BD–6.
222	Thermometer, self-indicating, liquid in glass, distillation petroleum products, mercury actuating medium, range 30° to 760° F., division 2°, total immersion, length 15 in.	6685–247–3760	ea	6	BD–6 (4), BD–11 (2).
223	Thermometer, self-indicating, liquid in glass, distillation petroleum products, mercury actuating medium, range 30° to 580° F., division 2°, total immersion, length 15 in.	6685–256–2448	ea	6	BD–6 (4), BD–11 (2).
224	Thermometer, self-indicating, liquid in glass, flash and fire, mercury actuating medium, range 20° to 760° F., division 5°, immersion 1 in., length 12 in.	6685–247–3749	ea	4	BD–6 (2), BD–11 (2).
225	Thermometer, self-indicating, liquid in glass, flash point, mercury actuating medium, range 200° to 700° F., division 5°, immersion 2¼ in., length 10⅞ in.	6685–245–9520	ea	2	BD–6.
226	Thermometer, self-indicating, liquid in glass, flash point, mercury actuating medium, range 20° to 230° F., division 1°, immersion 2¼ in., length 10⅞ in.	6685–255–9978	ea	10	BD–6 (4). BD–11 (6).
227	Thermometer, self-indicating, liquid in case, flash point, mercury actuating medium, range −4° to 122° F., division 1°, immersion 2½ in., length 10⅞ in.	6685–245–9519	ea	2	BD–11.
228	Thermometer, self-indicating, liquid in glass, general use, mercury actuating medium, range −5° to 300° F., division 2°, immersion 3 in., length 12 in.	6685–247–3747	ea	3	BD–6.
229	Thermometer, self-indicating, liquid in glass, grease dropping point, mercury actuating medium, range 20° to 580° F., division 2°, immersion 3 in., length 15 in.	6685–247–3744	ea	2	BD–6.
230	Thermometer, self-indicating, liquid in glass, tank cup case, mercury actuating medium, range 0° to 180° F., division 1°, total immersion, length 16 in.	6685–247–3774	ea	2	ED–2.
231	Thermometer, self-indicating, liquid in glass, vapor pressure, mercury actuating, range −30° to 120° F., division 1°, total immersion, length 12 in.	6685–245–7696	ea	6	BD–6 (4), BD–11 (2).
232	Thermometer, self-indicating, liquid in glass, vapor pressure, mercury actuating medium, range 91° to 108° F., division 1/5°, total immersion, length 10 in.	6685–245–7695	ea	4	BD–6 (2), BD–11 (2)
233	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 97.5° to 102.5° F., division 1/10° total immersion, length 9⅜ in.	6685–247–3765	ea	3	BD–6.
234	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 127.5° to 132.5° F., division 1/10°, total immersion, length 9⅜ in.	6685–247–3764	ea	3	BD–6.
235	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 207.5° to 212.5° F., division 1/10°, total immersion, length 9⅜ in.	6685–247–3763	ea	3	BD–6.
236	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 66° to 80° F., division 1/5°, total immersion, length 10 in.	6685–247–3756	ea	3	BD–6.
237	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 94° to 108° F., division 1/5°, total immersion, length 10 in.	6685–247–3755	ea	6	BD–6.
238	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 120° to 134° F., division 1/5°, total immersion, length 10 in.	6685–247–3754	ea	6	BD–6.
239	Thermometer, self-indicating, liquid in glass, viscosity, mercury actuating medium, range 204° to 218° F., division 1/5°, total immersion, length 10 in.	6685–247–3762	ea	9	BD–6.
240	Thermostat, T 11A300, Acratherm, for heater control, range 55° to 85°, Minn-Honeywell.	NSN	ea	1	P/M.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
241	Thermostat (thermo-regulator), temperature controlling, laboratory, bath control, mercury sensing element, range 35° to 700° F., 12 in. long.	6685–254–9167	ea	1	AD–1.
242	Thief, drum, petroleum products, nonshatterable, 1-pt. capacity, 30 in. long, 1⅛ in. inside dia., 1½ in. outside dia., Emil Greiner Co. No. G–19025.	6640–360–0010	ea	2	P/A.
243	Thimble, extraction, Alundum, sediment apparatus, fuel oil, 25 x 77 mm., Emil Greiner Co. No. 19150.	6640–360–0011	ea	2	AD–5.
244	Time switch, General Electric, single pole, single throw, Cat. No. 93 x 932 model 3T44AAA1, 60 cycles; 115 v., contact rating 35 amp. at 230 v., ac with 2 w. telechron motor.	NSN	ea	1	P/M.
245	Tongs, beaker, Craig, steel, nickel-plated, rubber covered jaws, effective opening 4½ in., overall length 9 in., E. H. Sargent & Co. No. S–82105.	6640–360–0012	ea	1	BD–1.
246	Tongs, crucible, steel, nickel-plated, overall length 18 in., Central Scientific Co. No. 19640.	6640–360–0017	ea	2	BD–1.
247	Triangle, Conradson, carbon residue apparatus, chromel "A" square wire, Precision Scientific Co. No. 73588.	6640–360–0025	ea	3	BD–1.
248	Tube, centrifuge, oil, ASTM, graduated, pear shaped, Pyrex tip graduated 3 ml. in 1/10 ml., 100-ml. capacity, Emil Greiner Co. No. 4942.	6640–360–0031	ea	4	AD–3.
249	Tube, rubber, natural, black, inside dia. 3/16 in., wall thickness 1/16 in.	4720–260–6866	ft	50	DC–4.
250	Tube, rubber, synthetic, inside dia. ¼ in., wall thickness 3/32 in....	4720–273–1032	ft	50	DC–4.
251	Tube, test, chemical, Pyrex, with rim 20 x 150 mm., Emil Greiner Co. No. G–23400.	6640–00–19279	ea	6	BD–9.
252	Tube, test, grease dropping point apparatus, Pyrex, with 3 indentations for holding grease cup, Precision Scientific Co. No. 73461.	6640–360–0046	ea	2	BD–3.
253	Tube, viscosity, Saybolt, ASTM D 88, bronze alloy, with corrosion resisting steel Universal orifice tip, Central Scientific Co. No. 27846–A.	6640–00–19286	ea	2	BD–3.
254	Tubing, gum stability apparatus, gasoline, flexible metal, for connection between bomb and recorder, 1/16 in. inside dia., 5 ft. long with coupling at each end, Emil Greiner Co. No. G–18545.	4720–360–0047	ea	2	BD–14.
255	Tubing, resistance glass, medium heavy wall, assorted sizes, 2-ft. lengths, 5-lb. pkg., E. H. Sargent & Co. No. S–40135.	6640–360–0049	pkg	1	CC–2.
256	Typewriter, portable, American Standard keyboard, 42 keys, elite type, upper and lower case characters.	7430–254–4319	ea	1	DC–4.
257	U-tube, aniline point apparatus, glass, S. I. L. model.....	6630–360–0050	ea	3	AD–4.
258	Vapor pressure apparatus, Reid, ASTM D323, 3-bomb capacity, 110 v., complete Emil Greiner Co. Nos. G–19530, G–19475, G–19510, G–23608 consisting of: 1—Bath, constant temperature, Reid, vapor pressure apparatus, ASTM D 323, complete, less bombs, gages, and thermometers, 110 v., 60 cycles, ac, 3 bomb capacity. 3—Bomb, Reid, vapor pressure ASTM D 323, immersion type, standard size, complete, with 10 ft. of chain, w/o gage. 3—Gage, vapor pressure type, 4½ in. dial, range 0 to 45 lb. in 1/5 lb. divisions, Helicoid movement. 1—Thermometer, vapor pressure, Reid air chamber, range −30° to 120° F., 1° divisions, total immersion, total length 12 in., ASTM D 323–43.	6640–00–19287	ea	1	P/M.
259	Viscosimeter, Saybolt, Precision, ASTM D 88, thermostatically controlled, complete, less viscosity tubes, flasks, thermometers, and stopwatch, 115 v., 50 60 cycles, ac, 2-tube capacity, Precision Scientific Co. No. 74962.	6635–360 0056	ea	1	P/M.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location
260	Water determination apparatus, ASTM D 95, complete with gas burner, Emil Greiner Co. No. G–20175.	6640–360–0060	ea	1	AD–1, AD–2, AD–5, CC–2, ED–1.
261	Weight set, analytical balance, brass, 1 gm. to 1,000 gm., complete w/hardwood block container.	6670–255–9601	set	1	BD–13.
262	Weight set, analytical balance, class S, stainless steel, 1 gm. to 100 gm., complete w/velvet-lined box.	6670–359–2242	set	1	AD–3.
263	Wick, burner, lamp assembly, sulfur determination apparatus, petroleum oils, 60 cm. long, 12 to pkg., Emil Greiner Co. No. G–19334.	6640–360–0062	pkg	4	BD–3.
264	Wick, lamp, kerosene burning test, pkg. of 12, Emil Greiner Co. No. G–17363.	6640–360–0063	pkg	1	AD–2.
265	Grid, wire gauze, laboratory, chromel, 16 mesh, 24 B & S gage, size of square 6 x 6 in.	6640–269–8345	ea	10	BD–13.
266	Wool, glass, Pyrex, filtering, in sheets about ⅛ in. thick by 10 in. wide, ½-lb. roll, Fisher Scientific Co. No. 11–388.	6640–360–0066	roll	1	DC–4.
267	Wool, steel, No. 00	5350–00–19153 No longer in QM system (deleted).	lb	1	DC–4.
268	Wrench, drain plug, steel, Universal, Buckeye Iron & Brass Co., model 663–W.	5120–494–2768	ea	2	CC–1.
269	Wrench, orifice, Saybolt, viscosity tube, Precision Scientific Co. No. 74995.	6640–360–0068	ea	1	BD–3.
270	Wrench, Saybolt, viscosimeter, to fit hexagon nut that locks tube into bath, Precision Scientific Co. No. 74996.	6640–360–0069	ea	1	BD–3.

APPENDIX III

CHEMICAL LISTING FOR QUARTERMASTER MOBILE PETROLEUM LABORATORY

Legend: NSNA—No stock number available.
* Chemical Corps requisition item.
** Engineer Corps requisition item.
*** Medical Corps requisition item.
**** Ordnance Corps requisition item.
Letter and number designations indicate drawer or cabinet location.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location	Label category
1	Acacia, USP, granular, 1 lb. container	6505-240-6309**	lb	1	BD-4	No label.
2	Acetone, USP, 1-lb. container, Fisher A-17	NSNA*	lb	1	ED-2	Red.
3	Acetone, USP, 1-gal. container, Fisher A-17	NSNA*	gal	2	ED-4	Red.
4	Acid, acetic, glacial, 99.5 percent purity, ¼-lb. bottle, A-38.	NSNA	bot	1	ED-4	White.
5	Acid, benzoic, Calorimetric and Acidimetric Standard, with National Bureau of Standards certificate, 30-gm. bottle, Fisher A-69/1.	NSNA*	bot	1	BD-5	Yellow.
6	Acid, citric, ACS, TP, powder, ¼-lb. bottle, Fisher A-105.	NSNA*	bot	1	BD-5	No label.
7	Acid, hydrochloric, ACS, TP, sp. gr. 1.19, 6-lb. bottle, Fisher A-144.	NSNA*	lb	8	ED-2	White.
8	Acid, hydrofluoric, ACS, TP, 48 percent, ¼-lb. bottle, Fisher A-147.	NSNA*	bot	1	ED-2	White.
9	Acid, oleic, technical, 1-lb. bottle, Fisher A-214	NSNA*	lb	1	ED-2	No label.
10	Acid, phosphoric, ACS, 85 per cent ortho, 7-lb. bottle, Fisher A-242.	NSNA	lb	1	ED-2	White.
11	Acid, tannic, TP, light clearly soluble, 1-lb. bottle, Fisher A-310.	NSNA*	lb	1	BD-5	No label.
12	Alcohol, ethyl (Ethanol) USP, 95 percent, 1-gal. container, Fisher A-405.	NSNA*	gal	2	Utility compt.	Red.
13	Ammonium acetate, ACS, TP, 1-lb. container, Fisher A-637.	NSNA*	lb	1	BD-4	No label.
14	Ammonium carbonate, ACS, TP, lump, 1-lb. container, Fisher A-656.	NSNA*	lb	1	BD-4	No label.
15	Ammonium chloride, ACS, granular, 1-lb. bottle, Fisher A-661.	NSNA	lb	1	BD-5	No label.
16	Ammonium hydroxide (pyridine-free), ACS, TP, sp. gr. 0.900, 1-lb. bottle, Fisher A-669.	NSNA*	lb	2	ED-2	White.
17	Ammonium iodine, NF, ¼-lb. bottle, Fisher A-671	NSNA*	bot	1	BD-5	No label.
18	Ammonium molybdate, TP, ¼-lb. bottle, Fisher A-674.	NSNA*	bot	1	BD-5	No label.
19	Ammonium nitrate, ACS, granular, 1-lb. bottle, Fisher A-676.	NSNA	lb	1	BD-5	Yellow.
20	Ammonium oxalate, ACS, TP, 1-lb. container, Fisher A-679.	NSNA*	lb	1	BD-4	Yellow.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location	Label category
21	Ammonium phosphate, ACS, TP, secondary (dibasic), crystal, 1-lb. container, Fisher A–686.	NSNA*	lb	1	BD–4	No label.
22	Ammonium sulfate, ACS, TP, granular, 1-lb. container, Fisher A–702.	NSNA*	lb	1	BD–5	No label.
23	tert.-Amyl alcohol, practical, b. p. 100–103°, 500-gm. container, Fisher 19–P.	NSNA*	cont	1	ED–2	Red.
24	Aniline, ACS, 1-lb. bottle	6810–222–2635	lb	2	ED–2	Poison.
25	Barium chloride, TP, anhydrous, 1-lb. container, Fisher B–35.	NSNA*	lb	1	BD–5	Poison.
26	Barium hydroxide, ACS, TP, crystal, 1-lb. container, Fisher B–46.	NSNA*	lb	1	BD–5	No label.
27	Benzene, ACS, sp. gr. 0.897, 1-gal. container, Fisher B–245.	6810–281–5267	gal	2	BD–14, ED–4	Red.
28	Bromine, ACS, TP, ¼-lb. bottle, Fisher B–385	NSNA*	bot	1	BD–14	White.
29	n-Butyl alcohol, TP, 1-lb. container, Fisher A–399	NSNA	lb	1	ED–2	Red.
30	n-Butyl phthalate, purified, 1-lb container, Fisher D–29.	NSNA*	lb	1	ED–2	No label.
31	Calcium carbonate, TP, precipitated, 1-lb. container, Fisher C–64.	NSNA*	lb	1	BD–4	No label.
32	Calcium chloride, ACS, TP, calcined, porous, granular, 8 mesh, 1-lb. container, Fisher C–75.	NSNA*	lb	1	BD–4	No label.
33	Calcium chloride, technical, calcined, porous, granular, 4-mesh, 1-lb. container, Fisher C–72.	NSNA*	lb	2	BD–4	No label.
34	Calcium chloride, technical, calcined, porous, granular, 8-mesh, 1-lb. container, Fisher C–73.	NSNA*	lb	2	BD–4	No label.
35	Calcium sulfate, native, calcined, powder, 1-lb. container, Fisher C–138.	NSNA*	lb	1	BD–5	No label.
36	Carbon disulfide, ACS, TP, 1-lb. bottle, Fisher C–184.	NSNA	lb	5	ED–4	Red.
37	Carbon tetrachloride, technical, 1-lb. container, Fisher C–185.	NSNA	lb	1	ED–2	Poison.
38	Carbon tetrachloride, technical, 1-gal. container, Fisher C–185.	NSNA*	gal	2	Utility compt.	Poison.
39	Celite (analytical filter aid), 1-lb. container, Fisher C–211.	6850–359–9212**	lb	1	BD–4	No label.
40	Chloroform, ACS, TP, 1-lb. bottle, Fisher C–298	NSNA*	lb	1	ED–2	Red.
41	Cobaltous chloride, TP, crystal, ¼-lb. container, Fisher C–371.	NSNA*	cont	1	BD–5	No label.
42	Cobaltous nitrate, ACS, TP, crystal, ¼-lb. bottle, Fisher C–378.	NSNA*	bot	1	BD–5	Yellow.
43	Cupric sulfate, analyzed reagent, large crystals, 1-lb. bottle, J. T. Baker No. 1–1840.	NSNA*	lb	1	BD–5	No label.
44	2,4-Dinitrophenol, pH indicator, 10-gm. bottle	6810–227–1256	bot	1	BD–5	No label.
45	Diphenyl thiocarbazone, CP, 10-gm. bottle, Fisher D–90.	NSNA*	bot	1	BD–5	No label.
46	Dithizone reagent, 8-oz. bottle, Hellige, Special No. 850–62.	NSNA	bot	1	ED 2	Poison.
47	Drierite (calcium sulfate, anhydrous) 4 mesh, 1-lb. container, Fisher D–102.	NSNA*	lb	1	BD–4	No label.
48	Ether, ethyl anhydrous, ACS, TP, 1-lb. bottle, Fisher E–138.	NSNA*	lb	2	ED–2	Red.
49	Ethylene glycol, purified, 1-gal. container, Fisher E–177.	NSNA*	gal	4	BD–14 (1) Utility compt. (3).	No label.
50	Fiber, asbestos, filter, acid washed, ¼-lb. container	6810–00–1935	cont	1	BD–4	No label.
51	Glycerin, USP, white, 1-lb. container, Fisher G–32	NSNA*	lb	1	ED–2	No label.
52	Hydrogen peroxide, technical, 30 percent, 1-lb. bottle, Fisher H–327.	NSNA*	lb	1	ED–2	White.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location	Label category
53	Hydrogen peroxide, TP, 3 percent, 1-lb. bottle, Fisher H–324.	NSNA*	lb	1	ED–2	White.
54	Hydrogen sulfide, gas, 99.9 percent pure, in lecture-size 12 in. x 2 in. cylinders, Fisher G–3/1–L.	NSNA*	ea	1	DC–4	Red.
55	Hydrogen sulfide solution, USP, 16-oz. bottle, Fisher So–H–38.	NSNA*	bot	1	ED–2	No label.
56	8-Hydroxyquinoline, reagent, CP, 1-lb. bottle	6810–241–4699***	lb	1	BD–5	No label.
57	Iodine reagent, 1. oN, 8-oz. bottle, Hellige, Special No. 850–60.	NSNA*	bot	1	ED–2	Yellow.
58	Iodine, resublimed, ACS, TP, ¼-lb. bottle, Fisher I–37.	NSNA*	bot	1	BD–5	Yellow.
59	Iron (ic) chloride, ACS, TP, lump, 1-lb. container, Fisher I–88.	NSNA*	lb	1	BD–5	No label.
60	Iron (ous) sulfate, TP, crystal, 1-lb. container, Fisher I–146.	NSNA*	lb	1	BD–5	No label.
61	Iron (ous) sulfide, granular, 1-lb. container, Fisher I–150.	NSNA*	lb	1	BD–5	No label.
62	Lead, metal, CP, granular, 1-lb. container, Fisher L–24.	6810–174–3218	lb	1	BD–5	No label.
63	Lead acetate, ACS, TP, normal, 1-lb. container, Fisher L–33.	NSNA*	lb	1	BD–5	No label.
64	Lead nitrate, ACS, TP, crystal, 1-lb. container, Fisher L–62.	NSNA*	lb	1	BD–5	Yellow.
65	Lead oxide, mono-, TP, yellow, 1-lb. container, Fisher L–71.	NSNA*	lb	1	BD–4	No label.
66	Magnesium acetate, TP, 1-lb. container, Fisher M–13.	NSNA*	lb	1	BD–4	No label.
67	Mercury, ACS, metal, 5-lb. bottle, Fisher M–141	6810–281–7450	lb	5	BD–5	Poison.
68	Methyl alcohol, absolute, ACS, TP, 1-lb. container, Fisher A–412.	NSNA*	lb	1	ED–2	Red.
69	Methyl ethyl ketone, technical, 1-lb. container, Fisher M–208.	NSNA	lb	1	ED–2	Red.
70	Methyl ethyl ketone, technical, 1-gal. container (6.5 lb.), Fisher M–208.	NSNA*	gal	2	ED–4	Red.
71	Methyl orange reagent, CP, ¼-lb. bottle	6820–227–1259	bot	1	BD–5	Yellow.
72	Methyl red, ACS, ¼-lb. bottle	6820–174–3213	bot	1	BD–5	Yellow.
73	Naphtha, aliphatic, ASTM D–91, 1-qt. screwtop can.	6810–227–1270	qt	1	BD–14	Red.
74	Naphtha, aliphatic, ASTM D–91, 1-gal. can	6810–227–1271	gal	2	BD–14, ED–4	Red.
75	Naphtha, aliphatic, ASTM D–95, 1-gal. can	6810–227–1273	gal	1	ED–4	Red.
76	Nitric acid, ACS, TP, sp. gr. 1.42, 7-lb. bottle	6810–237–2954****	lb	10	ED–2	White.
77	Nitric acid, fuming, ACS, sp. gr. 1.50, 1-lb. bottle	6810–00–19052****	lb	1	BD–14	White.
78	p-Nitrophenol, CP, 25-gm. container, Fisher N–105	NSNA*	cont	1	BD–5	Yellow.
79	Petroleum benzine, AOCS and NCPA, 1-gal. can	6810–227–1299	gal	3	ED–4 (2), ED–2 (1).	Red.
80	Phenolphthalein, ACS, powdered, 4-oz. bottle	6810–223–7612	bot	1	BD–5	No label.
81	Phosphorus pentoxide (phosphoric anhydride) TP, 1-lb. bottle, Fisher A–245.	NSNA*	lb	1	BD–5	Yellow.
82	Potassium bromide, ACS, TP, crystal, 1-lb. container, Fisher P–205.	NSNA*	lb	1	BD–5	No label.
83	Potassium chloride, ACS, TP, 1-lb. container, Fisher P 217.	NSNA*	lb	1	BD–4	No label.
84	Potassium chromate, ACS, crystals, 5-lb. container	NSNA	lb	1	BD–5	Yellow.
85	Potassium cyanide, TP, ¼-lb. bottle, Fisher P–226	NSNA*	bot	1	BD–5	Poison.
86	Potassium dichromate, ACS, crystals, 5-lb. bottle, Fisher P–188.	NSNA	lb	2	BD–5	Yellow.
87	Potassium ferrocyanide, ACS, crystal, ¼-lb. bottle, Fisher P–236.	NSNA*	bot	1	BD–5	No label.

Item No.	Nomenclature	Federal stock No.	Unit of measure	Quantity	Location	Label category
88	Potassium hydrogen phthalate, ACS, TP, ¼-lb. bottle, Fisher P-243.	NSNA*	bot	1	BD-5	No label
89	Potassium hydroxide, ACS, TP, pellets, 1-lb. container, Fisher P-250.	NSNA*	lb	1	BD-5	Yellow.
90	Potassium iodide, ACS, TP, granular, ¼-lb. container, Fisher P-257.	NSNA*	cont	1	BD-5	No label.
91	Potassium nitrate, ACS, TP, fine granular, 1-lb. container, Fisher P-264.	NSNA*	lb	1	BD-5	Yellow.
92	Potassium oxalate, neutral, ACS, TP, crystal, 1-lb. container, Fisher P-273.	NSNA*	lb	1	BD-5	Yellow.
93	Potassium permanganate, ACS, crystals, ¼-lb. bottle, Fisher P-279.	NSNA*	bot	1	BD-4	Yellow.
94	Potassium pyrosulfate, fused, TP, 1-lb. bottle, Fisher P-292.	NSNA*	lb	1	BD-5	Yellow.
95	iso-Propyl alcohol, TP, 5-lb. container, Fisher A-416.	NSNA*	lb	5	ED-4	Red.
96	Pyridine, TP, 1-lb. container, Fisher P-368	NSNA*	lb	1	ED-2	Red.
97	Rottenstone, pulverized, 5-lb. container, Fisher T-358.	5350-00-19001**** No longer in QM system (deleted).	lb	1	BD-4	No label.
98	Silver nitrate, ACS, TP, crystal, ¼-lb. bottle, Fisher S-181.	NSNA*	bot	1	BD-4	Yellow.
99	Sodium acetate, ACS, TP, crystal, 1-lb. container, Fisher S-209.	NSNA*	lb	1	BD-4	No label.
100	Sodium carbonate, ACS, TP, anhydrous, 1-lb. container, Fisher S-263.	NSNA*	lb	1	BD-5	No label.
101	Sodium chloride, technical, white, 1-lb. container, Fisher S-269.	NSNA*	lb	1	BD-5	No label.
102	Sodium cobaltic nitrite, CP, ¼-lb. bottle, Fisher S-280.	NSNA*	bot	1	BD-5	Yellow.
103	Sodium hydroxide, ACS, pellets, 5-lb. container, Fisher S-318.	NSNA	lb	1	BD-5	Yellow.
104	Sodium nitrate, ACS, crystalline, 1-lb. container	6810-233-0118	lb	1	BD-5	Yellow.
105	Sodium oxalate, TP, 1-lb. container, Fisher S-355	NSNA*	lb	1	BD-4	Yellow.
106	Sodium peroxide, ACS, TP, ¼-lb. container, Fisher S-363.	NSNA*	cont	1	BD-5	Yellow.
107	Sodium phosphate, TP, secondary, dibasic anhydrous, powder, 1-lb. container, Fisher S-374.	NSNA*	lb	1	BD-5	No label.
108	Sodium sulfate, ACS, TP, anhydrous, 1-lb. container, Fisher S-421.	NSNA*	lb	1	BD-5	No label.
109	Sodium sulfite, ACS, TP, anhydrous, (phosphate free), 1-lb. container, Fisher S-430/1.	NSNA*	lb	1	BD-5	No label.
110	Sodium thiosulfate, ACS, TP, crystal, 1-lb. container, Fisher S-445.	NSNA*	lb	1	BD-5	No label.
111	Starch, corn, USP, powder, 1-lb. container, Fisher S-510.	NSNA	lb	1	BD-4	No label.
112	Sulfite ammonia reagent, 16-oz. bottle, Hellige, Inc. Special No. 850-61.	NSNA*	bot	1	ED-2	Poison.
113	Sulfur (sulfur flowers) USP, sublimed, 1-lb. container, Fisher S-591.	NSNA*	lb	1	BD-5	No label.
114	Sulfuric acid, ACS, TP, sp. gr. 1.84, 9-lb. bottle	6810-251-6259****	lb	14	ED-2	White.
115	Uranyl acetate, TP, (Na free), ¼-lb. bottle, Fisher U-4.	NSNA*	bot	1	BD-5	No label.
116	Whiting, pure, 1-lb. container, Fisher W-36	6810-227-1286	lb	1	BD-4	No label.
117	Xylene, technical, sp. gr. 0.865 to 0.870, 1-gal. can	6810-227-1253	gal	1	ED-4	Red.
118	Zinc oxide, ACS, TP, dry process, ¼-lb. container, Fisher Z-52.	NSNA*	cont	1	BD-5	No label.

APPENDIX IV

TEXTBOOK LISTING FOR QUARTERMASTER MOBILE PETROLEUM LABORATORY

Item No.	*Nomenclature*
1	ASTM Manual of Engine Test Methods for Rating Fuels. American Society for Testing Materials.
2	ASTM Standards on Petroleum Products and Lubricants (With related information). American Society for Testing Materials.
3	Chemical Technology of Petroleum and Its Products. McGraw-Hill Book Co., Inc.
4	Evaluation of Petroleum Products. American Society for Testing Materials.
5	Federal Standard No. 791, Lubricants, Liquid Fuels, and Related Products; Methods of Testing.
6	Handbook of Chemistry and Physics. Acme Code Co.
7	Instructions for Measuring, Sampling and Testing Petroleum Products. Standard Oil Development Co.
8	New and Revised Tag Manual for Inspectors of Petroleum. Acme Code Co.
9	Technical Methods of Analysis. McGraw-Hill Book Co., Inc.
10	The Significance of Tests of Petroleum Products. American Society for Testing Materials.
11	ASTM Manual on Measurement and Sampling of Petroleum and Petroleum Products. American Society for Testing Materials.

Note. One copy of each publication listed is located in the laboratory bookcase. All text books listed are authorized and will be furnished as required.

APPENDIX V
AIR-CONDITIONING UNIT

1. General

This appendix provides information on the air-conditioning unit and modifications to the heating ducts occasioned by the addition of the air-conditioning system to the mobile petroleum laboratory. It includes operating and organization maintenance instructions.

2. Description

a. Air-Conditioning Unit. The air-condition-unit is located in the utility compartment (figs. 61 and 62). The unit consists of the following major components:

(1) *Compressor.* The compressor is a 2-cylinder 90°, V-type compressor, directly connected and hermetically sealed with its 5-horsepower driving motor. It is mounted on the floor in the left side of the utility compartment. The compressor is equipped with suction inlet valve, discharge outlet valve, high-low pressure cut-out switch, high pressure-low gage (compound gage), and suction strainer.

(2) *Condenser.* The condenser, mounted directly above the compressor, consists of a series of parallel copper tubes equipped with external radiator-type fins, housed in a rectangular frame. The condenser outlet is connected to the receiver. Condenser coils are cooled by a 24-inch fan, belt driven by a 3-horsepower motor mounted atop the condenser housing. Free circulation of air over the coils is provided by the louvered intake panel in the utility-compartment door and condenser-fan exhaust hatch in the left side of the semitrailer (fig. 63).

(3) *Receiver.* The receiver, mounted upright on the floor, is a cylindrical container with inlet and outlet fittings. Directly above the receiver, in the tubing connecting it with the condenser, is the receiver inlet valve. The receiver outlet valve is located at the bottom of the receiver.

(4) *Dehydrator.* The dehydrator, located in the tubing between the receiver outlet and the sight glass, consists of a cylindrical housing and circular cover plate, flange connected. The housing contains a charge of granular silica gel, a material that removes water by absorption. Cover plate and housing are equipped with threaded fittings for connection with refrigerator tubing.

(5) *Sight glass.* The sight glass, located in the refrigerant line above the dehydrator, provides a means of visual examination of the refrigerant during operation. Each of the two glass windows is provided with a threaded safety cap to protect glass when visual examination is not being made.

(6) *Expansion valve.* The thermostatic expansion valve, located beside the evaporator, is a pressure-regulating device that meters liquid refrigerant into the evaporator coil. It is controlled by a diaphragm connected through a capillary tube to a sensitive feeler bulb filled with Freon 12. The feeler bulb is taped against the evaporator outlet line. The equalizer tube, connected to the evaporator line, permits use of the pressure of refrigerant gas to help balance the forces acting on the diaphragm. The thermo-

static expansion valve is factory set to permit a steady flow of fluid refrigerant at low pressure into the evaporator. When the differential beleaving the evaporator is approximately 10° warmer than that entering the evaporator. When the differeneial becomes greater, the Freon in the sensitive feeler bulb contracts, causing the valve opening to be reduced or closed. When the differential is reduced, the expansion of Freon in the bulb causes the expansion-valve opening to become larger, permitting entry of more refrigerant.

(7) *Evaporator.* The evaporator, inclosed in the cool-air plenum, consists of a series of parallel copper tubes equipped with external radiator-type fins. Refrigerant flowing from the expansion valve is divided among the several tube assemblies by the refrigerant distributor. The evaporator outlet is connected to the compressor suction inlet.

(8) *Piping.* The components of the air-conditioning unit are connected by copper tubing assemblies. Tubing assemblies are removeable as units and are connected to the various components by threaded flare fittings.

b. Airflow System. There are 3 air ducts for the air-conditioning system in the laboratory compartment: 2 cool-air supply ducts are located in the ceiling, and a summer return-winter supply duct is located beneath the left cabinets and drawers.

(1) *Cool-air ducts.* The two cool-air ducts in the ceiling of the laboratory compartment channel the flow of cool air from the air-conditioning unit to the laboratory compartment.

(2) *Summer return-winter supply duct.* The summer return-winter supply duct serves a dual function. In summer it serves as an intake for the air conditioning unit, drawing warm air from the laboratory compartment for conditioning. In winter it serves as an outlet for the space heater, distributing warm air to the laboratory compartment. Flow of air through the duct to the air-conditioning unit or from the space heater is controlled by a bypass-damper control knob located on top of the left forward workbench.

(3) *Outside-air intake.* An outside-air intake hatch is located on the left side of the semitrailer (fig. 63). Fresh air from outside the trailer is drawn through this hatch by the blower motor and passed over the air-conditioning unit. The flow of outside air is controlled by dampers, operated by a damper-control motor. Control box for the damper-control motor is located beneath the reagent shelf of the left side of the laboratory compartment.

3. Data

a. Compressor:

Manufacturer	Westinghouse Electric Corp.
Type	CLS–188, 220 volts, 5 horsepower.

b. Condenser:

Manufacturer	Westinghouse Electric Corp.
Type:	
Condenser-fan motor	3 horsepower, 230 volts, 3-phase, 1,750 r. p. m.
Condenser fan	24 inches, with expanded-metal guard.
Cooling coil	Westinghouse EA 2024–6.
Condenser coil	Westinghouse 22–B–3141.

c. Cooling Fan:

Manufacturer	Buffalo Forge Co.
Type:	
Motor	1½ horsepower, 2 speeds.
Fan	Type LL.

d. Damper-Control Motor:

Manufacturer	Minneapolis-Honeywell Regulator Co.
Type	M905E Spring-Return Modutrol Motor, 115 volts, 60 cycles.

e. Refrigerant: Freon 12.

4. Controls and Instruments

a. Electrical Controls

(1) *Circuit breaker switches.* The air-conditioning unit is controlled by circuit breaker switches 31, 32, and 33 (fig. 64).

(2) *Cooling-blower-motor control box.* The cooling-blower motor is controlled by

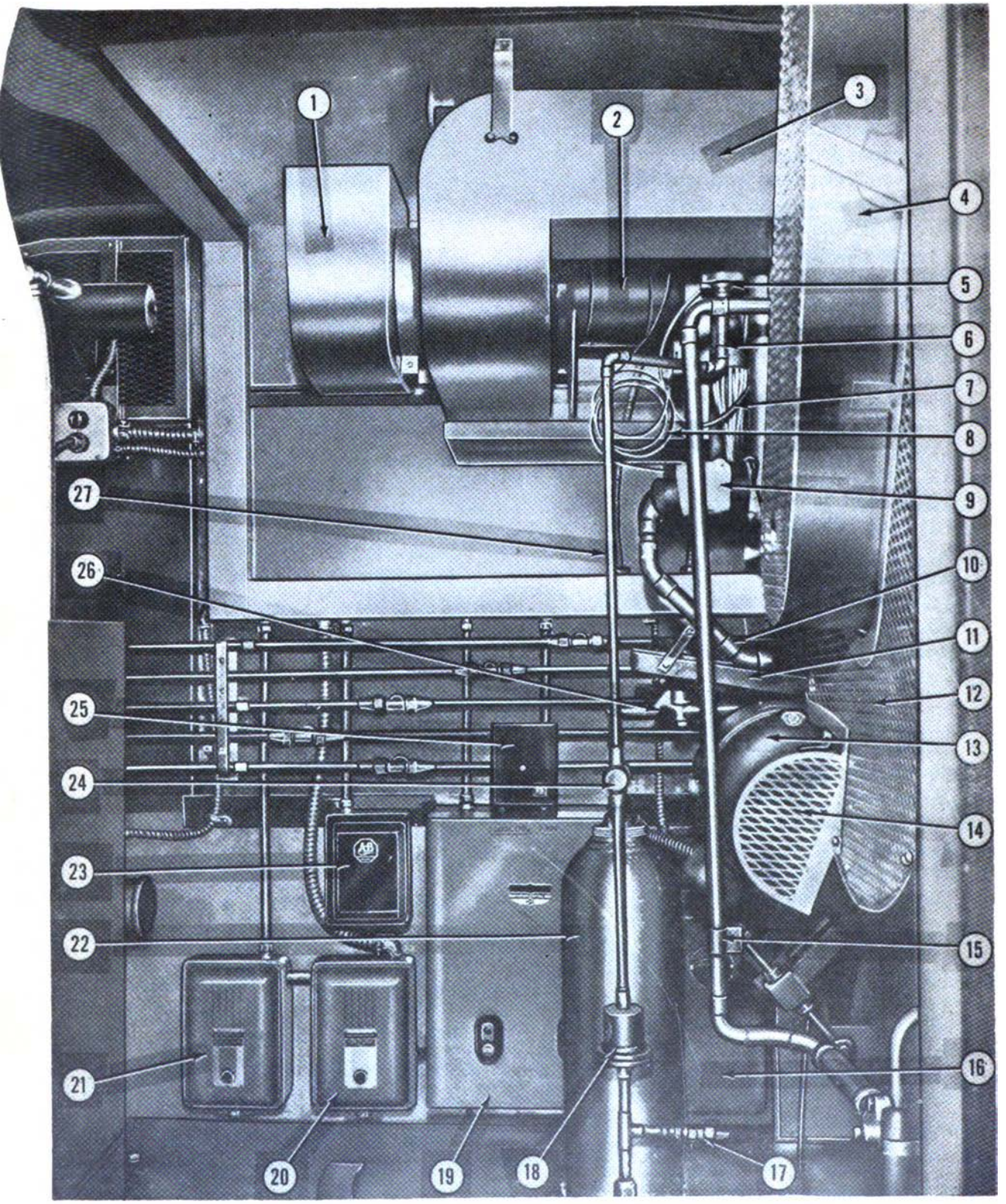


Figure 61. Air-conditioning unit (view from front of utility compartment).

1 Fume-hood exhaust duct from fume hood
2 Fume-hood exhaust-blower motor
3 Fume-hood exhaust-blower duct to exhaust hatch
4 Condenser-fan-belt guard
5 Expansion valve
6 Refrigerant distributor
7 Equalizer line
8 Capillary tube
9 Asbestos covering for sensitive feeler bulb
10 Low-pressure gas line to compressor intake
11 Drip pan
12 Condenser-fan guard
13 Cooling-blower motor
14 Cooling-blower-belt guard
15 High-pressure gas line to condenser inlet
16 Heater starter-relay box
17 Refrigerant charging valve
18 Dehydrator
19 Cooling-motor starter-relay box
20 Compressor-motor starter-relay box
21 Condenser-fan-motor starter-relay box
22 Receiver
23 Exhaust-blower starter-relay box
24 Sight glass with covers attached
25 Pressure switches
26 Receiver inlet valve
27 High-pressure line to expansion valve

Figure 61—Continued.

push-type switches, SLOW, FAST, STOP, located on the cooler-blower-motor control box on the left wall of the laboratory compartment. Two pilot lights on the control box indicate the operating speed. When the cooling blower is operating at slow speed, the green pilot light is lit; when operating at fast speed the red pilot light is lit (fig. 65).

(3) *Condenser-fan-motor control box.* The condenser-fan motor and compressor are controlled by START and STOP push switches on the condenser-fan-motor control box on left wall of laboratory compartment. A red pilot light on the motor control box is lit when condenser-fan-motor and compressor are operating (fig. 65).

(4) *Thermostat.* A wall thermostat, located above the main control panel in the laboratory compartment, controls the temperature within the compartment.

(5) *Pressure switches.* Pressure is controlled by a compressor high-low pressure switch and a condenser pressure switch located in the utility compartment. Both switches are preset by the manufacturer and operate automatically.

(6) *Outside-air-damper control.* The outside-air-damper control knob, located on left side of laboratory compartment under reagent shelf, controls the damper motor. Damper motor controls the dampers which open to admit air into the air-conditioning unit from the outside-air intake hatch.

(7) *Starter-relay boxes.* Starter-relay boxes for the condenser fan, compressor motor, and cooling motor are located in the utility compartment.

b. Pressure Gages. Two pressure gages for the compressor, a high-pressure gage and a low-pressure gage, are located in the utility compartment.

c. Refrigerant Valves. There are six refrigerant valves in the air-conditioning unit: the compressor suction valve and the compressor discharge valve, the receiver inlet valve and the receiver outlet valve, the expansion valve, and the recharging valve.

d. Bypass-Damper Control Knob. The bypass-damper control knob, located on the left forward work bench, has WINTER and SUMMER positions. When in SUMMER position, the heater intake register on the left forward cabinet is closed, allowing the cooling fan to draw air from the laboratory compartment and pass it over the air-conditioning unit. When in the WINTER position, the bypass damper is closed and allows the space heater to draw air into the heater intake register from the laboratory compartment.

5. Operation

a. Airflow Cycle. Warm air is drawn into the summer return-winter supply duct from the laboratory compartment and fresh air is drawn through the outside-air intake by the cooling blower. This air is then forced over the evaporator coils where its heat is transferred to the Freon within the coils. The cool air is then forced into the laboratory compartment through the cool-air ducts in the ceiling.

b. Operating Procedures.

(1) Open outside-air intake and condenser-fan exhaust hatch covers.

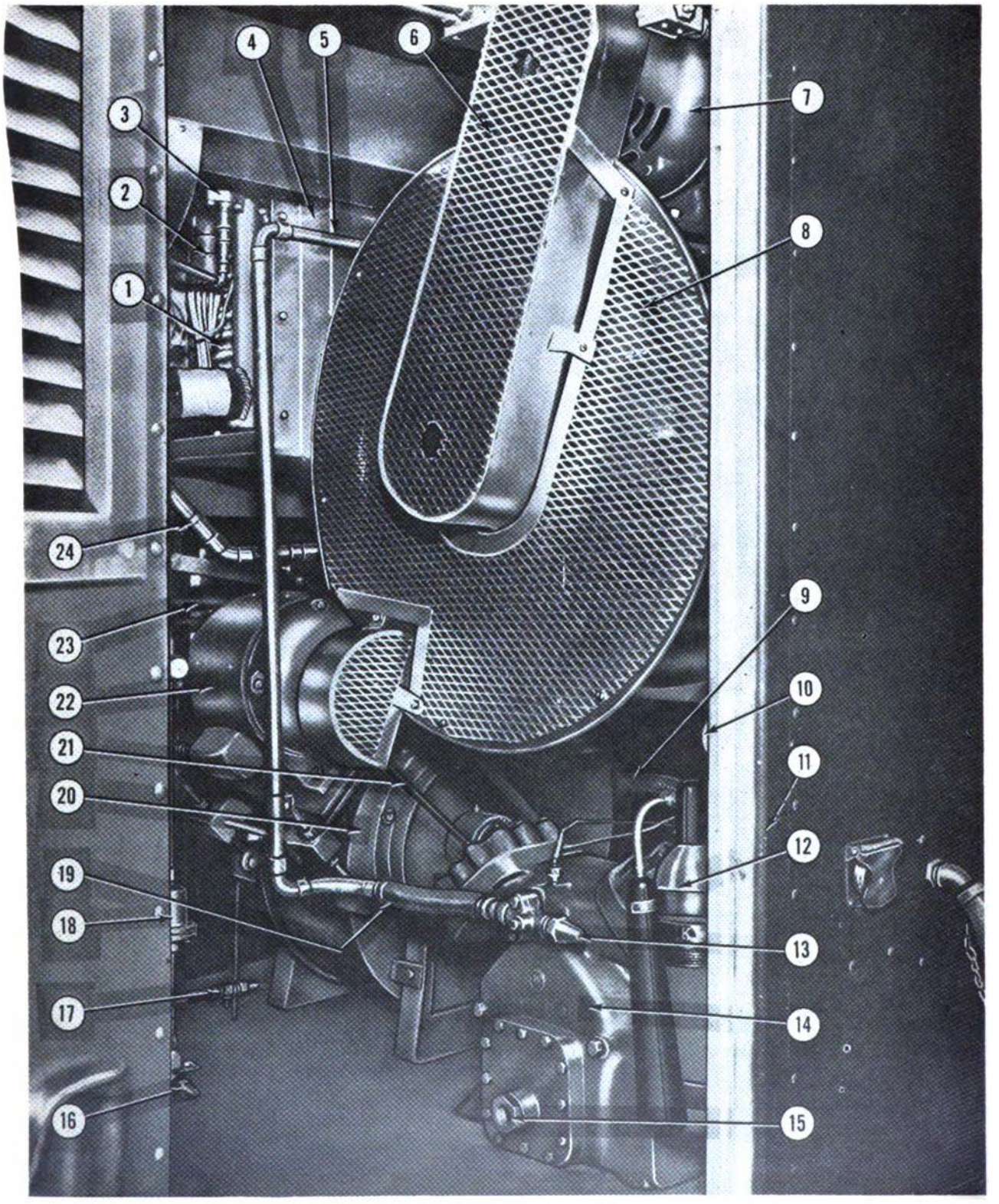


Figure 62. Air-conditioning unit (view from utility-compartment door).

1 Evaporator coils
2 Refrigerant distributor
3 Expansion valve
4 Evaporator housing
5 High-pressure gas line to condenser inlet
6 Condenser-fan-belt guard
7 Condenser-fan motor
8 Condenser-fan guard
9 Compressor-vibration-absorber tube, suction
10 High-pressure gage
11 Low-pressure gage
12 Fire extinguisher
13 Compressor discharge valve
14 Compressor
15 Oil-level sight glass
16 Receiver outlet valve
17 Refrigerant charging valve
18 Dehydrator
19 Compressor-vibration-absorber tube, discharge
20 Cooling blower
21 Cooling-blower belt
22 Cooling-blower motor
23 High-pressure liquid line, condenser to receiver
24 Low-pressure gas line, evaporator to compressor

Figure 62—Continued.

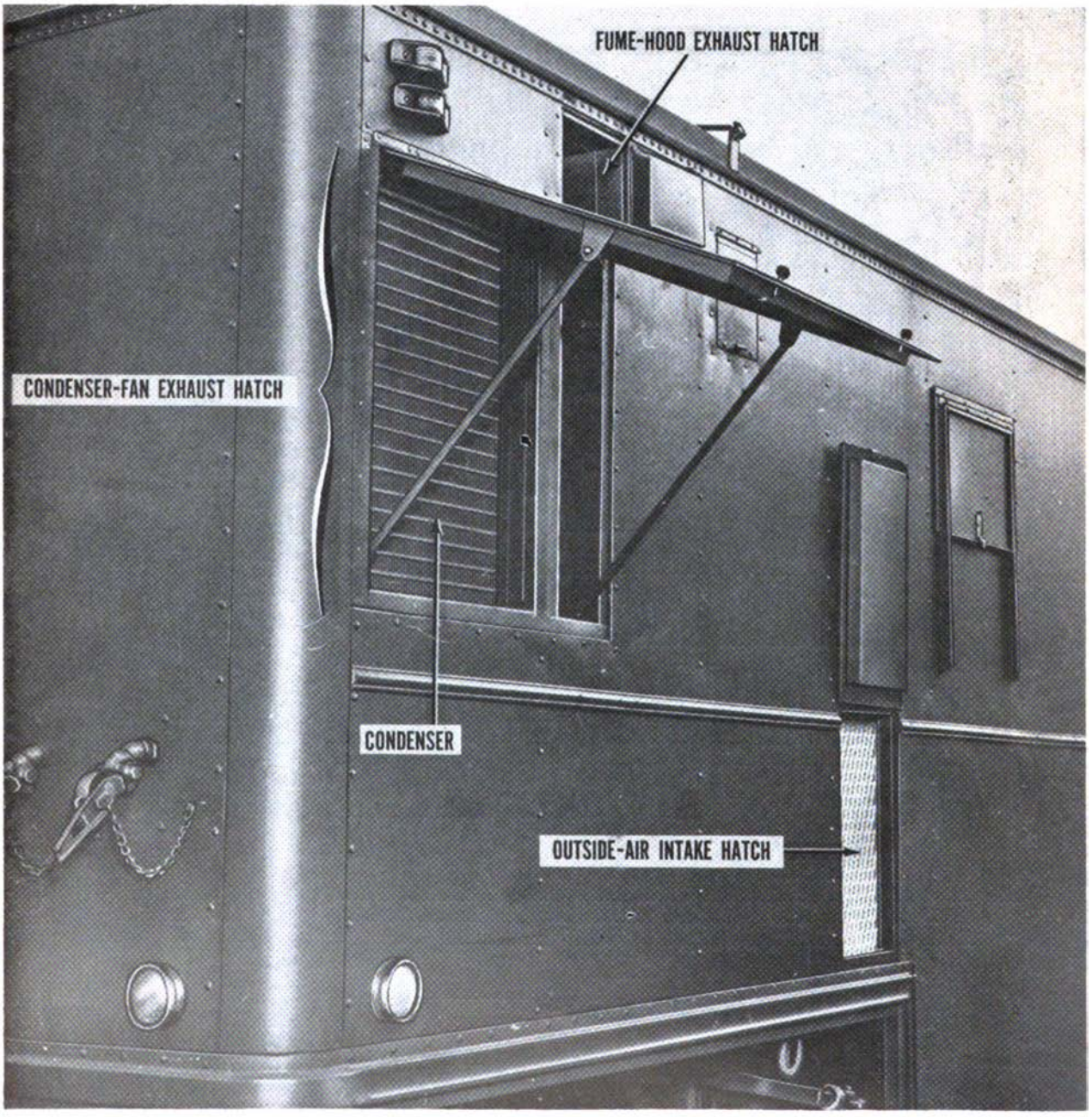


Figure 63. Semitrailer exterior, showing air-conditioning-unit hatches.

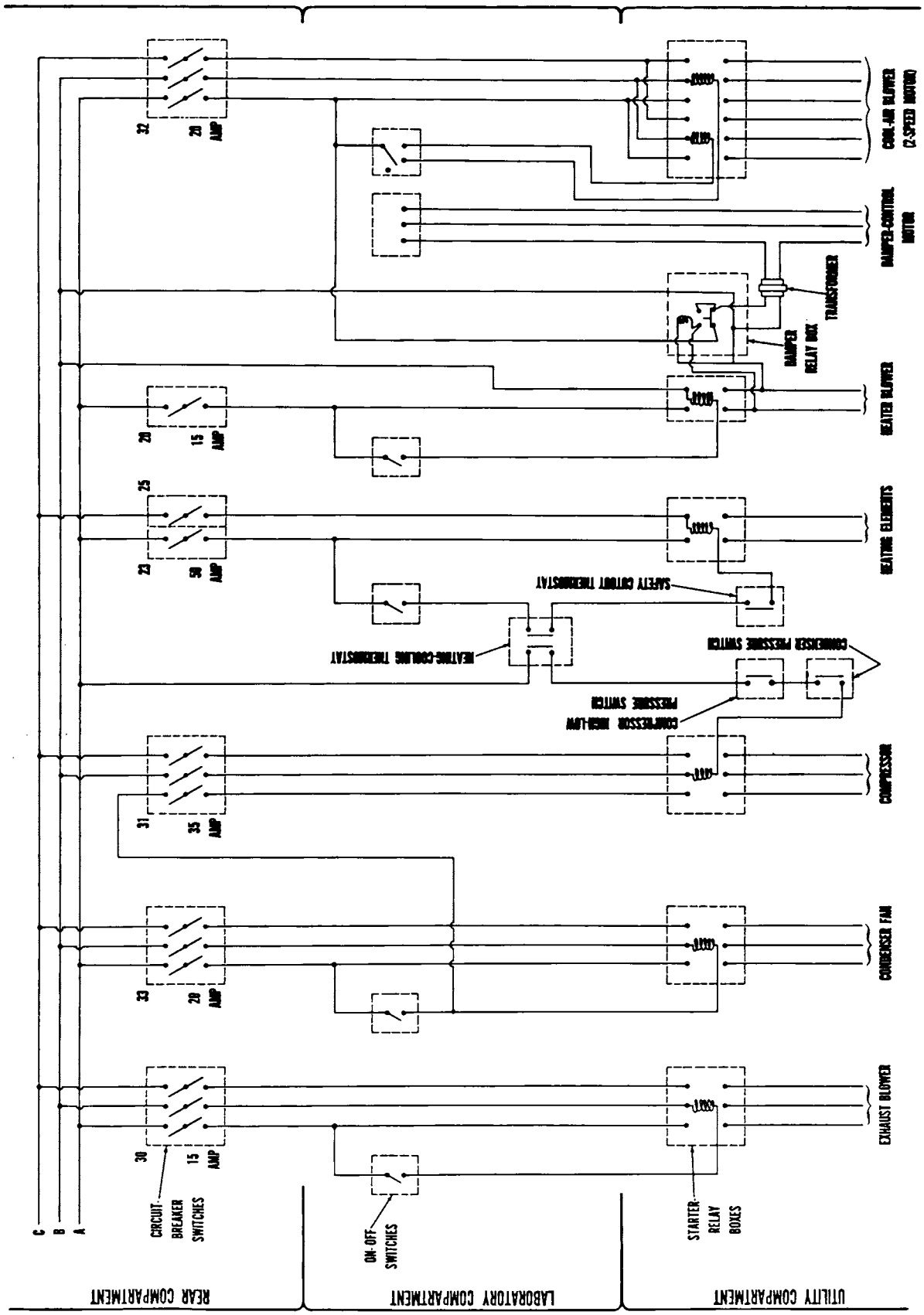


Figure 64. Wiring diagram showing modifications for air-conditioning unit.

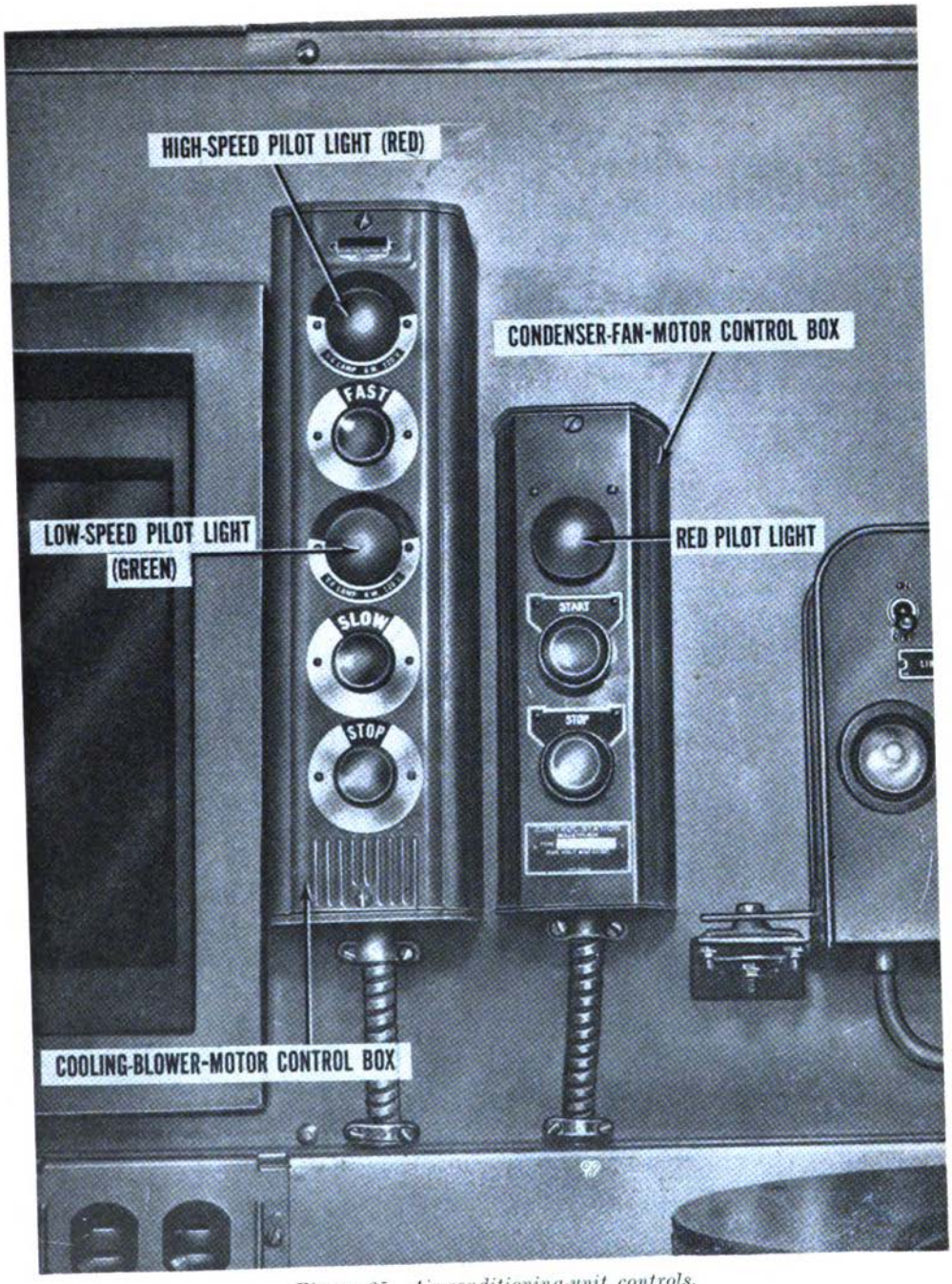


Figure 65. Air-conditioning-unit controls.

(2) Set outside-air-damper control knob to OPEN.

(3) Make certain circuit breaker switches 20, 23, and 25, which control heater, are in OPEN position (fig. 64).

(4) Make certain circuit breaker switches 31, 32, and 33 are closed (fig. 64).

(5) Set bypass-damper control knob on left forward workbench to SUMMER position.

(6) Start cooling blower by depressing either the SLOW or FAST pushbutton switch on the cooling-blower control box.

(7) Start condenser-fan motor by depressing the START pushbutton switch on the condenser-fan-motor control box.

(8) To circulate summer air without conditioning, depress STOP pushbutton switch on condenser-fan-motor control

box, depress either the SLOW or FAST pushbutton switch on cooling-blower control box. If condenser and compressor are not to be used for some period of time, open circuit breaker switches 31 and 32.

(9) To shut down the air-conditioning system, depress STOP switches on the condenser-fan and cooling-blower control boxes, set outside-air-damper control knob to CLOSED position, set bypass-damper control knob to WINTER position, open circuit breaker switches 31, 32, and 33, and close the condenser-fan and outside-air intake hatch covers.

6. Organizational Maintenance

a. Lubrication. Lubricate bearings of the blower motor at least once every 6 months, or as needed, using automotive and artillery grease, GAA. Periodically, check compressor oil through oil sight glass. Changing of oil is not necessary unless compressor repair operations require removal of oil. If oil must be added or if the crankcase has been completely drained for repairs, refrigerant compressor crankcase oil OR–I must be used.

(1) *Adding oil to compressor crankcase.* If a check of the sight glass indicates that the oil level is below the center of the sight glass, add oil as follows:

(*a*) Connect tubing, containing a shutoff valve, to the gage port of the suction valve, and run the line into a can containing sufficient oil to fill the compressor.

(*b*) Bleed this oil charging line by turning suction valve from backseat position and letting Freon bubble into can of oil.

(*c*) Operate the compressor, partially closing the suction valve until pressure is reduced below the atmospheric pressure and holding the reset lever of the cutoff switch to keep compressor running.

(*d*) Add oil by opening the charging-line shutoff valve, carefully controlling valve to charge oil gradually.

(*e*) Operate compressor normally for a period of time, and then observe oil level.

(*f*) Add any additional oil needed to raise oil level to at least center of sight glass.

(2) *Filling compressor crankcase after repair.* If compressor crankcase has been completely drained for repair, do not add oil as in (1) above. Upon reassembly of compressor, before head valve is replaced, add oil through the suction-port opening at top of cylinder. Add the same quantity of oil as that drained from the compressor (approx 5½ pts).

b. Preventive Maintenance.

(1) *Before-operation service.*

(*a*) Check to make sure that all electrical connections and all pipe connections are tight.

(*b*) Make certain that compressor has proper supply of oil.

(*c*) Check to make sure that all valves in the air-conditioning unit are properly opened.

(*d*) Check pulleys and belts for proper alinement and tension. Check condition of belts.

(*e*) Check for dirt, dust, and grease on fans, compressor fins, and condenser tubes and fins. If necessary clean them with a brush, clean cloth, or compressed air.

(*f*) Check all lines and connections for leaks with a Halide leak detector.

(2) *During-operation service.*

(*a*) Listen for unusual noises. If trouble is indicated, determine cause and correct as soon as possible.

(*b*) Be alert for smoke or odors indicative of overheated components or shorted wiring.

(*c*) Observe action of automatic controls to see that they function properly.

(*d*) Check thermostat cut-in and cut-out temperature against temperature of the laboratory compartment to see that average temperature desired is being maintained.

(*e*) Inspect air-conditioning-system tubing for defects or leaks.

(*f*) Observe liquid Freon through sight glass for air bubbles, dirt, or other foreign matter.

(*g*) Check oil level in compressor.

(3) *After-operation service.*

(*a*) Correct all deficiencies noted during operation or report to proper authority.

(*b*) Inspect unit for any deficiencies not noted during operation. Clean equipment of all dirt, dust, and grease.

c. Troubleshooting Chart. Irregularities that may be observed during operation of the unit, and possible causes and remedies, are given in the following chart.

Trouble	Possible cause	Remedy
Unit will not operate:		
Suction pressure above normal but starting circuit open.	Thermostat out of adjustment or defective.	Readjust or replace thermostat.
	Break in wiring	Replace or repair.
	Air in system	Purge air from system.
Suction pressure above normal but unit not operating due to open pressure cutout switch.	Overcharge of Freon.	Purge excess Freon.
	Poor air circulation through condenser.	Clean condenser.
	Liquid receiver inlet valve not fully open.	Open valve fully.
	Restriction in liquid line.	Remove restriction or replace defective line.
Discharge pressure normal but suction pressure abnormally low.	Moisture frozen in expansion valve.	Thaw valve and replace dehydrator.
	Clogged expansion valve.	Remove and clean or replace valve.
	Liquid line restricted.	Check line for restriction, and remove restriction or replace line.
	Shortage of refrigerant.	Check for leak and add refrigerant.
	Expansion valve defective.	Replace expansion valve.
Unit short cycles:		
Suction pressure normal but unit cycles on pressure cutout switch.	Air in system	Purge air from system.
	Overcharge of Freon.	Purge excess Freon.
	Dirty condenser	Clean condenser.
	Restriction in compressor discharge line.	Remove restriction or replace line.
Suction pressure, discharge pressure, and laboratory temperature normal, but unit short cycles on thermostat.	Thermostat differential set too close.	Reset thermostat.
Unit runs continuously:		
Laboratory temperature and suction pressure remain high and discharge pressure low.	Compressor valves stuck open or leaking.	Remove compressor and have repaired.
	Shortage of refrigerant.	Check for leak and add Freon.
Laboratory temperature and suction and discharge pressures remain high.	Air in system	Purge air from system.
	Overcharge of Freon.	Purge excess Freon.
	Dirty condenser	Clean condenser.
Laboratory temperature and suction pressure high, discharge pressure normal or high, and suction line cold.	Expansion valve set too far open.	Readjust expansion valve.
	Expansion valve stuck.	Replace expansion valve.
	Expansion valve bulb loose from clamp.	Clamp bulb to suction line at evaporator outlet.
Laboratory temperature and suction pressure low and unit operates continuously.	Thermostat set too low.	Reset thermostat.
	Thermostat terminal leads shorted.	Check wiring.
	Thermostat contacts stuck closed.	Replace thermostat.
Unit operates too long:		
Suction pressure normal or high and discharge pressure low.	Expansion valve too far open.	Adjust expansion valve.
	Compressor valves stuck open or leaking.	Remove compressor and have repaired.
	Shortage of Freon.	Check for leak and add Freon.
Laboratory temperature normal, suction pressure normal or high, and discharge pressure high.	Air in system	Purge air from system.
	Overcharge of Freon.	Purge excess Freon.
	Dirty condenser	Clean condenser.
	Receiver inlet valve partly closed.	Open valve.
Dampers do not operate correctly:		
When damper-motor control knob is turned damper motor will not run, runs less than full travel, or does not run smoothly.	Defective potentiometer.	Replace.
	Defective modutrol motor.	Replace.
	Insufficient power supply.	Check wiring and repair or replace.

Trouble	Possible cause	Remedy
Power supply is adequate, motor and potentiometer in good condition.	Binding linkage connections.	Adjust connections.
Modutrol motor will not run in direction to open dampers, or starts and then reverses.	Motor balancing potentiometer dirty.	Clean.

d. Pumping Down the System. When the air-conditioning system is pumped down, the Freon in the low-pressure side of the system is pumped into the liquid receiver. This operation is performed when service is required on the low-pressure side of the system. To pump down system, proceed as follows:

(1) Remove cap from the receiver outlet valve (figs. 62 and 66) and close the valve completely by turning clockwise.

(2) Depress the START switch on the condenser-fan-motor control box (fig. 65).

(3) Allow compressor to operate until the pressure switch cuts off the compressor motor. This will occur when the pressure on the low side reaches the minimum setting.

(4) Allow the compressor to cycle (repeat its off-on cycle) automatically until the low-pressure gage stays at or near the minimum reading. Do not allow the low-pressure side to drop below the zero reading. A slight amount of pressure should be in the line to prevent excess air and moisture entering when line is opened.

(5) Immediately after the compressor stops, close the compressor discharge valve (figs. 62 and 66) completely.

(6) Depress the STOP switch on the condenser-fan-motor control box.

(7) Perform required service on the low-pressure side of the system and its related valves and components.

e. Purging the System.

(1) Use a Freon cylinder having at least a 25-pound capacity to store the Freon from the system. A length of copper tubing capable of withstanding 200 p. s. i. pressure should be used to connect the cylinder to the compressor discharge valve.

(2) Remove the cap from the compressor discharge valve (figs. 62 and 66) and make sure the valve stem is turned fully counterclockwise.

(3) Remove the plug from the auxiliary port on the discharge valve and connect the copper tubing. Connect other end of tubing to the empty Freon cylinder.

(4) Turn the stem of the compressor discharge valve clockwise to the closed position. Make sure all other valves in the system are open.

(5) Depress the START button on the condenser-fan-motor control box (fig. 65).

(6) The compressor may be shut off automatically by the pressure-control switch. Open the compressor discharge valve slightly to reduce the head pressure. Leave the valve open for about 10 minutes of operating time, then close completely.

(7) When the low-pressure gage stays at about 1 or 2 pounds after the compressor stops, the system has been purged. Close the valve on the Freon cylinder.

(8) Open the compressor discharge valve and remove tubing from the Freon cylinder. Install the plug to close the port on the discharge valve.

(9) Perform maintenance service as required.

f. Charging the System. Should Freon escape from or be removed from the system a new charge must be applied.

(1) Use a fresh or reconditioned charge of Freon.

(2) Connect Freon cylinder to the charging valve (fig. 62).

(3) Open the charging valve.

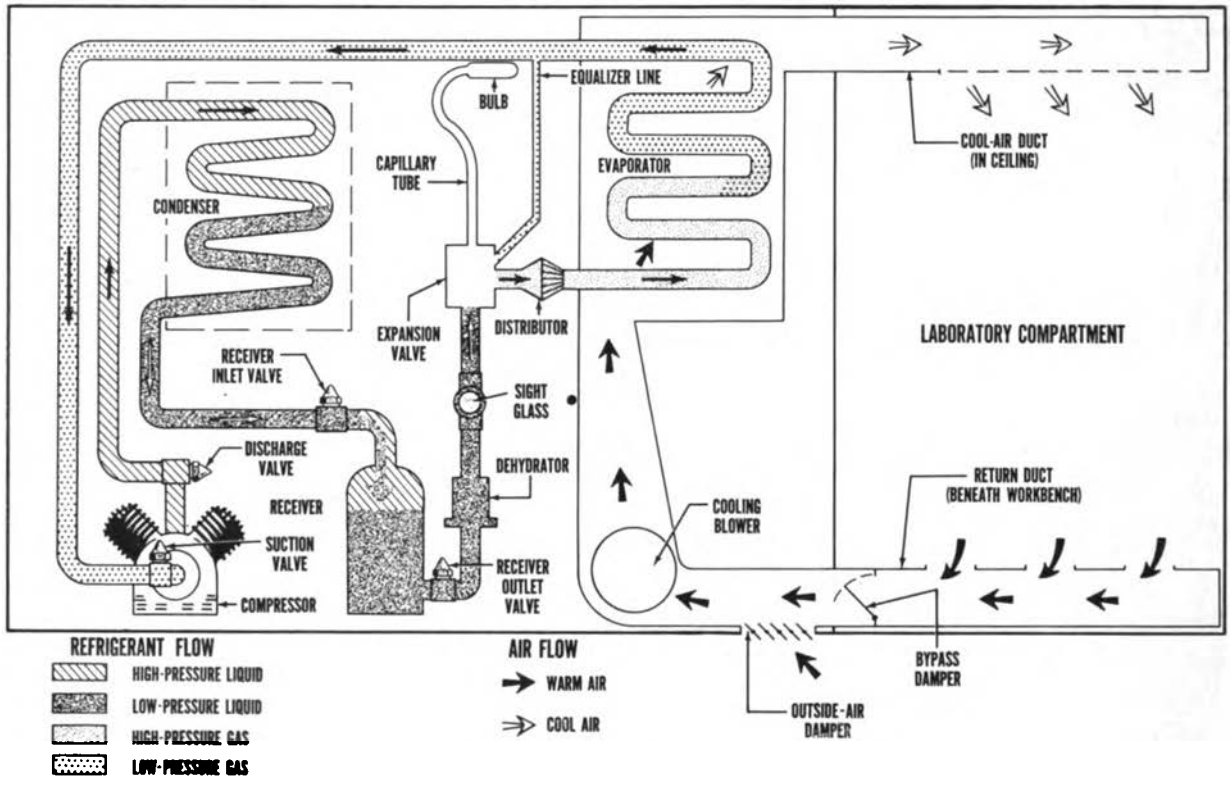
(4) Depress START switch on the condenser-fan-motor control box (fig. 65).

(5) Regulate the flow of Freon into the

system. Fill the system until the sight glass (figs. 61 and 66) is clear. If the Freon cylinder frosts, or if filling procedure is too lengthly, place the cylinder in hot water (150° F.). Keep a check on the system pressure; if pressure rises to above 200 p. s. i., lift the cylinder from the water until the pressure drops.

(6) Close the charging valve and replace covers. Close the Freon cylinder valve before removing from charging valve.

(7) The air-conditioning unit is now ready for operation.



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[AG 451.3 (7 Dec 55)]

[AG 451.3 (18 Apr 56)]

By Order of *Wilber M. Brucker*, Secretary of the Army:

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USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

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