DEPARTMENT OF RAILWAYS
NEW SOUTH WALES

RESCUE AND RESUSCITATION IN CASES OF ELECTRIC SHOCK

For the Information of Employees Working in Electrified Areas

For the Information of Employees and not for Publication.

DEPARTMENT OF RAILWAYS,
NEW SOUTH WALES.

SECTION 8.

RESCUE AND RESUSCITATION IN CASE OF ELECTRIC SHOCK

801.—FOREWORD.

THE procedure for the rescue of persons from contact with a "live" conductor cannot be definitely laid down for all cases. This section, however, describes in some detail methods of rescue of persons from contact with "live" railway overhead equipment, and briefly touches upon the extra precautions to be taken in cases where the voltage concerned is higher than this (1500 volts).

The procedure (see Instruction 806) advised in the case of 1500-volt equipment holds good in all circumstances where the voltage of supply concerned is not above 3,000 volts, and for such cases the methods of rescue recommended may be adopted accordingly.

The treatment of the patient after rescue from a "live" electrical conductor (see Instruction 809, etc.) is applicable for all cases of electric shock.

The guiding principles herein are given for the use of staff trained to deal with the railway overhead wiring, and cover some of the major risks incurred in rescuing a person touching, or entangled in, a fallen overhead railway contact wire. The methods shown are applicable where it is thought that undue time, otherwise, would be taken in cutting off the supply of electricity. It should be borne in mind, however, that the methods of rescue are somewhat hazarous, particularly for untrained staff. At the same time it is thought that the information may, in some emergency, be of value to any member of the staff.

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802.—DESCRIPTION OF 1500-VOLT OVERHEAD CONTACT EQUIPMENT.

(i) Over the centre of each electrified railway track, at a height of about 16 feet above the rails, is suspended the heavy " contact wire " from which the electric trains collect current for their propulsion. The contact wire is supported at frequent intervals by " droppers " from a steel or copper cable called the " catenary " or " messenger " cable, which in turn is suspended at each main structure by means of porcelain insulators. The contact line is steadied against wind, etc., or directed round curves by " steady arms " attached to wires spanning the tracks at main structures, and at intermediate " pull off " structures. These " span wires " are fastened to their structure poles through insulators (see Fig. 1).

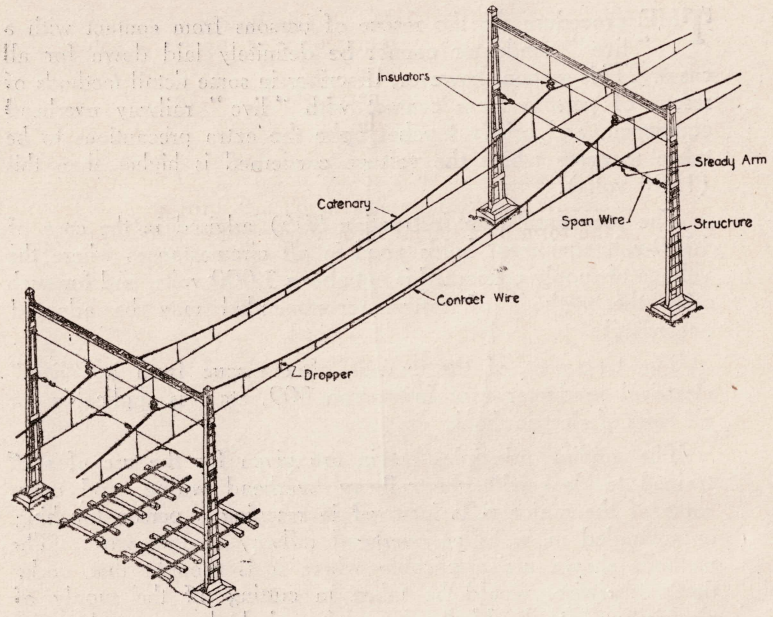

Fig. 1.—1500-volt overhead line construction. All the wires named in this figure are "alive."

(ii) The contact wire, catenary, droppers, steady arms, and span wires, under normal running conditions, are all maintained at approximately 1500 volts above earth potential. Whenever

a conducting path bridges between these charged members and earth (including the rails, structures, etc.) an electric current passes through the path so formed. The insulators, or non-conductors, are to prevent the passage of current.

803.—EFFECT OF TOUCHING LIVE ELECTRICAL CONDUCTORS.

(i) Material such as metals, flesh, damp clothing, damp ropes, etc., are all capable of conducting current to a greater or less degree.

(ii) The human body is a conductor and will, if subjected to a sufficiently high voltage, allow a current to pass which, under certain circumstances, would be large enough to cause death. The passage through the body of an electric current of only a little greater strength than is required to operate a telephone is sufficient to paralyse the diaphragm, and so suspend breathing, or cause heart failure due to nerve action. The diaphragm is a strong muscular wall across the body about level with the bottom of the ribs. It is largely the action of this set of muscles which causes the breath to be taken in. It is due to this result of electric shock that resuscitation measures are usually prescribed in the form of artificial respiration. (See also Instruction 809.)

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804.—WARNING AGAINST TOUCHING LIVE 1500-VOLT CONDUCTORS.

(i) It will be seen how essential it is to exercise the utmost caution when in the vicinity of live electrical conductors. Special care must be taken that no part of the body or, say, tools of conducting material in contact with the body, should touch the live conductors. For this reason it has been laid down in Regulation 16, page 3, of the " Working of Electric Trains " book that " No person is to go on the roof of any vehicle on either an electric or steam-hauled train, or on the roof of any detached car or other vehicle, or on the roof or load of any goods type vehicle either on a train or elsewhere on electrified lines, when by so doing there would be a possibility of any portion of the body or clothing of the person concerned, when standing in an erect position, coming within four feet of any section of the overhead wiring, or live portion of 1500-volt equipment, until the prescribed ' Permit to work ' form has been obtained from the Chief Electrical Engineer's representative." (Such positions include verandah roofs over platforms, tenders of locomotives, steel structures of overhead equipment, etc.)

(ii) Further, in Regulation 21 on page 6 of the " Working of Electric Trains " book it is provided that " work must not be undertaken at any place directly above the overhead electrical equipment or within four feet thereof, where there is danger of contact, unless the employee in charge of such work has been specially instructed by a technical officer, foreman, sub-foreman or examiner, who is authorised by the Chief Electrical Engineer as qualified to differentiate between safe and unsafe conditions."

(iii) The various authorised officers mentioned in paragraph (ii) are employed in the overhead wiring section, and as an indication that they have been properly authorised by the Chief Electrical Engineer each such officer has been supplied with a red leather badge with his name inscribed thereon.

(iv) Although the overhead equipment is not at sufficiently high voltage to have any effect until actual contact is made, the aforementioned instruction has been framed in order to prevent accidental contact being made through tools or material which the employee might be handling. Too much care cannot be exercised in this respect when using fire irons, metal tapes, piping, wires, etc. Even when in use well below the contact

wires, a metallised tape has been known to be flung up by the wind into contact with the live conductors (see Regulation 12 of the " Working of Electric Trains " book).

(v) Equipment Examiners and other employees attending to the 1500-volt electrical equipment on trains must take every precaution to see that the pantograph of the car on which they are working is lowered and cannot be raised until they have finished their work. Instructions have been issued to ensure safe working, and they must be strictly observed.

805.—DAMAGED OVERHEAD EQUIPMENT.

Do not attempt to touch any disarranged wire or conductor connected with the overhead equipment. Report the fact as quickly as possible to the nearest station master, signalman, or substation attendant, as directed in Regulation 25 (*a*) of the " Working of Electric Trains " book. Suitable instructions will then be issued to enable the defect to be remedied.

806.—REMOVAL OF PERSON FROM CONTACT WITH LIVE ELECTRICAL CONDUCTORS.

(a) Rescue in Dry Weather.

(i) Owing to the fact that the passage of an electric current through the body of a person can paralyse the action of the diaphragm and thus stop breathing, it is obviously of first importance, in the event of a person receiving a shock, to free the patient as soon as possible from the conductor carrying the current. Delay may prove fatal. Every second is of importance.

(ii) *The safest course for releasing a person in contact with a live conductor is to have the current switched off immediately. When this is the quickest way it should be adopted.*

(iii) In the case of train equipment the current can normally be switched off by lowering the pantograph.

(iv) In the case of 1500-volt overhead equipment at a car shed, the power thereto should be immediately switched off.

(v) In the case of 1500-volt overhead equipment other than at car sheds, a message should be sent by telephone or otherwise to the Electrical Trouble Officer requesting the immediate switching off of current on the section affected, and if necessary to send assistance to free the sufferer. To do this use one of the

telephones indicated in Instruction 808 headed "Location and use of telephones on railway lines for urgent calls in emergencies."

(vi) When it would take longer to effect release by having the current switched off than by adopting one of the methods shown hereafter, then one of these latter methods may be followed if reasonably safe, *but it must be clearly understood that to rescue anyone from a "live" 1500-volt conductor is generally a dangerous procedure unless carried out in a proper manner.*

(vii) If a person is found in a collapsed condition, one's first impulse is to take hold of and help the patient to a better position in order to render first-aid. But, bearing in mind what has been mentioned in the foregoing, if the person has collapsed owing to electric shock and is still in contact with the live conductor, the patient is a conductor of electricity, and is therefore liable to transfer a shock to a rescuer unless the latter is suitably protected by insulating his hands or his feet, or preferably both.

(viii) To insulate the hands use a dry hempen rope, and throw a loop over the patient (Fig. 2), or a coat held by the sleeves, or a neck-tie, or a bent-handled wooden stick, or any dry article

Fig. 2—Risky method of rescue.

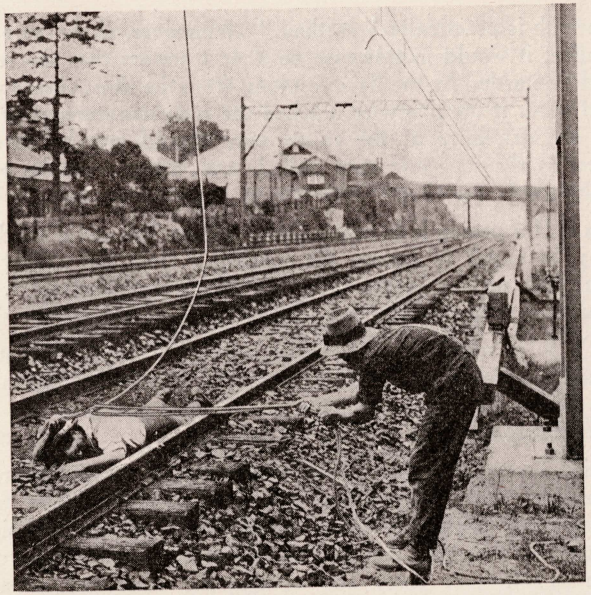

Fig. 3—Safe method of rescue.

of clothing, supplemented by rubber gloves (if available), in order to pull the victim, or that part of the body in contact with the conductor, away from contact. Be careful not to touch the sufferer's bare skin, or any part of the clothing that may be damp with perspiration, especially the arm-pits and fork of trousers, with your bare hands at any time during this procedure. At the same time stand on a dry piece of wood, or several thicknesses of dry sack, tarpaulin, or similar article, to assist in insulating feet from the ground, and take care that your feet are not liable to slip and make contact with the earth, earthed metal structures, rails or live conductor, or even concrete, which is a fair conductor of electricity. This applies also to your arms or any part of your body. These points are illustrated in Fig. 2 which shows an assumed case of a live wire having fallen on an employee, and illustrates also some risky features to be avoided when attempting rescue. It will be noted that, should the patient be freed by means of the rope provided, the probabilities are that either the patient or the wire would come in contact with the rescuer, probably leading to a second patient. Also, the rescuer has his feet, although standing on a wooden log, too close to the

rail, which is practically "earthed." Moreover, if the wire were still alive, it would in this case be almost certain that the rescuer would be startled by the flash resulting from the short-circuit which would occur if the live wire touched the rail; therefore, if practicable, the extremity of the fallen wire should first be carefully lassoed by the rope and then *pulled*, taut, *away from* the patient and the tracks (see Fig. 3).

(ix) If a person is in contact with a loose live metal conductor it may be easier to remove the conductor from the patient than to pull the sufferer away from the conductor; that is, remove the sufferer or the conductor, whichever seems easier or quicker.

(x) It is important to release contact between patient and conductor quickly, if possible, and the greatest care must be taken not to let the patient receive a second shock, as the latter will certainly increase the risk of fatality.

(xi) To remove a loose metal conductor, stand on dry ground, if possible, and with rubber gloves, if available, pass a dry hempen rope, preferably twice, round the conductor. This can be done by fastening one end of the rope to some fixed object (such as a rail or post) and running the other end, at a safe distance (say, six feet or more), in a circle twice round the point at which it is desired to make it fast to the metallic conductor (Fig. 4). Grasp the two ends of the rope firmly (Fig. 3). Having adjusted the position of the rope on the conductor, and to have the best effect, give it a sharp jerk in order to remove it from contact with the patient, but in such a way that it is not drawn on to the rescuer.

(b) Avoid Dampness.

In the preceding clauses it is to be noted that stress is laid on the fact that dampness should be avoided on any material being used as an insulator. This is because water is ordinarily an electrical conductor, and consequently any material which tends to prevent the passage of an electric current when dry can no longer be regarded as an insulating material when wet.

(c) Rescue in Wet Weather.

(i) If it is raining at the time of rescue so that it is impracticable to keep dry the protecting material for hands and feet, the wisest course to adopt is to have the current switched off as described in Instruction 806—a (ii, iii, iv and v).

(ii) If a dry manilla or hempen rope is available, this could be used, even in wet weather, if kept reasonably dry until it is about to be used, provided the rescue operation is performed very quickly, and the distance along the rope between the hands of the rescuer holding the rope and the patient (or live metallic conductor), is not allowed to be less than, say, twelve feet, provided also that the rescuer is standing on dry ground or material.

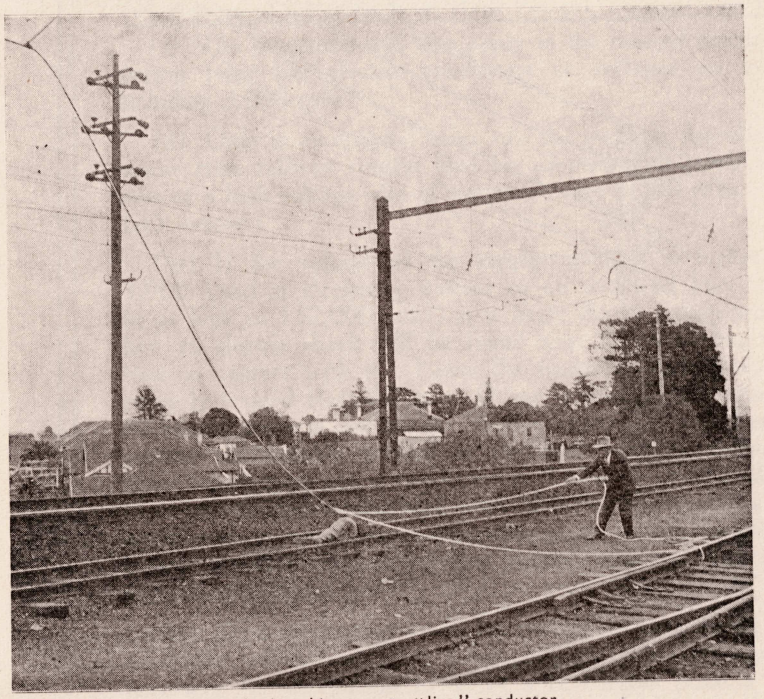

Fig. 4—Attaching rope to "live" conductor.

(d) Patient in a Position Difficult of Rescue.

(i) At the time of the occurrence the patient may be some distance from the ground, so that it is not practicable to separate him from the metal conductor while it is alive. In this case, first make sure if at all possible that the patient is secure from falling seriously, either by securing him with hempen

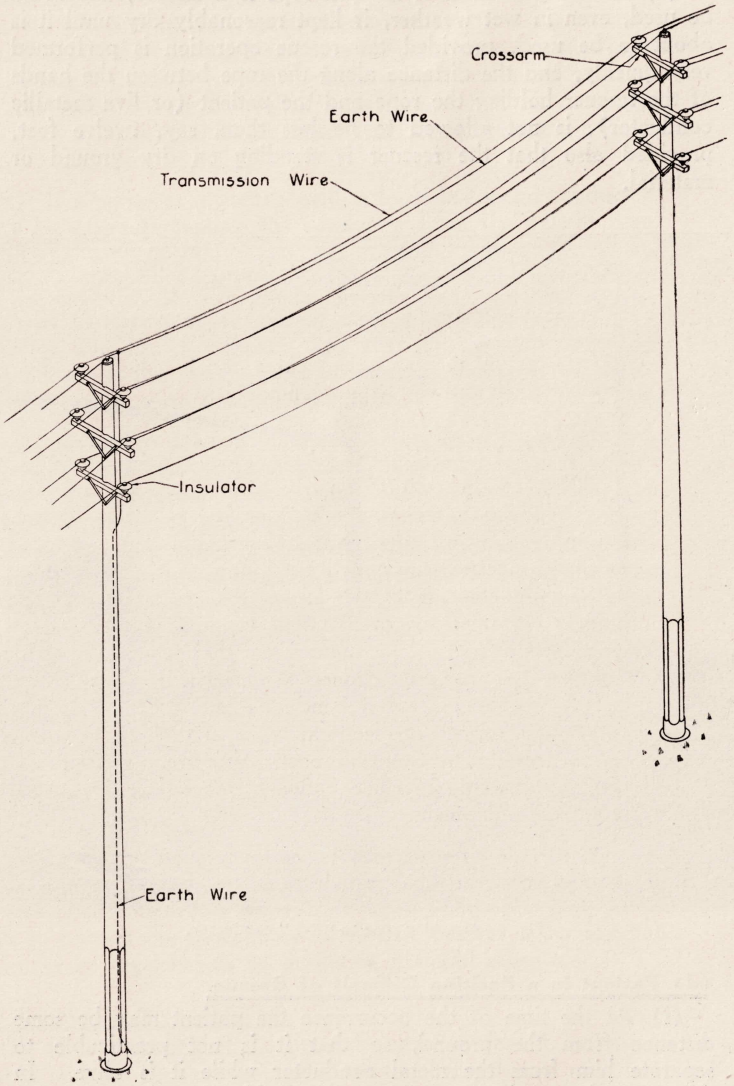

Fig. 5.

rope, or by providing a means to break the fall, and then proceed as described in Instruction 806—a (ii—v) to have the current switched off.

(ii) Cases have occurred where due precaution has not been taken to secure the sufferer before switching off the current, so that when the conductor was deadened the sufferer has suddenly relaxed and fallen, with fatal results.

(e) Rescue of a Person from High Voltage Transmission Lines.

(i) The procedure will also apply in the case of rescue of a person from live electric conductors at voltages up to and including 3,000 volts.

(ii) Only in exceptional cases can the methods described for rescue from railway contact lines be adopted with safety in the case of a high voltage wire at a pressure over 3,000 volts. (See (iv) below.)

(iii) If the voltage of the supply involved is higher than 3,000 (and in electricity stations or on overhead lines it may be as high as 132,000 volts) it is likely that a person who has had an electric shock will be found near the conductor rather than in contact with it. Leave the rescue in such cases to a properly trained electrical man, if one is immediately available. Although there is no danger if the current is switched off, anyone not suitably trained in electrical work is unlikely to know whether or not a conductor is " alive." In the absence of anyone trained in electrical work, if the circumstances warrant an attempt at rescue, approach with great caution keeping the greatest possible distance between yourself and any part of the electrical equipment.

(iv) Or a person may be on the ground in contact with a live conductor which has fallen down, in which case it would be necessary for the patient to be in a favourable position to be lassoed with, say, a dry hempen rope at a minimum distance between the patient and rescuer of, say, twenty feet.

(v) In general it will be necessary to have the current switched off from the live conductor in these cases before attempting to remove the patient.

(vi) Fig. 5, shows the typical appearance of a high-voltage overhead transmission line of this character.

The only parts normally " alive " are the transmission wires themselves. These wires rest on the porcelain insulators which insulate them from the earth. The crossarms and poles when dry also assist in this insulation, but if wet no reliance can be placed on the insulation afforded by the poles or crossarms.

It is to be noted, however, that many departmental high voltage transmission lines are provided with an " earth wire " strung from pole to pole and attached to the tops thereof, generally by means of insulators. At approximately every fourth pole a branch of this " earth wire " is carried down the pole to a pipe driven into the ground in order to connect the " earth wire " with the earth—this provision is a protection against lightning. If such an earth wire breaks, however, it should be treated as " alive " by other than trained members of the electrical staff, as it may come into contact with the other overhead wires.

807.—OBTAINING ASSISTANCE.

(i) If any employee is available to convey messages, and is no longer of vital assistance at the scene of the accident, send him immediately to telephone the Electrical Trouble Officer, Auto. X 3991 (Instruction 808), with a request that a doctor or motor ambulance, or both are required. The Electrical Trouble Officer should be notified of the nature of the accident and the location where medical attention is required.

(ii) Arrangements have been made for Electrical Trouble Officers to deal promptly with such cases.

(iii) Should difficulty be experienced in communicating with the Electrical Trouble Officer, call the Central Ambulance Brigade, telephone Railway Auto. X 3271 or Public Telephone M 6131.

808.—LOCATION AND USE OF TELEPHONES ON RAILWAY LINES FOR URGENT CALLS IN EMERGENCIES.

(i) On a number of automatic signal posts is attached a telephone connected to the nearest signal-box. The signalman there will transmit any message to the Electrical Trouble Officer. This also applies to telephones adjacent to signal locations on the underground sections of the City Railway.

(ii) Telephones are located at all signal-boxes and stations by means of which, on calling Railway Auto X 3991, communication may be obtained with the Electrical Trouble Officer.

(iii) A portable telephone may be plugged into one of the sockets, painted aluminium, which are attached to the troughing near every alternate steel structure supporting the overhead equipment, or located near high tension transmission line poles where there is no troughing. This telephone system connects with adjacent sub-stations on each side.

(iv) In the underground sections of the City Railway at stations and midway between stations is a telephone painted red connected to adjacent sub-stations.

(v) *Use of Telephone.*—When using a telephone to give information concerning an accident of the above nature or otherwise, the natural tendency is to be excited and shout some message that is difficult to understand. To save time adopt the following procedure:—Speak calmly and clearly. Do not shout. Give your name and grade. Then give your message in a few simple words, stating the nature of the accident, the stations between which the accident has taken place, and if necessary, ask for the current to be switched off the lines affected, and for assistance if required.

809. TREATMENT OF PATIENT AFTER RESCUE FROM LIVE ELECTRICAL CONDUCTOR.

(a) General Remarks.

(i) In cases of electric shock the patient is usually unconscious and the act of breathing is wholly or partially suspended. In addition electric shock, particularly at the higher voltages, is often accompanied by burns which may be very severe.

(ii) TREATMENT IN ALL CASES OF ELECTRIC SHOCK.

(*a*) Unless the patient is breathing normally immediately commence artificial respiration.

(*b*) Treat any burns after breathing is restored.

(b) Artificial Respiration.

SCHAFER'S METHOD.

(i) *Adjust the Patient's Position.*—At once lay the patient in a prone position (i.e., face downwards) with his arms above his head and the palms of his hands on the ground. Turn his head to one side to keep his nose and mouth away from the ground. Do not waste time in loosening clothing. A pad under the patient is not required nor need his tongue be drawn out.

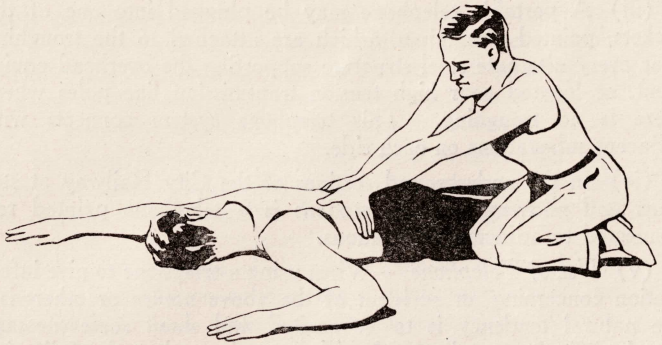

Fig. 6—Artificial Respiration (*Schafer's Method*).

(ii) *Turning the Patient.*—Should the patient be lying on his back, turn him to the prone position as follows:—

(*a*) Stoop at his side.

(*b*) Place his arms close to his body.

(*c*) Cross his far leg over his near leg.

(*d*) Protect his face with one of your hands.

(*e*) Grasp his clothing at the hip on the opposite side of the body and quickly and gently turn him over.

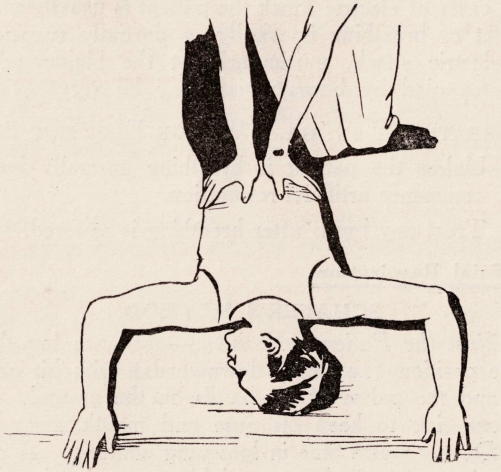

Fig 7—Artificial Respiration (*Schafer's Method*).

(iii) *Position of Operator.*

(*a*) Face the patient's head.

(*b*) Kneel on both knees in a position just below his hip-joint (Fig. 6).

(*c*) Sit back on your heels at the patient's side in a position to allow free sway.

(*d*) Place your hands on the loins of the patient, one on each side of the backbone with wrists almost touching, with thumbs as far forward as possible without strain, and the fingers close together at the side of the loins and bent over the flanks in the natural hollows just above the brim of the pelvis but clear of it, the tips of the fingers pointing to the ground (Fig. 7).

(*e*) Keep your elbows quite straight.

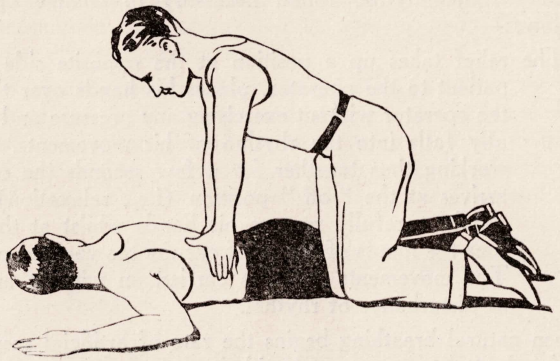

Fig. 8—Artificial Respiration (*Schafer's Method*).

(iv) *Application of Artificial Respiration.*

Movement 1.

Without bending your elbows, swing slowly forward by unbending the knees until the thighs are in an almost upright position and the shoulders vertically above the hands, so allowing the weight of your body to be communicated to the patient's loins (Fig. 8).

This causes the patient's abdominal organs to be compressed against the ground and up against the diaphragm.

Air is thus forced out of the lungs, i.e., *expiration* takes place.

The compression in movement 1 is to be effected solely by the weight of the operator's body and not by muscular effort.

Movement 2.

Swing slowly back on to your heels thus relaxing the pressure.

This causes the abdominal organs to fall back and the diaphragm to drop, thus inducing *inspiration.*

Rhythm.

The two movements, which must be carried out smoothly and rhythmically, should take five seconds (i.e., 12 times a minute), two seconds being occupied by movement 1 and three seconds by movement 2.

Changing Operators.

It may frequently be found necessary to change operators as follows:—

The relief takes up a position at the opposite side of the patient to the operator, places his hands over those of the operator without exercising any pressure and gradually falls into the rhythm of his movements. After working thus together for a few seconds the operator arrives at the "off" position (i.e., relaxation). He should carefully remove his hands whilst at the same time the hands of the relief occupy the vacated position. The movements are thus carried on without any jerk or disturbance of rhythm.

When natural breathing begins the rate of artificial respiration must be adapted to correspond with it.

(v) *Artificial respiration must be continued perseveringly until natural breathing is restored, unless a doctor decides that further efforts will be of no avail.*

(c) Treatment After Return of Natural Breathing:—

When natural breathing begins promote circulation by rubbing the limbs vigorously towards the heart and by applying warmth.

Promote warmth and circulation by wrapping the patient in dry blankets or other covering, and by hot flannels, hot water bottles, or hot bricks (wrapped in flannel) applied to the feet, to the limbs and body. When the power of swallowing has returned, give hot tea, coffee, or meat extract. The patient

should be kept in bed and encouraged to go to sleep. Large poultices or fomentations applied to the front and back of the chest will serve to assist breathing.

Watch the patient carefully for some time to see that the breathing does not fail; if it does, at once resort again to artificial respiration.

The patient must be cautioned not to resume physical or mental activity without the consent of a doctor however slight the shock may have been.

(d) Treatment of Burns or Scalds.

(i) The effects of a burn or scald are the same. There may be reddening of the skin or blister formation or destruction of the skin or destruction of the deeper tissues.

There is great danger from shock (which is increased by the intense pain and aggravated by loss of body fluid), and from septic infection of the wound.

The areas of most burns and scalds, including the clothing involved, are to all intents and purposes sterile for a short period, and every effort should be made to keep them so until medical aid is available. Prepared sterile dressings should always be used and great care must be taken in their handling and application.

(ii) General Rules for Treatment of Burns and Scalds.

(a) *When Medical Aid is Readily Available—*

1. Do not remove clothing and do not break blisters.
2. Cover the area (clothing included) with prepared sterile dressings.
3. Apply a pad of cotton wool.
4. Bandage firmly except when blisters are present or suspected, in which case bandage lightly.
5. Wrap the patient in blankets to keep him warm.
6. In severe cases immobilise the affected area by the application of slings, bandages or splints.
7. Give large quantities of warm fluids, preferably weak tea sweetened with sugar.

(*b*) *When Medical Aid is Not Readily Available.*

1. Do not remove clothing and do not break blisters.
2. Saturate the area, clothing included, with warm alkaline solution (two teaspoonfuls of baking soda (bicarbonate of soda) to one pint of sterile water at body temperature) or warm saline solution (one teaspoonful of common salt to one pint of sterile water at body temperature).

   This treatment will relieve pain and thereby minimise shock.
3. Cover the area with prepared sterile dressings soaked in a similar solution and keep them moist with the solution.

   If the above solutions are not available, cover the area with prepared sterile dressings.
4. Apply a pad of cotton wool.
5. Bandage firmly in position, unless blisters are present or suspected, in which case bandage lightly.
6. Wrap the patient in blankets to keep him warm.
7. In severe cases immobilise the affected area by the application of slings, bandages or splints.
8. Give large quantities of warm fluids, preferably weak tea sweetened with sugar.

(*c*) *If Prepared Materials are Not Available.*

Immediately cover the area so as to exclude air.

(e) Note carefully.

SHOCK to be given PROMPT ATTENTION.

Do NOT BREAK BLISTERS.

SMOOTH side of LINT DRESSING to be placed on BURN or SCALD.

Special CARE to be exercised that COTTON WOOL is NOT placed DIRECTLY on the BURN or SCALD.

Revised and re-issued March, 1952.

Department of Railways, New South Wales.

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Station or Depot.

Received copy of revised instructions—" Rescue and Resuscitation in case of " Electric Shock," dated March, 1952.

.....Signature.

To..... .....*Date.*

(Please fill in this form, detach it and send it to your issuing officer at the earliest possible date.)

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