CHAPTER 13

SAFETY

When working with radio, or with any electronic equipment, one rule that cannot be stressed too strongly is: SAFETY FIRST. Dangerous voltages energize most of the equipment with which you work. Power supply voltages range up to 40,000 volts, and radiofrequency voltages are even higher.

Special precautions are also necessary because electrical fields which exist in the vicinity of antennas and antenna leads may introduce fire and explosion hazards, especially where flammable vapors are present. Additional precautions are needed for personnel working aloft to prevent injuries from falls and stack gases.

Safety precautions outlined in this chapter are not intended to supersede information given in instruction books or in other applicable instructions for installation of electronic equipment. Check these before touching the gear. Additional safety information is contained in—

1. Electronic Installation Practices Manual, NavShips 900, 171.
2. Electric Shock, Its Causes and Prevention, NavShips 250-660-42.
3. Electric Shock and Its Prevention, NavShips 250-660-45.
4. U.S. Navy Safety Precautions, OpNav 34P1.

If at any time there is doubt about the steps and procedures you should observe while working on electronic equipment, consult the technician or Radioman in charge.

READ THE SIGNS

Danger signs and suitable guards are provided to prevent personnel from coming in accidental contact with high voltages. The warning signs shown in figure 13-1 are posted on or near every radio transmitter, transmitting antenna lead-in trunk, and in radar rooms and other electronic spaces throughout the ship. The signs are painted red to make them more conspicuous.

Additional signs warn against such hazards as explosive vapors and effects of stack gases aloft.

Look for warning signs and obey them. Notify your supervisor if a dangerous condition exists for which no warning sign is posted.

FUNDAMENTALS OF ELECTRIC SHOCK

One of the greatest safety hazards for Radiomen is electric shock. In order to avoid this hazard, an understanding of its causes and effects is necessary.

HOW MUCH DOES IT TAKE?

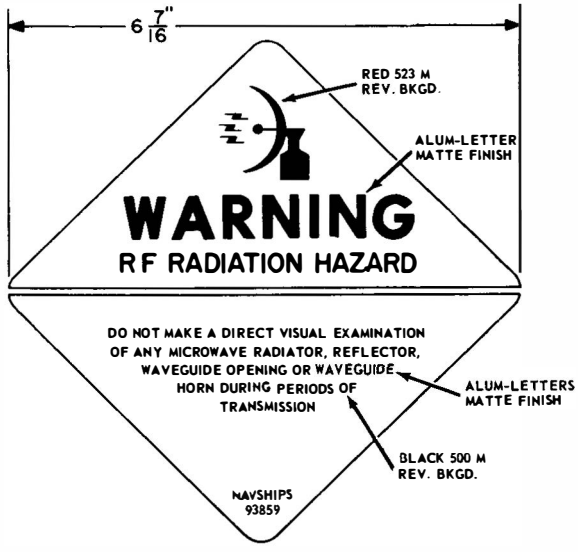
If a 60-cycle alternating current is passed through a man from hand to hand or from hand to foot, the effects when current is increased gradually from zero are as follows:

1. At about 1 milliampere (0.001 ampere) the shock can be felt.
2. At about 10 milliamperes (0.010 ampere) the shock is severe enough to paralyze muscles so that the man is unable to release the conductor.
3. At about 100 milliamperes (0.100 ampere) the shock is fatal if it lasts for 1 second or longer.

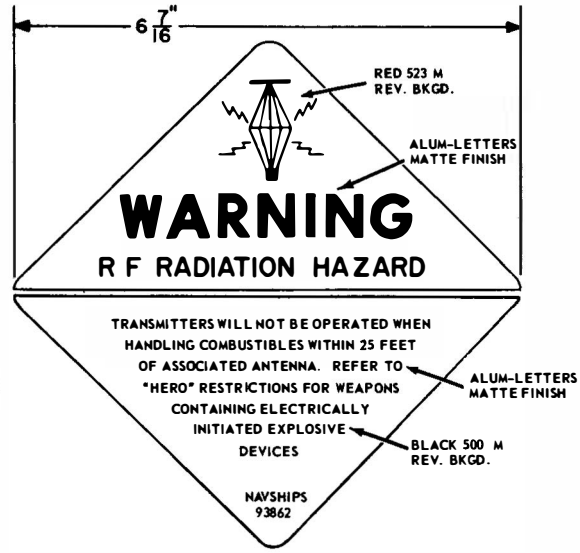
The resistance of the human body is insufficient to prevent fatal shock from 115-volt or lower voltage circuits. About 50 percent of shipboard electrocutions are caused by circuits of these types. It is important to remember that current, rather than the quantitative value of the voltage, is the shock factor.

CONDITIONS FOR SHOCK

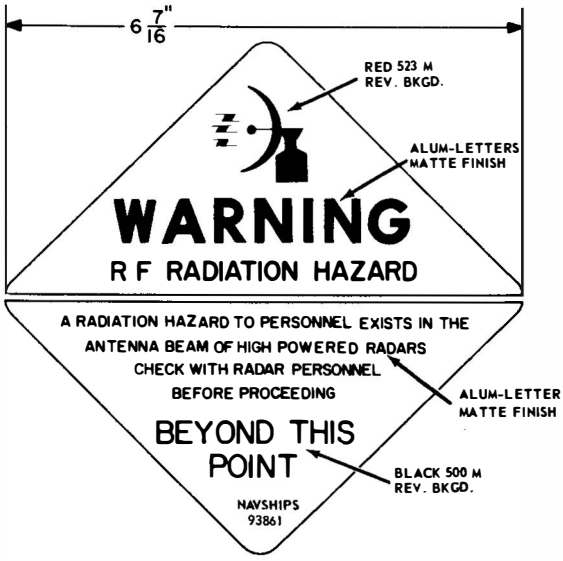
Two conditions must be met for current to flow through a man. First, he must form part of a closed circuit; and second, there must be a voltage to cause current to flow through the circuit. If these two conditions exist and in addition



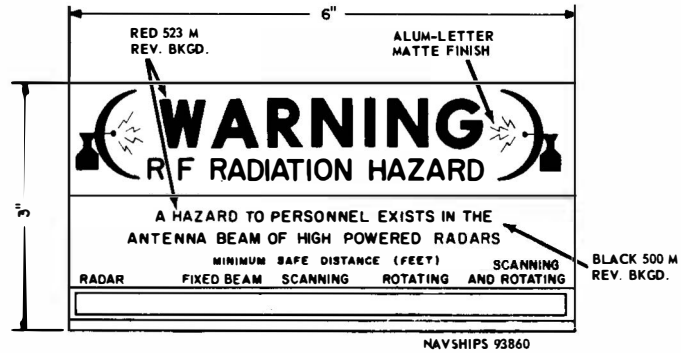
SPECIFICATIONS:
LOCATE ON RADAR ANTENNA PEDESTAL.



SPECIFICATIONS:
LOCATE IN RADIO TRANSMITTER ROOM IN SUITABLE LOCATION FOR FULL VIEW OF OPERATION PERSONNEL.



SPECIFICATIONS:
LOCATE AT EYE LEVEL AT FOOT OF LADDER OR OTHER ACCESS TO ALL TOWERS, MASTS, AND SUPERSTRUCTURE WHICH ARE SUBJECTED TO HAZARDOUS LEVELS OF RADIATION.



SPECIFICATIONS:
LOCATE ON OR ADJACENT TO RADAR SET CONTROL.

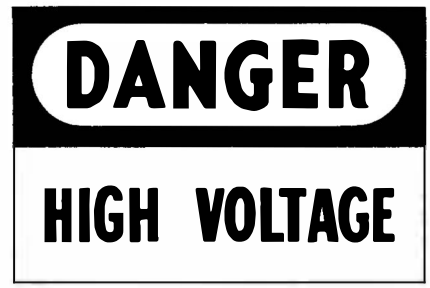


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Figure 13-1.— Hazard warning signs.

the potential difference between the points of contact is high enough (115 volts is more than high enough), the body resistance is low enough, and the current path goes through some of the man's vital organs, he will be shocked fatally. For this reason a man should see to it that his body does not form part of a closed circuit through which current can flow.

Don't go aboard ship with a casual regard for the deadly potentialities of electric current. Few people would handle electric appliances while in the bathtub, or stand ankle-deep in a flooded basement and fumble for the light switch. What is not so well recognized by many Navymen is that the hull of a ship—which, of course, floats in salt water—is an excellent conductor, and that for all practical purposes the man afloat is "standing in a bathtub" all the time.

SOME NOTES ON HUMAN ERROR

Most accidents are avoidable. So that you can see for yourself how avoidable they are, here are the causes of 22 shipboard electrocutions, all of which were traceable to human failure or error.

Causes	Deaths
1. Accidentally touched equipment or conductor, which man knew to be energized.	13
2. Unauthorized modifications to equipment or use of unauthorized equipment.	3
3. Failure to test equipment before working on it to see whether it was energized.	2
4. Failure to repair equipment that had given warning of an unsafe condition by one or more nonfatal shocks prior to the fatal shock.	2
5. Failure to test equipment for insulation resistance and correctness of ground connection AFTER making repairs, and BEFORE trying gear for operability or putting it to use.	2

Men are also electrocuted ashore. In one instance a man erecting an antenna tied a rock to the end of a bare copper wire and threw it over a 3300-volt powerline. Another died when he climbed a pole on a transmission line to capture a monkey sitting on one of the wires. A third walked out of a warehouse with a companion, saw a wire hanging from a pole, said "There's the wire that was popping yesterday," and, before his companion could stop him, walked up and grabbed the wire to throw it out of the way. These are not fairytales. Actually, they are true summaries of reports on the deaths of three men who were either ignorant or contemptuous of the lethal capabilities of electric current.

Intentionally taking a shock from any voltage is always dangerous and is strictly forbidden. When necessary to check a circuit to find whether it is alive, use a test lamp, voltmeter, or other suitable indicating device.

TAGGING SWITCHES

When repairing or overhauling any electronic equipment, make sure the main supply or cut-out switches in each circuit from which power could possibly be fed are secured in the OPEN (or SAFETY) position and tagged. Switches should be secured by locking, if possible. The tag should read; "This circuit was ordered open and shall not be closed except by direct order of----" (usually the person making, or in charge of, the repairs). After the work is complete, tags are removed by the SAME person. If more than one party is working, a tag for each is placed on the supply switch. Each party removes only its own tag as it completes its share of the work.

If switch-locking facilities are available, the switch should be locked in the OPEN (SAFETY) position and the key retained by the man doing the work.

When circuits are grounded for protection of personnel engaged in installation or overhaul, such grounds should be located in the vicinity of the working party and should be secured properly to prevent accidental removal. If the grounding point is not near the working party, the tagging procedure just described should be followed, with the working of the tags changed.

FUSES

Fuses should be removed and replaced only after the circuit has been completely

deenergized. A blown fuse is replaced with one of the SAME rated ampere capacity. You are permitted to replace a blown fuse with one of a higher rating only under emergency or battle conditions when continued use of the equipment is more important than the consequences of possible damage to the equipment. When possible, a circuit should be checked before the fuse is replaced, because a blown fuse usually indicates a circuit fault.

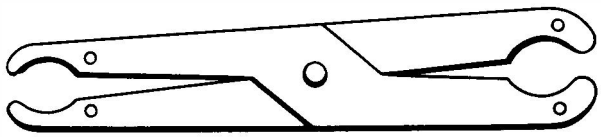

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Figure 13-2. — Fuse puller.

Never change a knife or cartridge-type fuse with your bare hands. Use an approved fuse puller (fig. 13-2). These pullers are made either of laminated bake lite or fiber, and can handle a range of fuses up to 60 amperes. Grasp fuse firmly with puller (using end that best fits fuse size) and pull straight out from fuse cabinet.

Plug-type fuse holders are used extensively in modern electronic equipment. The fuses are removed easily and safely by unscrewing the insulated plug.

Unless work is being done on them, fuse boxes, junction boxes, lever-type boxes, and the like are kept closed.

WORKING ON ENERGIZED CIRCUITS

Insofar as possible, work on energized circuits is NOT undertaken except in time of emergency, and then only under proper supervision. Proper supervision is considered to mean supervision by experienced electronics maintenance personnel. In all such work, care is taken to insulate the workman from ground and to observe every known safety precaution. Here are some of them:

1. Provide ample illumination.
2. Remove metal objects from pockets and clothing.
3. Insulate worker from ground with dry wood, rubber matting, several layers of sandpaper or dry canvas, or a sheet of phenolic insulating material.
4. Cover metal tools with insulating rubber tape (not friction tape).
5. Work with one hand only.
6. Wear rubber gloves if nature of work permits; if not, a glove should be worn on hand not holding tools.
7. Have men stationed by circuit breakers or switches ready to cut the power in case of emergency.
8. Have a man qualified in first aid standing by during entire period of repairs.
9. Never trust insulating material too far when working with live circuits.

SWITCHES AND CIRCUIT BREAKERS

As a general rule, use one hand to open and close switches and circuit breakers. Keep the other hand clear so that, if an accident occurs, current will not trace a path up one arm, through your heart, and out the other arm. Touch one switch at a time. Before closing a switch, make sure that—

1. The provisions for tagging, described previously, are met.
2. The circuit is ready, and all parts are free.
3. Proper fuses are installed for protection of the circuit.
4. Men near moving parts are notified that the circuit is to be energized.
5. The circuit breaker is closed. To close a switch with maximum safety, ease it to a position from which the final motion may be completed with a positive and rapid action. To open a switch carrying current, the break should also be positive and rapid. Be sure your hand is dry so that it will not slip off the switch handle and make contact with high voltage. A dry hand also offers better resistance.

All parts of a circuit breaker except the operating handle usually are good conductors of electricity. When working with circuit breakers, remember these rules:

1. Use only one hand.
2. Keep hands clear of parts except operating handles.
3. Touch only one breaker handle at a time.
4. Positive and negative breakers with two handles should not be closed simultaneously.
5. Close breaker first; then close switches.
6. Trip circuit breakers before opening switches.
7. Never disable a circuit breaker.
8. Keep the face turned away while closing open-type circuit breakers.

9. Never stand over a circuit breaker while power is on.

HIGH-FREQUENCY OPERATING HAZARDS

Aside from the danger of shock, the hazards involved in the operation of electronic equipment in the high-frequency range may be divided into 3 categories: (1) radiation hazards to personnel (RADHAZ), (2) hazards of electromagnetic radiation to ordnance (HERO), and (3) hazards associated with volatile liquids (SPARKS).

RADHAZ

Generally, the possibility of biological injury from radiation at the operating frequencies of most radio communication equipment is slight. But, your duties bring you into close proximity of radar antennas, and here the radiation hazard is very real.

Overexposure to r-f radiation is thermal in nature, and is observed as an increase in overall body temperature or as a temperature rise in certain organs of the body. In short, your body is comprised of skin tissues that form the outer surface, a layer of fat tissue that lies immediately underneath the skin, and a central mass of deeper tissues consisting of muscles, high water content tissues, and bone formations. While working aloft (or in the vicinity of radar transmitting equipment) you may enter a field of electromagnetic radiation. The electromagnetic energy is absorbed in the tissues of your body, thus heat is produced in them. If the organism cannot dissipate this heat energy as fast as it is produced, the internal temperature of the body will rise. This results in damage to the body tissue and, if the rise is sufficiently high, in your death.

You must remember that electromagnetic radiation is NOT visible, and its presence must be measured by instruments.

Proper warning signs are located at various points to warn you when you are entering an area that may be a radiation hazard.

HERO

Another danger of r-f radiation is the danger of permature firing of rockets or missiles, or the explosion of their warheads. The hazard to electronic explosive devices (EEDs), such as missiles, rockets, VT fuses, and the like, occurs because of the heat associated with a current passed through the sensitive wires surrounded by a temperature-sensitive explosive. If energy is dissipated in wires, the explosive gets hot and an explosion can result.

Normally, the circuitry of EEDs is shielded in containers, and if properly shielded, there is little danger of an accident. But, to be safe, there should be no ordnance in any personnel hazard zone or within 25 feet of any radiating antenna.

SPARKS

Aboard ship, shock hazards and sparks exist on rigging, cables, transmitting and receiving antennas, and other structures that are resonant to a radiated frequency. The position of the radiating antenna relative to these objects governs the amount of induced voltage present. If the induced voltage in an object is large enough, arcs and sparks may be drawn when contact is made or broken by personnel, tools, or other conductive devices. Consequently, during refueling, the arming of aircraft, and the handling of ammunition or volatile liquids and gases, extreme care must be exercised by working personnel. Additionally, all transmitting equipment should be deenergized. If this is impossible, a separation of at least 25 feet must be maintained between the work area and an energized antenna as a safety precaution.

SOLDERING IRONS

The soldering iron is a fire hazard and a potential source of burns. When soldering cables or wires, keep the iron holder in the open where the danger is minimized. Disconnect the iron when leaving work, even for a short period.

When using the iron, keep the ends of wires and cables in such a position that they do not provide a source of injury to the face or eyes. Keep your head away from the iron. Don't flip the iron to dispose of molten solder accumulated on the tip; a drop may strike someone's eye.

HANDLING CATHODE RAY TUBES

Cathode ray tubes used in communication equipment are not as large as those required for radar and TV. Nevertheless, handling the relatively small cathode ray tubes found in teletypewriter converters and test equipment presents certain hazards. The following safety precautions apply in handling all cathode ray tubes.

When working with cathode ray tubes, wear safety goggles to protect your eyes from flying glass in event of envelope fracture, which might cause implosion owing to high vacuum within the tube. Recommended goggles provide side and front protection and have clear lenses designed to withstand a fairly rigid impact test. Be sure that no part of your body is directly exposed to possible glass splinters caused by implosion of the tube. The inside fluorescent coating on some tubes is poisonous if absorbed into the blood stream. For these reasons, heavy gloves should be worn when handling tubes.

Remove the tube from its packing box with caution. Take care not to strike or scratch the envelope. Insert the tube into the equipment socket cautiously, using only moderate pressure. Do not jiggle the tube. (These precautions also apply when removing tube from equipment socket.) The neck of the tube is made of thin glass. If the tube should break, particles from the neck may scatter with enough force to cause severe injury.

RUBBER MATTING

Aboard ship a gray, fire retardant, rubber matting with a diamond-shaped surface is cemented to the deck in all electronic spaces. Rubber matting insulates the operator from the steel deck, and the diamond-shaped surface pattern is easy to keep clean and provides safe, nonskid footing. At shore stations, rubber matting is installed around electronic equipment to protect the personnel who service or tune the equipment. Usually the matting does not cover the entire deck area.

SHORTING/GROUNDING BAR

Discharge and ground the circuit components before you work on them. Even when secured, electrical and electronic equipment may retain a charge sufficient to cause a severe shock. Be safe!

The shorting/grounding bar shown in figure 13-3 provides a safe way to ground deenergized circuits. Connect the flexible lead to a grounded part of the cabinet or chassis by means of the alligator clip. Always make this ground connection first. Then, holding only the insulated handle, touch the copper probe to the circuit or part you want to discharge to ground. Repeat this discharge operation several times.

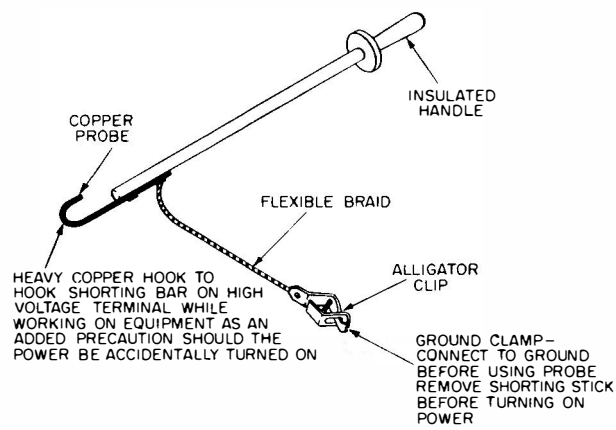

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Figure 13-3.—Shorting/grounding bar.

Before touching a capacitor that is connected to a deenergized circuit, or that is disconnected entirely, short-circuit the terminals with the shorting bar. Repeat this operation several times to make sure the capacitor is fully discharged.

PAINTING

When you paint radio rooms or use insulating varnish, lacquer, paint thinner, or other volatile liquids in radio spaces, make sure there is adequate ventilation. Use both exhaust ventilators and power blowers. Blowers should be arranged to ensure rapid removal of explosive, combustible, or toxic vapors. Such vapors should be exhusted in such a way that they will not drift into other areas or be sucked into the ship's supply vents.

If paint vapors or fumes are suspected of being explosive, do not allow anyone in the vicinity to use portable electrical equipment of a type that might set off an explosion. Do not permit smoking in the danger area, or allow any type of work that may produce flames or sparks. See that firefighting equipment is handy.

Practice good housekeeping. See that unnecessary objects are picked up and kept out of the way. Place rags, sweepings, and waste that may be contaminated with paint in a covered metal container or in a bucket of water.

Never eat, drink, or store food in a compartment where painting is being done. Remove the coffee mess. Keep your hands out of your mouth. Paint is a poison, and ingesting the smallest amount can be serious.

CLEANING ELECTRONIC EQUIPMENT

Clean electronic equipment helps to assure good performance. Prior to cleaning, certain precautions are necessary to protect the equipment as well as the operator.

Turn off the power switches and ground capacitors with the shorting bar.

A vacuum cleaner with a nonmetallic hose is safe and useful but will not reach all the areas where dust accumulates. The preferred method for cleaning inside electronic equipment is to use a brush, such as a typewriter cleaning brush, together with the vacuum cleaner to remove the dirt as it is loosened by the brush.

A hand bellows may be used to blow dirt out of equipment. Compressed air lines are available aboard ship but are not recommended for cleaning radio equipment because the air pressure may be so strong as to cause damage to delicate electronic parts.

Do not use steel wool or emery paper for cleaning electronic equipment. Tiny particles of these conducting materials cause troublesome and dangerous short circuits.

Do not use solvents unless absolutely necessary. Some solvents are flammable, others are toxic (poisonous), and still others are both flammable and toxic. Besides these hazards, all solvents are harmful to electronic equipment. They dissolve waxes and compounds used to protect the equipment from fungus growth. They soften most types of insulation and cause it to become saturated with the very dirt that the user is trying to remove. The commonly available chlorinated solvents combine chemically with wax and oil to produce enough hydrochloric acid to etch metal surfaces, causing such troubles as erratic operation of switch contacts.

Flammable solvents such as alcohol must never be used on energized equipment or near any energized equipment from which a spark may be received.

If solvents must be used for cleaning electronic gear, be sure the area is well ventilated, and use only the smallest possible quantity of solvent to do the job.

Carbon tetrachloride is no longer authorized by the Navy as a cleaning solvent. Many serious accidents were caused by the improper storage and use of carbon tetrachloride, resulting in headaches, dizziness, nausea, loss of consciousness, and even death. Actually, it is four times as poisonous as the deadly carbon monoxide. Methyl chloroform is approved for cleaning applications in which carbon tetrachloride previously was used. Even though it is less toxic than carbon tetrachloride, methyl chloroform presents some hazards to personnel. As a result, the following safety precautions must be observed:

1. Use with adequate ventilation.
2. Avoid prolonged or repeated breathing of the vapor.
3. Avoid prolonged or repeated contact with the skin.
4. Do not take internally.

FIRST AID

It is necessary that you understand first aid to be given for electric shock and burns, and how to revive a person by artificial respiration.

RESCUE FROM ELECTRICAL CONTACT

In many cases, it is necessary to rescue the victim before you can begin first aid treatment. Rescuing a person who has received an electrical shock is likely to be difficult and dangerous. Extreme caution must be exercised to avoid being electrocuted yourself. Speed is important, of course, but a few moments to evaluate the situation may make the difference between life and death—for you as well as for the person you are trying to rescue.

If the victim still is in contact with the conductor, the first thing to do is to stop current flow through his body. You can shut off power by opening switches or circuit breakers, or by cutting the conductor with a wooden-handle ax or hatchet or with insulated pliers. If circumstances are such that power cannot be shut off quickly, use some dry material such as line, cloth, canvas, rubber, or wood to lift or pull the man away from the conductor. DON'T USE METAL OR MOIST MATERIALS. When you are trying to break an electrical contact, stand on any dry, nonconducting material to prevent the current from reaching ground through your body.

ARTIFICIAL RESPIRATION

A victim of electrical shock who has stopped breathing is not necessarily dead, but he is in immediate and critical danger. The method by which a person can be saved after breathing stops is called artificial respiration. The same methods of artificial respiration used for victims of electrical shock can be used for drowning or gas asphyxiation cases.

The purpose of artificial respiration is to force air out of the lungs and into the lungs, in rhythmic alternation, until natural breathing is restored. Artificial respiration should be given only when natural breathing ceases. It must NOT be given to any person who is breathing naturally on his own. Do not assume that a person's breathing has stopped merely because he is unconscious, or because he has been rescued from contact with an electrical circuit. Remember: DO NOT GIVE ARTIFICIAL RESPIRATION TO A PERSON WHO IS BREATHING NATURALLY.

If possible, send for a medical officer or a Hospitalman; but don't go yourself if you are alone with the victim. Speed in beginning artificial respiration is essential in any instance in which breathing has stopped. Every moment's delay cuts down the victim's chance of survival. Do not take time to move the victim to a more comfortable location, unless he is in such a dangerous position that he must be moved in order to save his life.

If another person is present while artificial respiration is being administered, he can be very helpful. Have him remove false teeth, chewing gum, or other matter from the victim's mouth; at the same time he can bring the victim's tongue forward. He also can loosen the clothing around the victim's neck, waist, and chest. If you are alone, you will have to attend to these details yourself before beginning artificial respiration.

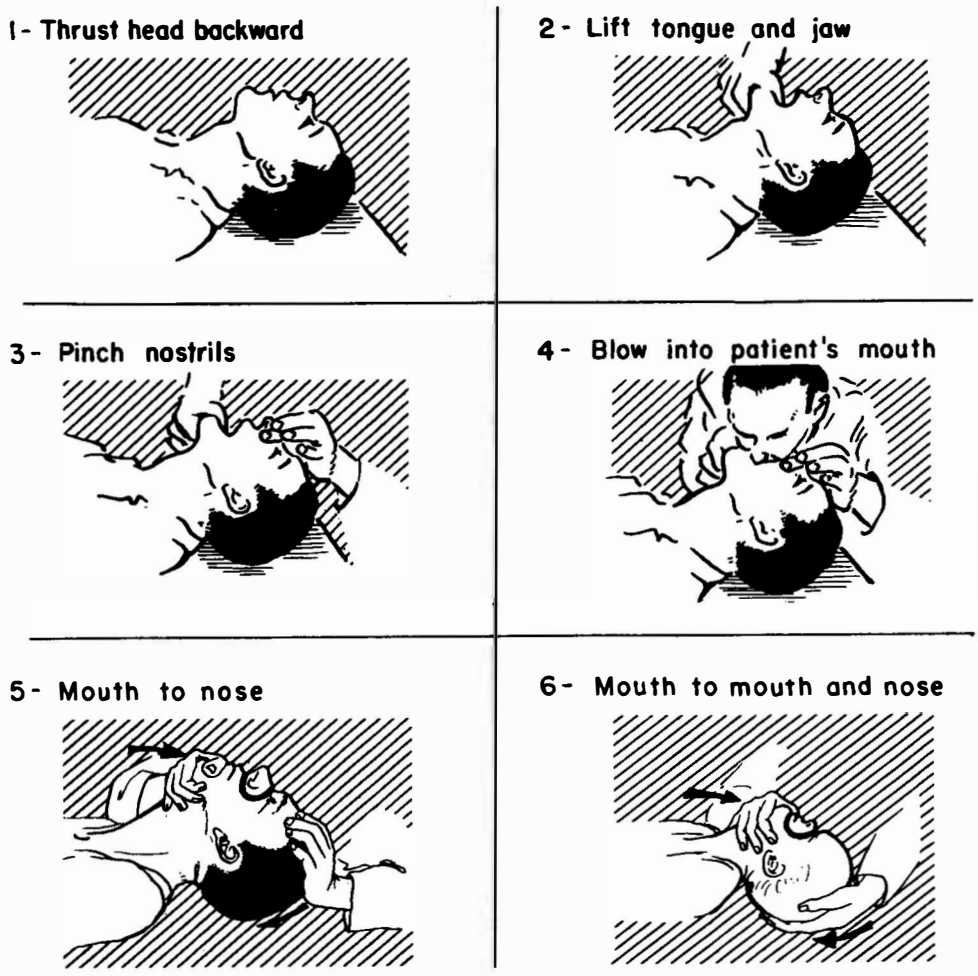

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Figure 13-4. — Mouth-to-mouth method of resuscitation.

Artificial respiration must be continued for at least 4 hours unless natural breathing is restored before that time or a medical officer declares the person dead. Some people have been revived after as much as 8 hours of artificial respiration.

Three methods of artificial respiration are described in this manual. They are the mouth-to-mouth method, the back-pressure arm-lift method, and the back-pressure hip-lift method.

In addition to the foregoing procedures, there are several other methods of artificial respiration. If you have had training in first aid, it is possible that you learned one of the older methods, but they no longer are considered the most effective. It is now your responsibility to learn the new techniques.

Mouth-to-Mouth Resuscitation

Mouth-to-mouth resuscitation, shown in figure 13-4, is recommended by the National Academy of Sciences, National Research Council, the American Red Cross, and the Armed Forces as the preferred and most effective way of providing artificial respiration. All other procedures are considered alternate methods for use only when mouth-to-mouth resuscitation is not practicable.

Mouth-to-mouth resuscitation is particularly recommended for use aboard ship in cases of electric shock. Investigations of shipboard electric shock fatalities indicate that, despite the good intentions of rescuers, valuable seconds are sometimes lost in first moving the victim from an awkward, cramped, wet, or isolated location to a roomier, drier place before applying resuscitation measures. Familiarity with this new method enables the man nearest the victim to start revival action readily while sending or yelling for medical help. Commencing artificial respiration can thus be reduced to a matter of a few seconds after freeing the victim from his contact with the electricity.

The following six steps are easy to learn:

1. Place the victim on his back. Loosen collar and belt.

2. Clear the mouth of any foreign matter with your fingers or a cloth wrapped around your fingers.

3. Tilt the head back so the chin is pointing upward. With one hand push the jaw forward into a jutting-out position. Tilting the head and pushing the jaw forward should relieve obstruction of the airway. With the fingers of one hand, pinch the victim's nostrils shut to avoid any air leakage.

4. Take a deep breath. Place your mouth over the victim's mouth and breathe into him. The first blowing effort should determine whether any obstruction exists. Watch his chest rise to make sure his air passage is clear.

5. Remove your mouth, turn your head to one side, and listen for the return rush of air that indicates air exchange. Repeat the blowing effort about 12 times per minute.

6. If you are not getting air exchange, recheck the head and jaw position. If you still do not get air exchange, turn the victim quickly on his side and administer several blows between his shoulder blades in an effort to dislodge foreign matter. Again clean his mouth with your fingers.

Don't worry about germs when a life is at stake. Those who do not wish to come into direct contact with the victim may hold a cloth or handkerchief over the victim's mouth or nose and breathe through it. The cloth does not greatly affect the exchange of air.

The Navy has available a plastic resuscitation tube, which is a part of every first aid kit. Use of the plastic tube makes it easier to keep the victim's tongue from blocking the air passage, and avoids the necessity for direct oral contact between rescuer and victim.

Medical research has established conclusively that the mouth-to-mouth respiration technique is superior to all others in reviving a person whose breathing has stopped for any reason. The method is adaptable to a victim of any age. Everyone should be familiar with it.

Back-Pressure Arm-Lift Method

The back-pressure arm-lift method of artificial respiration is illustrated in figure 13-5. This procedure requires the following steps:

1. Place the victim so that he is lying face down. If he is on a sloping surface, position him so that his head is slightly lower than his feet. Bend both his elbows and place one hand on the other, as shown in figure 13-5. Rest the victim's head on his hands, with his face turned to one side.

2. Kneel on one knee, facing the victim. (You can use either knee.) Place your knee close to his head. Put your other foot near his elbow. You may find it more comfortable to kneel on both knees; if you do this, have one knee on each side of the victim's head. Next,

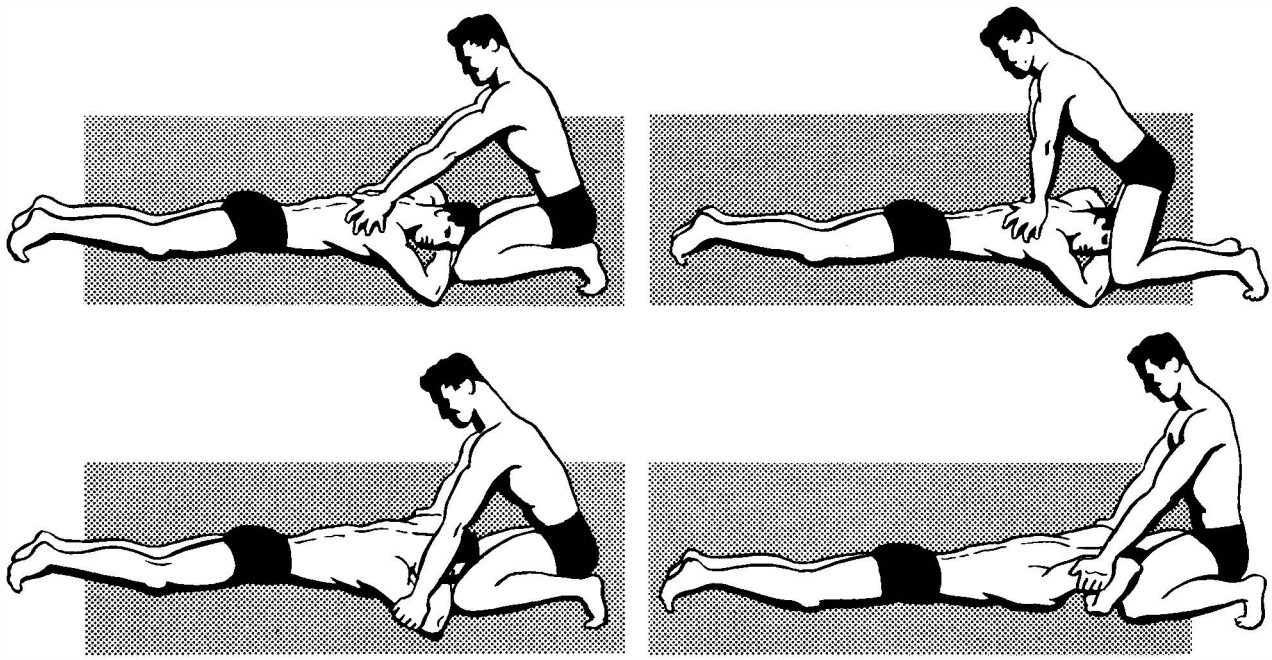

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Figure 13-5.— Back-pressure arm-lift method of resuscitation.

place your hands on the middle of his back, just below the shoulder blades, in such a position that your fingers are spread downward and outward, with thumb tips just about touching.

3. With your arms held straight, rock forward slowly so that the weight of your body is gradually brought to bear on the victim. This action compresses his chest and forces air out of the lungs. Do not exert sudden pressure, and do not put your hands too high on his back or on his shoulder blades.

4. Release the pressure quickly by peeling your hands from the victim's back.

5. Now rock backward, and allow your hands to come to rest on the victim's arms just above his elbows. As you swing backward, lift the victim's arms upward. The arm lift pulls on the victim's chest muscles, arches his back, releases the weight on his chest, and causes his chest to expand and fill with air. Finally, lower the victim's arms, and you have finished one full cycle.

Repeat the cycle approximately 12 times per minute (5 seconds per cycle). Follow this rhythm: Rock forward and press, rock backward and lift. The pressing and lifting should take approximately equal periods of time; the release periods should be as short as possible.

Try to maintain a slow, easy rhythm—rocking forward on the back-pressure phase, rocking backward on the arm-lift movement. The rocking motion helps to maintain rhythm. Remember that a smooth rhythm is important in performing artificial respiration, but split-second timing is not essential.

Back-Pressure Hip-Lift Method

The back-pressure hip-lift method of resuscitation is shown in figure 13-6. It is used when necessary to give artificial respiration to a person injured in the upper part of the body—chest, neck, shoulders, or arms. The hip—lift procedure is also useful in situations where lack of space makes it difficult or impossible to use the arm-lift method. The hip-lift technique has the disadvantage of being somewhat harder on the operator.

The back-pressure hip-lift principle requires the following steps :

1. Place the victim face down, with one arm bent at the elbow and the other arm extended as in figure 13-6. Rest his head on his hand or forearm, with his face turned so that his nose and mouth are free for breathing. Clear his mouth of any objects or materials that might

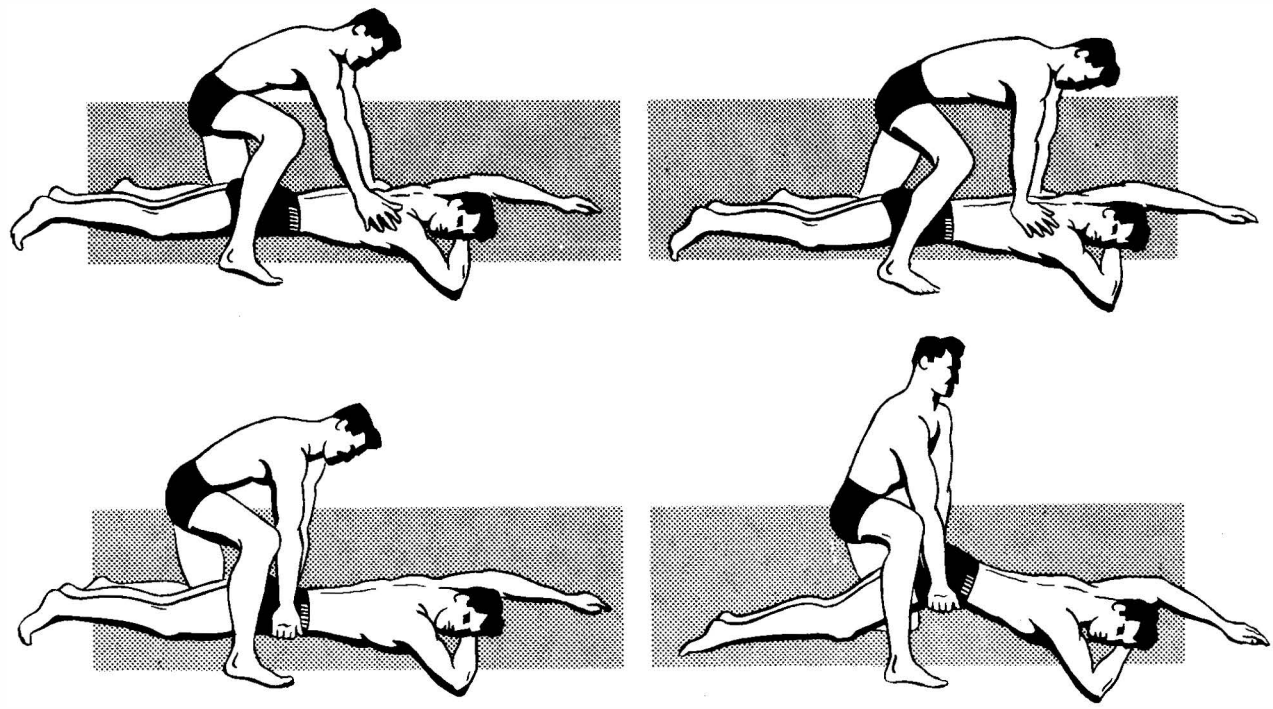

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Figure 13-6. —Back-pressure hip-lift method of resuscitation.

obstruct his breathing. At the same time, bring his tongue forward so that it will not clog the air passage.

2. Kneel on either knee, and straddle the victim at the level of his hips. Place your hands on the middle of his back, just below the shoulder blades. Your fingers should be spread downward and outward, with your thumb tips just about touching. Be careful that your hands are not too high on his back; they should be below the shoulder blades.

3. With your arms held straight, rock forward slowly so that the weight of your body is gradually brought to bear upon the victim. Keep your elbows straight and your arms almost vertical, so that the pressure is exerted almost directly downward. Do not exert sudden pressure, or any more pressure than is required to feel a firm resistance.

4. Release the pressure quickly by peeling your hands from the patient's back.

5. Now rock backward and let your hands come to rest on the victim's hips, well below his waist. Slip your fingers underneath his hip bones.

6. Lift the victim's hips 4 to 6 inches. The lifting allows the abdomen to sag downward and the diaphragm to descend, causing his chest to expand and fill with air. Lower the victim's hip's and you have finished one full cycle.

As in the arm-lift method, the cycle should be performed approximately 12 times per minute. If a relief operator is available, he can come in on one side and take over after one of the lift movements.

Treatment During Recovery

When a person is regaining his breath, the bluish or pale appearance of his skin may be succeeded by a distinct flush of color. Then his muscles may begin to twitch and his fingers to scratch and clutch. Swallowing movements are sometimes the first sign of natural respiration. The first attempt to breathe may be a faint catch of breath, or a sigh. You must be very careful not to exert pressure when the victim is trying to get his first breath. If he begins to breathe on his own, adjust your timing to assist him. Do not hinder his efforts to breathe; instead, synchronize your efforts with his.

Keep the patient warm. Do not give any liquids until he is fully conscious. To avoid

strain on his heart, the patient should be kept lying down and not allowed to stand or sit immediately after he revives. Do not allow the patient to walk or otherwise exert himself. The slightest exertion at this point might easily cause death from heart failure. After a temporary recovery of respiration, the patient sometimes stops breathing again. If natural breathing stops, resume artificial respiration at once.

SHOCK

Some degree of shock follows all injuries. It may be slight and almost unnoticed, lasting only a few moments, or it may be severe enough to cause death. An interruption of breathing, from whatever cause, almost always is followed by severe shock.

Symptoms

A person suffering from shock feels weak, faint, and cold. His face is usually pale and his skin is cold and clammy. Sweating is likely to be very noticeable. Remember, however, that signs of shock do not always appear at the time of the injury. Indeed, in many serious cases, they may not appear until hours later.

The symptoms of a person suffering from shock are, directly or indirectly, the result of the circulation of the blood becoming disturbed. The pulse is weak and rapid. Breathing is likely to be shallow, rapid, and irregular, because the poor circulation of the blood affects the breathing center in the brain.

It is unlikely that you will see all these symptoms of shock in any specific instance. Some of them appear only in late stages of shock when the victim's life is in serious danger. It is imperative that you know the symptoms that indicate the presence of shock, but don't ever wait for symptoms to develop before beginning the treatment for shock.

Prevention and Treatment

The most helpful deed you can perform for a person revived by artificial respiration is to begin treatment for shock. If shock has not yet developed, the treatment may actually prevent its occurrence. If it has developed, you may be able to keep it from reaching a critical stage. It is extremely important, therefore, that you begin the treatment at the earliest practicable moment.

Get medical assistance as quickly as possible. Meanwhile, place the patient in a horizontal position, with his head slightly lower than the rest of his body. If it is impossible to do this, it might still be feasible for you to raise his feet and legs enough to help the blood flow to the brain. Do the best you can, under the circumstances, to get the patient into this position. Never let the patient sit or stand or walk around.

Heat is important in the treatment of shock, to the extent that the patient's body heat must be conserved. Keep the patient warm, but not hot. Apply only enough clothing and blankets to bring the body to normal temperature.

As a general rule, liquids should NOT be given as a part of first aid treatment for shock. Until recently, first aid books emphasized giving warm fluids (in particular water, tea, and coffee) as a part of the treatment. Now it is believed that administering fluids is not a necessary or even desirable part of first aid treatment. It is true that a person is shock is in need of liquids. But liquids given by mouth are not absorbed—and therefore ineffective—except in very mild cases of shock. In moderate or deep shock, intravenous administration of fluids is necessary; but this is a medical procedure and cannot, under any circumstances, be performed by a person giving first aid.

One final precaution must be given concerning the use of liquids: Never give alcohol to a person who is in shock or who may go into shock. Alcohol increases the blood supply to the surface blood vessels, and diminishes the blood supply to the brain and other vital organs.

BURNS

Burns and scalds are caused by exposure to intense heat, such as heat generated by fire, bomb flash, hot solids, liquids, and gases, and contact with electric current.

Burns usually are classified according to the depth of injury to the tissues. A burn that reddens the skin is called a first-degree burn. One that reddens and blisters the skin is called a second-degree burn. When the skin is destroyed and the tissues actually are charred or cooked, the injury is described as a third-degree burn.

It is easy to see that a deep burn (third-degree) is more serious than one not so deep. Remember, however, that the size of the burned area may be far more important than the depth of the burn. A first-degree or second-

degree burn which covers a very large area of the body is nearly always more serious than a small third-degree burn. A first-degree sunburn, for example, can cause death if an extensive area of the body is involved.

It should be noted that burns and scalds are essentially the same type of heat injury. When the injury is caused by dry heat, it is called a burn; when caused by moist heat, it is referred to as a scald. Treatment is the same for both.

The chief dangers from burns are shock and infection. All first aid treatment for burns must be directed toward relieving the victim's pain, combating shock, and preventing infection.

Minor burns should be dressed immediately. Apply a thin coat of sterile petrolatum (vaseline) to the burned area and cover with a sterile bandage. The pain will be lessened if the bandage is airtight and fairly firm.

Serious burns should be treated as follows:

1. Relieve the pain. Burns are painful, and the pain contributes to the severity of shock. For a person who has suffered extensive burns, first give 1/4 grain of morphine to relieve the pain.

CAUTION: Remember that the victim may have other injuries besides the burns. Do NOT give morphine to any person who has a head injury, even if he is suffering from extensive burns.

2. Treat for shock. Any badly burned person must be treated for shock immediately. Serious shock always accompanies an extensive burn, and is, in fact, the most dangerous consequence of the injury. Start the treatment for shock before making any attempt to treat the burn itself.

Relieving the victim's pain is, of course, an important part of the treatment for shock. When you have done this, try to place him in position so that his head is slightly lower than the rest of his body. Make sure that he is warm enough. Do not remove his clothing immediately. Cover him with a blanket if he appears to be cold. Do not overheat him, but remember that exposure to cold will cause shock to become even worse.

The general rule that liquids should not be given in first aid treatment for shock was emphasized earlier. In serious burns, however, an exception must be made to this rule. A seriously burned person has an over whelming need for fluids; and administering liquids is an important part of the treatment for shock. Give small amounts of warm water, warm tea, or warm coffee if the victim is conscious and able to swallow and if he has no internal injuries.

3. Treat the burn. In cases of extensive burns, the first aid treatment depends upon the probable length of time that must elapse before the victim receives medical aid. If you believe that a medical officer will be available within a period of about 3 hours, simply wrap the victim in a clean sheet (or whatever clean material is available), continue to treat him for shock, but do no attempt any treatment of the burn itself.

If more than 3 hours may elapse before the services of a medical officer can be obtained, you will have to dress the burn. First remove the victim's clothing around and over the burn, being careful not to cause further injury. If clothing sticks to the burn, do not attempt to pull it loose. Merely cut around the part that sticks, and leave it in place. If any material such as wax, metal, tar, dirt, grease, etc., adheres firmly to the burn, do not try to remove it. Do not allow absorbent cotton, powder, adhesive tape, or any other substance that might stick to the burn to come in contact with it. Never put iodine or any other antiseptic on a burn.

When you clear away as much clothing as you can, dress the burn. Cover strips of sterile gauze with a thin coating of petrolatum (vaseline). The petrolatum should not be applied too thickly. Wrap the gauze strips smoothly and gently around the burned areas, and cover with a roller bandage. The bandage must be firm, but it must not be tight enough to restrict circulation of the blood or to interfere with breathing. A smooth, firm bandage greatly reduces the victim's pain.

Once the bandage is applied, it should not be disturbed. Leave it in place until the victim receives medical treatment.

As we have seen, shock is the most immediate danger in burn injuries. Infection is the second danger that must be guarded against. Second-degree and third-degree burns are, in effect, open wounds. At first the burned areas are probably sterile, because of the intense heat that caused the burn. In handling and treating a person who has been burned, therefore, you must do everything possible to prevent contamination of the burn. Do not allow unsterile objects or materials to come in contact with the burn. Do not open any blisters. Contamination of the burn can cause serious (sometimes fatal) infections.

ELECTRICAL FIRES

Any fire is a potential source of disaster. In electrical fires, observe the following procedures.

1. Deenergize the circuit for the equipment affected. Every radio transmitter has an EMERGENCY OFF switch that removes all power from the equipment. In addition to local power switches on the equipments, the power supply to all transmitters and receivers, converters, and teletypewriters can also be secured at the power distribution panels.

2. Spread the alarm. Ashore, call the fire department. Aboard ship, use the phone or intercom—if available, send another person—to sound the alarm in accordance with the ship's fire bell.

3. Secure ventilation. Turn off the blowers; close the doors.

4. Report the fire to the OOD by telephone or messenger.

5. Attack the fire with equipment available in the immediate vicinity, such as portable 15-pound CO2 (carbon dioxide) extinguishers.

When extinguishing an electrical fire, remember that quick action is required only to deenergize the circuit. When this has been done, STOP! LOOK! THINK! The use of CO2 fire extinguishers directed at the base of the flame is always best for all electrical fires. Because carbon dioxide is a dry, noncorrosive, inert gas, it will not damage electrical equipment. And, because it is a nonconductor of electricity, it can be used safely in fighting fires that otherwise would present the additional hazard of electric shock.

PORTABLE FIRE EXTINGUISHERS

Some portable 15-pound carbon dioxide fire extinguishers have a squeeze-grip style release valve that is operated by a simple hand squeeze-grip. Others have a release valve operated by a handwheel at the top. Both valves have a locking pin to prevent unintentional discharge of the carbon dioxide. To operate:

1. Carry the extinguisher in an upright position, and approach the fire as closely as the heat permits. (Keep the extinguisher erect while using it. Because of its construction, it should not be laid on its side.)

2. Remove the locking pin from the valve.

3. Grasp the nozzle horn by its handle. (It is insulated to protect your hand from the extreme cold of the discharging carbon dioxide.)

4. Open the valve by turning the valve wheel to the left (or squeeze the release lever), thus opening the valve and releasing the carbon dioxide, and at the same time direct the flow toward the base of the fire. Move the horn slowly from side to side, and follow the flames upward as they recede.

5. Close the valve as soon as conditions permit, and continue to open and close it as necessary. The firefighter may shut off the handwheel type of valve for brief intervals without an appreciable loss of carbon dioxide, but once the valve seal is broken, the carbon dioxide will leak away in 10 minutes or so. The squeeze-grip type likewise may be turned off while in use, but it will hold the contents indefinitely without leakage. In continuous operation, the 15-pound cylinder of either type will expend its contents in about 40 seconds.

6. The discharge should not be stopped too soon. When the flame is extinguished, coat the entire surface involved in the fire with carbon dioxide snow in order to prevent reflash.

The firefighter must be warned that the very qualities that make carbon dioxide a desirable extinguishing agent also make it dangerous to life if the compartment should become filled with it. Certainly, when it replaces oxygen in the air to the extent that combustion cannot be sustained, breathing cannot be sustained either. Radio rooms do not have CO2 systems for total flooding such as those installed in uninhabited spaces used for gasoline and paint stowage. Consequently, when using the 15-pound portable fire extinguishers, the firefighter usually does not have to consider the possibility of harm to personnel. Because carbon dioxide is heavier than air, it does not rise, but remains in a pool close to the deck. The quantity of gas released from one— or several—of these extinguishers is insufficient to reduce below a dangerous minimum the total oxygen content of the air in a compartment.

Anyone using a carbon dioxide extinguisher should be warned that the snow blisters the skin and causes painful burns if allowed to remain on the skin.

In the event that all efforts with carbon dioxide fail to put out the fire, fresh water applied with a fog applicator may be used. Because of the fine diffusion of its particles, fog reduces but does not entirely remove the danger of electric shock.

In cable fires in which the inner layers of insulation (or insulation covered by armor) support combustion, the only positive method of preventing the fire from running the length of the cable is to cut the cable after it is deenergized, and separate the two ends.

WORKING ALOFT

To work on antennas, you must go aloft. Radarmen, Signalmen, and the deck force also may have work to do on the masts and stacks. Before going aloft, it is necessary to obtain permission from the OOD and CWO, and to inform them when work is complete and the men are down.

When radio or radar antennas are energized by transmitters, workmen must not go aloft unless advance tests show positively that no danger exists. A casualty can occur from even a small spark drawn from a charged piece of metal or rigging. Although the spark itself may be harmless, the "surprise" may cause the man to let go his grasp involuntarily. There is also shock hazard if nearby antennas are energized, such as those on stations ashore or aboard a ship moored alongside or across a pier.

Danger also exists that radar or other rotating antennas might cause men working aloft to fall by knocking them from their perch. Motor safety switches controlling the motion of radar antennas must be tagged and locked open before anyone is allowed aloft close to such antennas.

If you work near a stack, draw and wear the recommended oxygen breathing apparatus. Among other toxic substances, stack gas contains carbon monoxide. Carbon monoxide is too unstable to build up to a high concentration in the open, but prolonged exposure to even small quantities is dangerous.

Here is what the CWO requires you to do when he receives word that men are going aloft: (1) Secure all radio transmitters and disconnect and ground the transmitting antennas. (2) Unpatch remote control units at the transmitter transfer panel, and place a "Secure, men aloft" sign on all transmitters. (3) Report accomplishment of these details to the CWO so that he can inform the COD and men going aloft that all radio transmitters are secured.

Make entries in your radio log to show the time of securing, the time of opening up to resume operating, the name of the OOD granting permission to open up, and the time the men came off the mast.

Under no circumstances turn on any transmitter unless informed that the men are off the mast, and then only with permission of the OOD and CWO.

Observe these safety precautions when you are going aloft:

1. You must have permission of the CWO and OOD.
2. You must have the assistance of another man along with a ship's Boatswain's Mate qualified in rigging.
3. Wear a safety belt. To be of any benefit, the belt must be fastened securely as soon as you reach the place where you will work. Some men have complained on occasion that a belt is clumsy and interferes with movement. It is true the job may take a few minutes longer, but it is also true that a fall from the vicinity of an antenna is usually fatal.
4. Do not attempt to climb loaded with tools. Keep both hands free for climbing. Tools can be raised to you by your assistant below. Tools should be secured with preventer lines to avoid dropping them on your shipmates.
5. Ensure yourself of good footing and grasp at all times.
6. Remember the nautical expression of old seafarers: HOLD FAST.