SECTION L-4 PART A
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EQUIPMENT

VOLUME 2

WORKSHOP INSTRUCTIONS

MOTOR CYCLE BATTERIES

MODELS LVW5E, PUW7E, PUZ7E, RUW7E, RUZ7E, GUWIIE and GUZIIE

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BATTERIES

MODELS LVW5E, PUW7E, PUZ7E, RUW7E, RUZ7E, GUW11E AND GUZ11E

1. GENERAL

The motor-cycle range of batteries consists of three basic sizes. All models are encased in 'Milam' (moulded-in-Lucas-acid-resisting-material) containers and fitted with robustly constructed terminals of non-corrosive alloy. Brief descriptions of current models are tabulated below:—

LVW5E	Small capacity battery for lightweight machines.
PUW7E	Standard motor-cycle battery for cradle mounting.
PUZ7E	As above but 'dry-charged' for Export.
RUW7E	Similar to standard battery but with special rubber mounting.
RUZ7E	As above but 'dry-charged' for Export.
GUW11E	Larger capacity battery for sidecar machines.
GUZ11E	As above but 'dry-charged' for Export.

'Dry-charged' batteries do not require initial charging, but are prepared for service as described in para. 6. Except that porous rubber separators are fitted, these batteries are identical with batteries supplied wet or uncharged and require the same routine maintenance when in service.

A battery must never be left for long periods without attention. If it is to be out of service for any length of time, it should receive a refreshing charge once a fortnight to prevent deterioration of the plates.

N.B.—When examining a battery never use a naked light. The mixture of oxygen and hydrogen given off by a battery on charge, and to a lesser extent when standing idle, can be dangerously explosive.

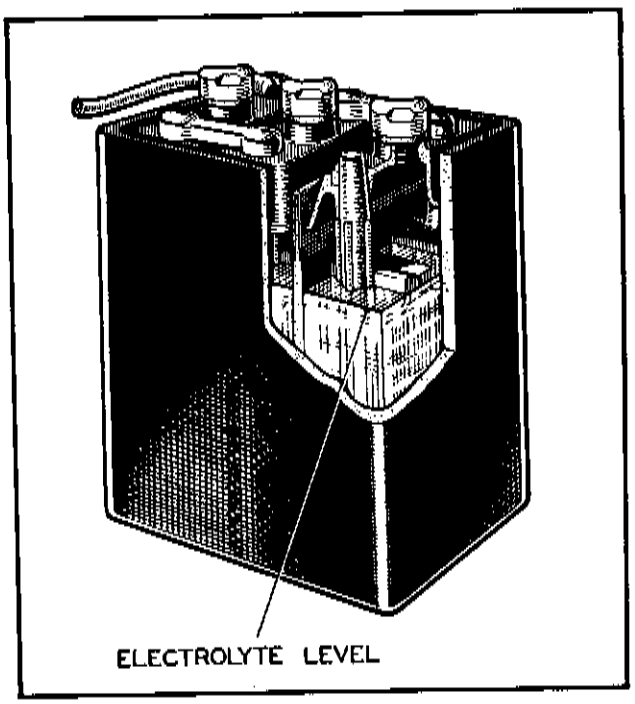

Fig. 1.
Model PUW7E Battery

2. ROUTINE MAINTENANCE

Every 1,000 miles, or monthly, or more frequently in hot climates.

(a) CLEANING.

Remove the battery cover and clean the battery top. Examine the terminals. If they are corroded, scrape them clean and coat with petroleum jelly.

Remove the vent plugs and check that the vent holes are clear and that the rubber washer fitted under each plug is in good condition.

(b) TOPPING UP

Examine the level of the electrolyte in each cell. In the case of model LVW5E, this examination should be made weekly. If necessary, add distilled water to bring the level up to the tops of the separators. The use of a Lucas motor-cycle Battery Filler will be found helpful in this topping-up process, as it will ensure that the correct electrolyte level is automatically attained and will prevent spilling of distilled water over the battery top.

If a battery requires topping-up too frequently, the voltage regulator may be out of adjustment, i.e. set too high, and should be checked (see SECTION L-3, para. 3). Conversely, a persistently low state of charge may be due to a regulator being set too low.

If one cell in particular needs topping-up more than another, it is likely the container is cracked, in which event the battery must be replaced and arrangements made to clean up the battery carrier, using a solution of ammonia or bi-carbonate of soda in water. After cleaning and drying, paint the battery carrier and other surfaces affected by the electrolyte with anti-sulphuric paint.

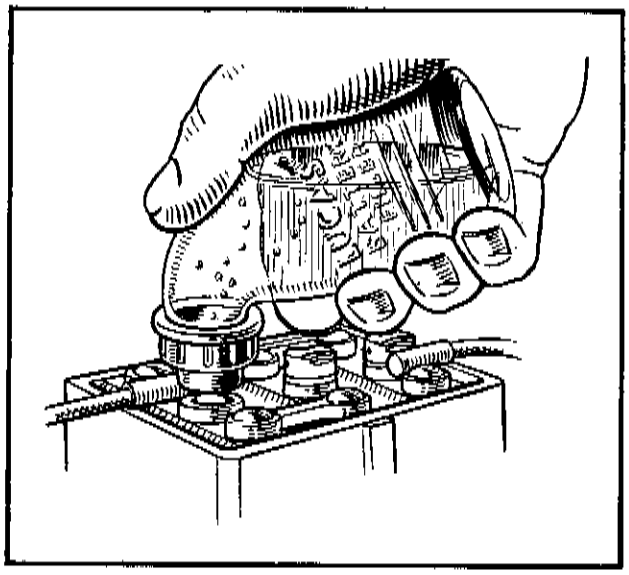

Fig. 2.
Topping up with the aid of a Lucas Battery Filler

3. TABLES OF SPECIFIC GRAVITIES AND CHARGING RATES

(a) BATTERY CAPACITIES AND CHARGING RATES

Battery Model	Plates in each cell.	Ampere hour capacity: at 10 hour rate	Ampere hour capacity: at 20 hour rate	Approx. volume of electrolyte required to fill one cell.	Initial Charging Current (Amps.)	Normal Recharge Current (Amps.)
LVW5E	5	5	6	⅛ pint	0.3	0.5
PUW7E, PUZ7E, RUW7E, RUZ7E	7	12	14	⅕ "	0.8	1.5
GUW11E, GUZ11E	11	20	23	⅓ "	1.3	2.2

(b) SPECIFIC GRAVITY OF ELECTROLYTE FOR FILLING UNCHARGED BATTERIES

Home trade and climates normally below 80°F. (27°C).		Sub-tropical climates, 80°–100°F. (27°–38°C.)		Tropical climates, over 100°F. (38°C.)	
Filling	Fully Charged	Filling	Fully Charged	Filling	Fully Charged
1.270	1.280—1.300	1.245	1.250—1.270	1.220	1.220—1.240

(c) SPECIFIC GRAVITY OF ELECTROLYTE FOR FILLING "DRY-CHARGED" BATTERIES

Temperature of battery and surroundings not normally rising above 90°F. (32°C.)		Temperature of battery and surroundings frequently in excess of 90°F. (32°C.)	
Filling	Fully Charged	Filling	Fully Charged
1.275	1.280—1.300	1.215	1.220—1.240

(d) MAXIMUM PERMISSIBLE ELECTROLYTE TEMPERATURE DURING CHARGE

Climates normally below 80°F. (27°C.)	Climates between 80°–100°F. (27°–38°C.)	Climates frequently above 100°F. (38°C.)
100°F. (38°C.)	110°F. (43°C.)	120°F. (49°C.)

(e) The specific gravity of the electrolyte varies with the temperature. For convenience in comparing specific gravities, they are always corrected to 60°F., which is adopted as a reference temperature. The method of correction is as follows :

For every 5°F. **below** 60°F., **deduct** .002 from the observed reading to obtain the true specific gravity at 60°F. For every 5°F. **above** 60°F., **add** .002 to the observed reading to obtain the true specific gravity at 60°F.

The temperature must be that indicated by a thermometer having its bulb actually immersed in the electrolyte, and not the ambient temperature.

4. SERVICING

(a) BATTERY PERSISTS IN LOW STATE OF CHARGE. First consider the conditions under which the battery is used. If the battery is subjected to continuous discharge, e.g., long periods of night parking with lights on without suitable opportunities for re-charging, a low state of charge is inevitable.

A fault in the dynamo or regulator, or neglect during a period out of commission, may also be responsible.

VENT PLUGS

See that the ventilating holes in each vent plug are clear, and that the rubber washer fitted under the plug is in good condition.

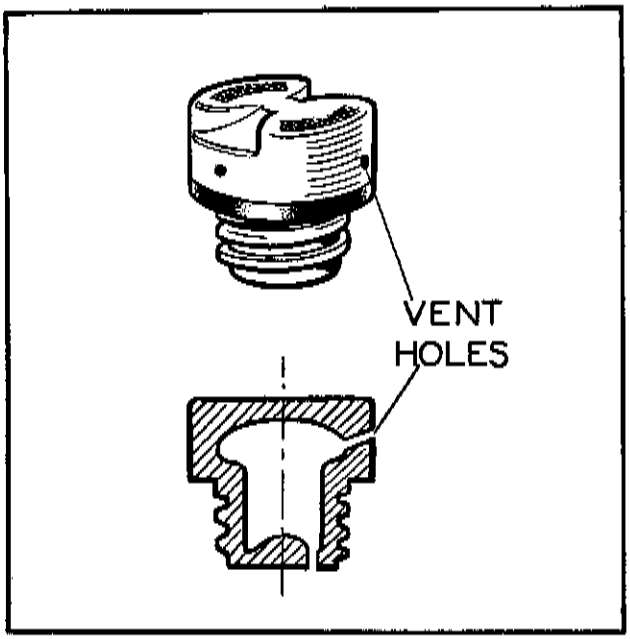

Fig. 3.
Vent Plug details

LEVEL OF ELECTROLYTE

The surface of the electrolyte should be level with the tops of the separators. If necessary, top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

CLEANLINESS

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Check that the battery connections are clean and tight.

HYDROMETER TESTS

The space between each separator is not wide enough to permit the nozzle of an hydrometer to be inserted. Before taking a sample, tilt the battery to bring sufficient electrolyte above the separators. If the level of the electrolyte is so low that an hydrometer reading cannot be taken, no attempt should be made to take a reading after adding distilled water until the battery has been on charge for at least 30 minutes.

Measure the specific gravity of the acid in each cell in turn. The reading given by each cell should be approximately the same; if one cell differs appreciably from the others, an internal fault in that cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives a useful indication of the state of the plates : if it is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

DISCHARGE TEST

Motor-cycle batteries must **not** be subjected to the heavy discharge test, as recommended for motor-car and commercial vehicle batteries.

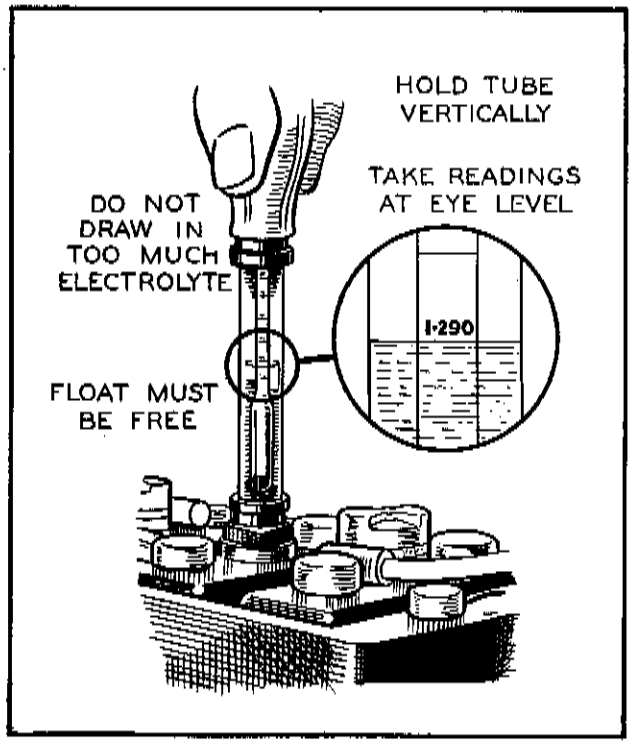

Fig. 4.
Taking hydrometer readings

(b) RECHARGING FROM AN EXTERNAL SUPPLY

If the hydrometer test indicates that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the motorcycle by a period of daytime running, or on the bench from an external supply.

If the latter, the battery should be charged at the rate given in Para. 3 (a) until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the tops of the separators by the addition of distilled water.

A battery that shows a general falling-off in efficiency, common to all cells, will often respond to the process known as "cycling". This process consists of fully charging the battery by passing through it from an external source the appropriate re-charge current given in Para. 3 (a). The battery is then discharged by connecting to a lamp board, or other load, taking a current equal to the normal re-charge current. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the 'cycle' of charge and discharge.

5. PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE

(a) PREPARATION OF ELECTROLYTE :

Batteries should not be filled with acid until required for initial charging. Electrolyte of the specific gravity given in Para. 3(b) is prepared by mixing distilled water and concentrated sulphuric acid of 1.835 S.G. The mixing must be carried out either in a lead-lined tank or in suitable glass or earthenware vessels. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportions of acid and water are indicated in the following table:

To obtain Specific Gravity (corrected to 60°F.) of :	Add 1 vol. of acid of 1.835 S.G. (corrected to 60°F.) to :
1.270	2.8 volumes of water
1.245	3.2 " " "
1.220	3.7 " " "

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature, and a correction applied to the reading as described in Para. 3(e) — and before pouring the electrolyte into the battery.

The total volume of electrolyte required can be estimated from the figures quoted in Para. 3(a).

(b) FILLING THE BATTERY

The temperature of the acid, battery and filling-in room must not be below 32°F.

Carefully break the seals in the filling holes and fill each cell with electrolyte of the appropriate specific gravity to the top of the separators. Allow to stand for twelve hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators, and then, if necessary, add more acid of the same specific gravity as before, to restore levels to the tops of the separators.

(c) INITIAL CHARGE

The initial charging rate is given in Para. 3(a). Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 40 to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit, or the generator output. **This charge should not be broken by long rest periods.** If, however, the temperature of any cell rises above the permissible maximum quoted in Para. 3(d), the charge must be interrupted until the temperature has fallen at least 10°F. below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separators by the addition of acid solution of the same specific gravity as the original filling-in acid, until specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge, carefully check the specific gravity in each cell to ensure that, when corrected to 60°F., it lies within the specified limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so, to ensure adequate mixing of the electrolyte, and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the tops of the separators.

The acid should now be emptied and replaced by fresh acid of the appropriate fully charged specific gravity.

6. PREPARING "DRY-CHARGED" BATTERIES FOR SERVICE

"Dry-charged" batteries are supplied without electrolyte but with the plates in a charged condition. When they are required for service it is only necessary to fill each cell with sulphuric acid of the correct specific gravity. No initial charging is required.

In these batteries porous rubber is used instead of wood for the separators between the plates.

(a) PREPARATION OF ELECTROLYTE

The electrolyte is prepared by mixing together distilled water and concentrated sulphuric acid, taking the precautions as para. 5(a). The specific gravity of the filling electrolyte depends on the climate in which the battery is to be used (see para. 3c).

The approximate proportions of acid and water are indicated in the following table:—

To obtain Specific Gravity (corrected to 60°F.) of:—	Add 1 vol. of acid of 1.835 S.G. (corrected to 60°F.) to:
1.275	2.8 vols. of water
1.215	4.0 vols. of water

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before pouring it into the battery.

The total volume of electrolyte required can be estimated from the figures quoted in para. 3(a).

(b) FILLING THE BATTERY

Carefully break the seals in the cell filling holes and fill each cell with electrolyte to the top of the separators, **in one operation.** The temperature of the filling room, battery and electrolyte should be maintained between 60°F. and 100°F. If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

(c) PUTTING INTO USE

Batteries filled in this way are 90 per cent charged. If time permits, however, a freshening charge of four hours at the normal recharge rate given in para. 3(a) would be beneficial.

During the charge the electrolyte must be kept level with the top edge of the separators by the addition of distilled water. Check the specific gravity of the acid at the end of the charge; if 1.275 acid was used to fill the battery, the specific gravity should now be between 1.280 and 1.300; if 1.215, between 1.220 and 1.240.

(d) MAINTENANCE IN SERVICE

After filling, a dry-charged battery needs only the attention recommended in para. 2.

7. NOTES ON CHARGING

Battery charging should be carried out in a cool, well-ventilated room, preferably provided with an insulated floor covering to protect the operators from shock. The charging benches should be covered with non-conducting material such as slate, glass or earthenware, and, together with the remainder of the plant, batteries and connecting cables, should be kept as clean and dry as is practicable.

Batteries on charge should have a space of at least one inch around them. Vent plugs should be completely unscrewed and left loosely in the vent holes.

When calculating the number of batteries that may be charged in series by a given plant, allow 9 volts, at the appropriate charging rate, for each 6 volt battery. If batteries of different capacities are to be charged in series, the charging rate must be that of the **lowest** capacity battery. All the connections between batteries, and between the bank and the supply lines, must be tight and make good electrical contact, to obviate the risk of a spark. For the same reason the charging circuit must always be broken at the main switch before removing batteries from the bank.

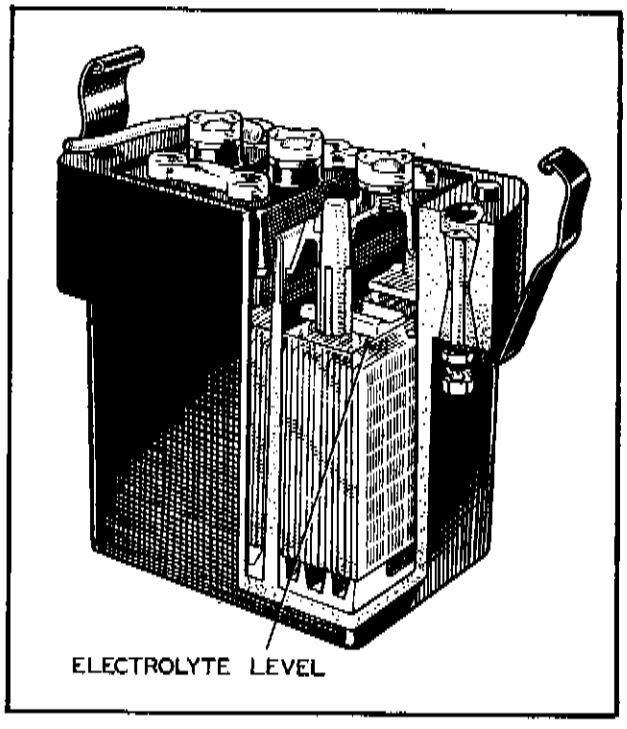

Fig. 5.
Model RUW7E Battery

8. STORAGE OF BATTERIES

(a) UNFILLED BATTERIES

Batteries received dry should be filled and charged within one year of the date of manufacture.

Battery store-rooms must be dry, and the store temperature maintained between 32°F. and 90°F. If stored in the open, batteries must be protected against direct sun-light, dirt and damp. They should be stored the correct way up—at no time should the batteries be stored on their sides.

When in storage, motor cycle batteries should never be stacked or have other articles placed on top of them.

(b) FILLED BATTERIES

Batteries must be fully charged before storing. In temperate climates they should be examined fortnightly, or weekly in the case of model LVW5E and all models when stored in the tropics. If necessary, give them a short refreshing charge.

After a long period of storage, the condition of the battery will often be improved if it is put through a "cycle", as described in para. 4 (b).