

Kymograph Instruction Manual

INITIAL SETTING UP OF APPARATUS

Before connecting any equipment to the mains supply, ascertain that the units are of the correct voltage and frequency.

For operation on 230 volt 50Hz, the mains lead is colour coded as follows:

BROWN – LIVE BLUE – NEUTRAL GREEN/YELLOW – EARTH

If a fused type mains connector or plug top is used, the fuse rating should not exceed 2 amps. The rating of the fuse at the rear of the unit is 1 amp.

For operation 115 volts 60Hz, the mains lead is colour coded as follows, and is fitted with a flat-pin connector:

BLACK – LIVE WHITE – NEUTRAL GREEN – EARTH

The rating of the fuse at the rear of the unit is 2 amps.

The efficiency of the mains earthing system is most important for the satisfactory operation of this equipment. Place the Kymograph on the bench, study and observe the various controls and switches, and note that the mains on and off switch is at the rear of the unit with the fuseholder. A mains power indicator lamp is on the front panel. Check that the mains switch is OFF, the ONE REV button is pulled out, the STIMULATOR voltage dial is set to zero, and that the SPEED SELECTOR is set to a neutral position between 1.0 and 10.

Clamp the muscle trough, (or myograph board) onto the vertical rod of the adjustable upright, place the electrode assembly on to the front edge of the trough and the combination lever assembly on the back edge. Arrange these items, which it will be noticed are fully adjustable, as shown in the diagram. Check that the drain plug is firmly in position.

SECURING A CHART PAPER TO THE CYLINDER

To fix a chart to the recording cylinder, first remove the cylinder by moving the locking lever towards the main spindle and lifting clear. With the open, or lever end of the cylinder to your right-hand side, wrap one of the printed recording charts around the cylinder, keeping the bottom edge of the chart (where the name is printed) against the flange. This will ensure that the paper is square and that the pen stylus will not be caught up by the lap or join edge of the chart. Moisten the gummed edge and

stick tightly down. Replace the cylinder on the spindle and set the height so that the bottom edge is approximately 75mm above the top of the case, then lock it in this position by moving the locking lever away from the main spindle. It will be found advantageous to set the join edge of the chart slightly in advance of the leading fixed contact striker.

The printed charts are provided with both vertical and horizontal rulings. The vertical rulings are time-base markings and are related to the various peripheral speeds of the writing cylinder. For example, if the MULTIPLIER dial is set to 62.5 and the SPEED SELECTOR to 10, (625mm per sec) the vertical rulings on the chart represent 1/100th sec. This is an appropriate speed for muscle twitch recording. Other easily set useful speeds and time-bases are as follows: **(using the formula Time base (seconds) = 6.25 ÷ chosen speed (mm/sec))**

REG SPEED IN mm per sec	SET MULTIPLIER TO	SET SPEED SELECTOR TO	TIME BASE ON CHART
625	62.5	10	.01 sec
25	25	1.0	.25 secs
2.5	25	0.1	2.5 secs
.25	25	.01	25 secs
.05	5	.01	125 secs

The horizontal rulings are provided for the ascertaining heights of trace and these are spaced at 5 and 10mm apart.

A typical gastronemius muscle twitch is shown to illustrate these points.

PEN FILLING

Remove the pen lever fitting by pulling apart very carefully at the junction of the two small forks. Remove the fine stylus cleaning wire. Using the filler provided, take up a small amount of the special ink and place the nozzle in the open end of the pen. Hold the pen over the ink bottle and gently squeeze the filler until the ink can be seen to be flowing through the stylus of the pen. This procedure should eliminate air bubbles which could cause erratic ink flow. The pen is now ready to write, and is plugged back onto the lever assembly.

IMPORTANT. Always wash the pen after use and clear the stylus with the fine wire provided.

SQUARE WAVE STIMULATOR

FREQUENCY

The frequency of the output pulse is set by the variable control and three-position switch. In the upward position the pulses range from 10 to 100 per sec. In the middle position they range from 1 to 10 per sec, and when the switch is down they range from 1 pulse in 10 secs to 1 pulse per sec. The switch immediately below the frequency dial has three settings. REPEAT for a continued stream of pulses; SINGLE for one pulse when the pulse button is pressed; and EXTERNAL TRIGGER which, when held down for one revolution of the cylinder, enables the adjustable fingers on the top of the Kymograph to trigger one or two pulses when they break the light path of the opto-electronic device. The EXTERNAL TRIGGER position used in conjunction with the fingers is used for the simple muscle twitch and summation of contractions experiments.

Using the mains switch to stop the Kymograph could artificially stimulate the preparation. Use the neutral position on the gear selector to stop the Kymograph, and the 'pulse off' position of the mode switch on the stimulator to discontinue the output.

WIDTH

Six pulse widths are provided by means of a stepped switch, from 0.05 to 5m/sec.

VOLTAGE

Three ranges are provided by a calibrated dial and switch. Ranges with dial subdivisions:

Switch upward (1V) 0-25V. each division = 1 Volt

Switch central (0.1V) 0-2.5V. each division = 100 millivolt

Switch downwards (0.01V) 0-0.25V. each division = 10 millivolt

The negative side of the output is internally connected to mains earth to reduce external interference. Visual monitoring of the output is provided by a small lamp at the top right hand corner of the front panel.

FROG NERVE AND MUSCLE EXPERIMENTS

The preparation is fixed in the bath using the headed pin provided. Holding the knee joint with a pair of forceps, push the pin along the shaft to the femur until it emerges. The preparation is anchored by pushing the pin into the socket in the bath, the other end of the muscle being tied with thread through one of the four holes in the vertical arm lever. (It is useful to note that these holes are at 5mm centres from the pivot centre of the combination lever. This also applies to the horizontal

arm). The length of the thread to the lever should be about 5cm. Now slacken off the upright clamp screw and move the entire lever assembly away from the preparation until the writing lever is approximately horizontal. Lock the upright clamp screw. The small adjustable counterbalance weight on the lever should be removed since it is not needed for this type of experiment. Also make sure that the afterload screw is wound clear of the lever. Position the electrode assembly adjacent to the fixing pin and lay the nerve across the two electrode conductors. Raise the electrode assembly with the nerve until it is approximately level with the top edge of the bath to avoid the possibility of shorting the nerve and the electrodes with solution. Plug in the electrode leads to the output sockets of the stimulator, and set the voltage switch downward to 0.01V. Switch on the mains supply and the power indicator should light. Adjust the height of the bath so that the writing lever is about 5cm above the lower edge of the chart. The stylus of the pen should be slightly to the left hand side of the centre line of the cylinder (see diagram) and this can be achieved by adjustment of both the slotted upright and the radial position of the bath. The pen should not be in contact with the chart until the conditions described above have been achieved. Bring the pen onto the chart by swinging the bath round until the stylus is touching the paper and then effect a slight pressure loading to the stylus by moving the bath radially a further 1.5 to 2.5 cms. Make sure the switch is in the central SINGLE position. Press the SINGLE button, and no stimulation being observed, move the writing cylinder by hand about 5mm, adjust the voltage setting to the first spot above zero and again press the button. Continue in this fashion and progressively increasing contractions of the preparation will result. It will be found that any increase in voltage above a certain level will not produce a larger contraction of the muscle (maximal stimulus) and this, therefore, is the optimum voltage setting for the simple muscle twitch. It is important to moisten the preparation from time to time with 'Ringer' solution. Surplus solution can be drained into a beaker by removing the plug in the corner of the bath.

To record a simple muscle twitch, set the MULTIPLIER to 62.5 and with the Stimulator controls adjusted to provide maximal stimulus, as already described, set the cylinder in motion by turning the SPEED SELECTOR to 10. Press the SINGLE button and a contraction of the muscle should then be recorded. Return the SPEED SELECTOR to the neutral position between 1.0 and 10, since it is important that the cylinder is not allowed to run needlessly round and round drawing ink unnecessarily from the pen. The procedure described above is also used where the adjustable fingers are employed to trigger the Stimulator, except that the EXTERNAL TRIGGER switch is pressed to initiate the contractions.

The ONE REVOLUTION feature incorporated in the Kymograph can be used in conjunction with the instructions above. First, push in the STOP button, turn the SPEED SELECTOR to 10, hold down the EXTERNAL TRIGGER switch, pull out the START button and immediately push it back in again. The cylinder will make one turn and stop, and a contraction will be recorded. Release the EXTERNAL TRIGGER switch and return the SPEED SELECTOR to neutral. Make sure that the adjustable fingers are closed together, otherwise two contractions will result. If the adjustable fingers are moved 180 degrees apart two contractions will be recorded, and then by moving them gradually closer together, successive recordings will produce a 'summation of contractions'.

Note that for the measurement of the velocity of the nerve impulse, a special 'Double electrode assembly with changeover switch unit' can be supplied. Catalogue number 50-7558.

FROG HEART EXPERIMENTS

The preparation is placed in the bath, the apex of the heart is attached to the horizontal portion of the lever using the Heart Clip provided, and tying with thread through one of the holes in the lever. Unplug the straight writing lever used for the muscle work and replace it with the Frontal type, specially designed for heart work. Adjust the bath position so that the lever writes radially as shown in the diagram. The whole assembly is gently raised until the writing lever begins to move under the action of the heart. The small counterbalance weight is placed on the lever rod and its position adjusted until the optimum response is obtained. Set the pen carefully onto the chart with minimum pressure applied to effect a good trace. A Kymograph speed of 2.5mm/sec is recommended. If it is desired to remove the cylinder or replace a chart during a series of experiments, it is advisable to unplug the writing lever from the fork fitting, rather than move the bath as a whole. This will maintain the initial setting of the stylus pressure throughout the experiment.

A small piece of cork is provided if it is preferred to pin down the preparation and since the cork plate is not secured in the bath, it may easily be removed if not required.

A small cork block is also provided which is pushed into the end of the bath in a vertical position and is intended for use with the locust tibia extensor (Levator) muscle preparation.

PLEASE NOTE that on no account should any attempt be made to 'smoke' a paper on the special plastic cylinder. Metal cylinders can be supplied for making tracings, using the smoked paper method if required.

If, having selected one of the slower cylinder speeds, the Kymograph appears not to be working, it is probably due to 'take-up' in the gear train, which is inherent in this type of mechanism. This can be very quickly corrected by simply moving the writing cylinder very slightly in an anti-clockwise direction when a slight resistance will be felt. The cylinder will immediately start rotating as a result of this.

For work calculations the following lever dimensions are maintained:

Fulcrum to stylus point :	200 mm
Fulcrum to weight hook :	20 mm
Fulcrum to tying holes :	5 mm

Tying holes are at 5 mm pitch.

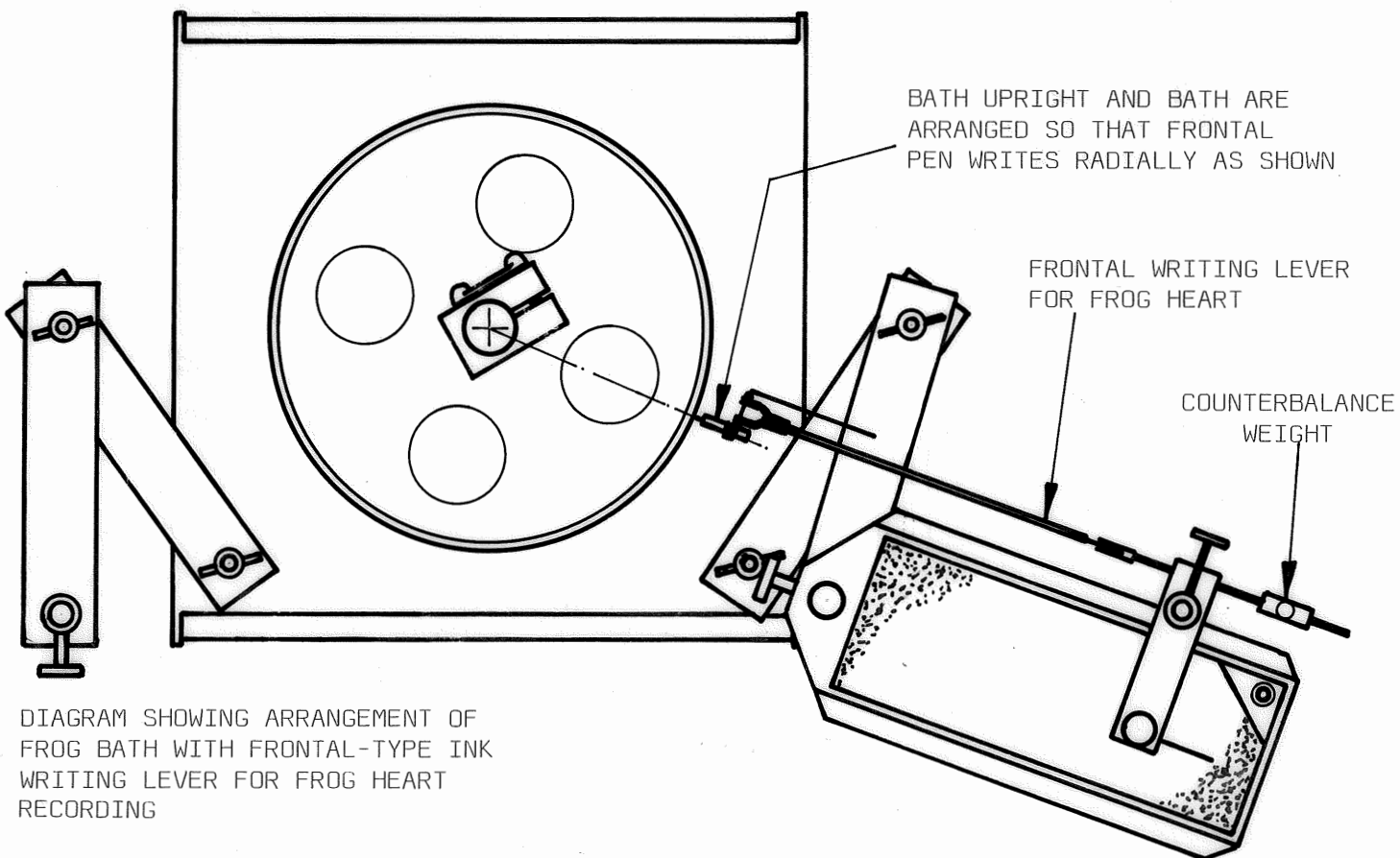
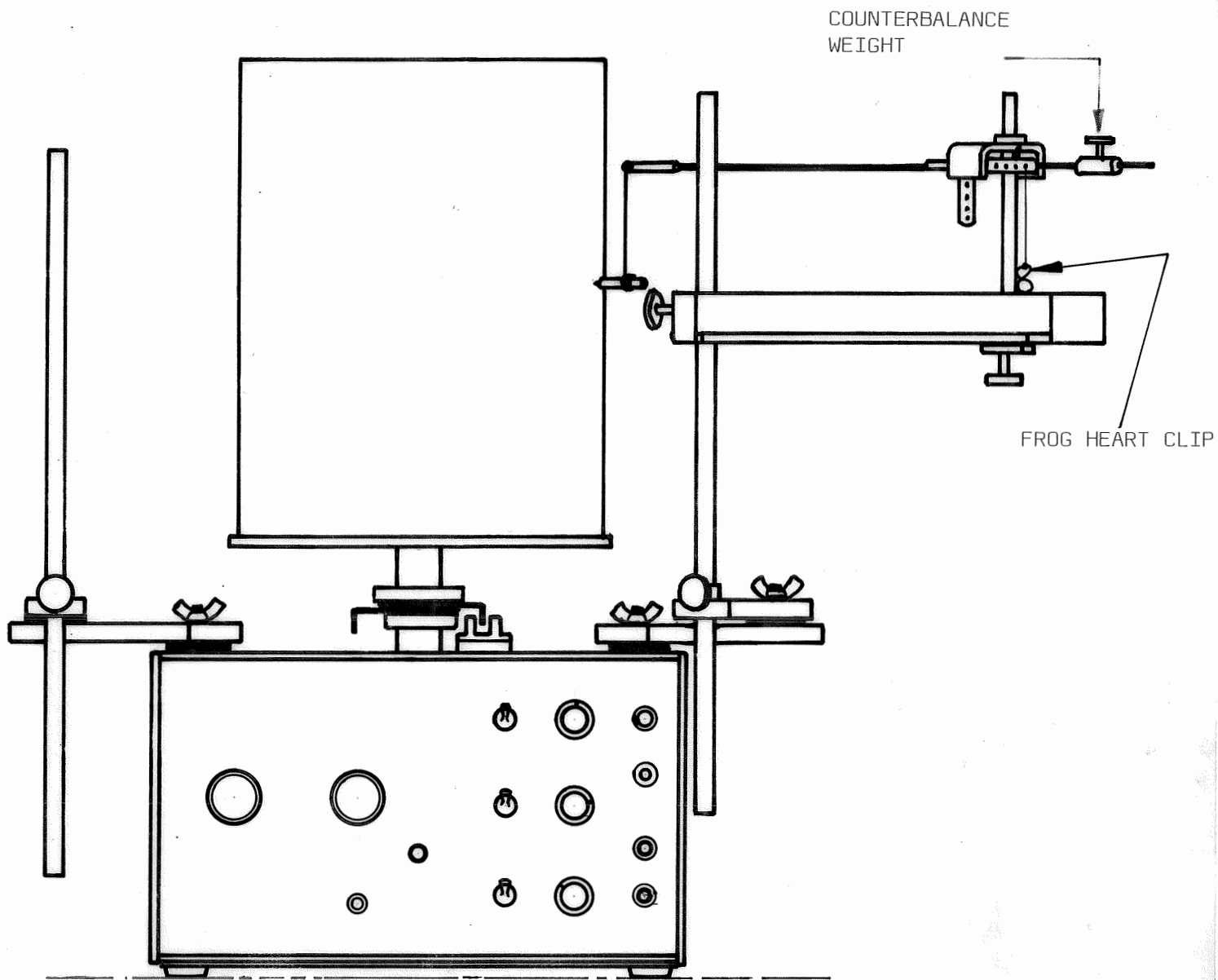
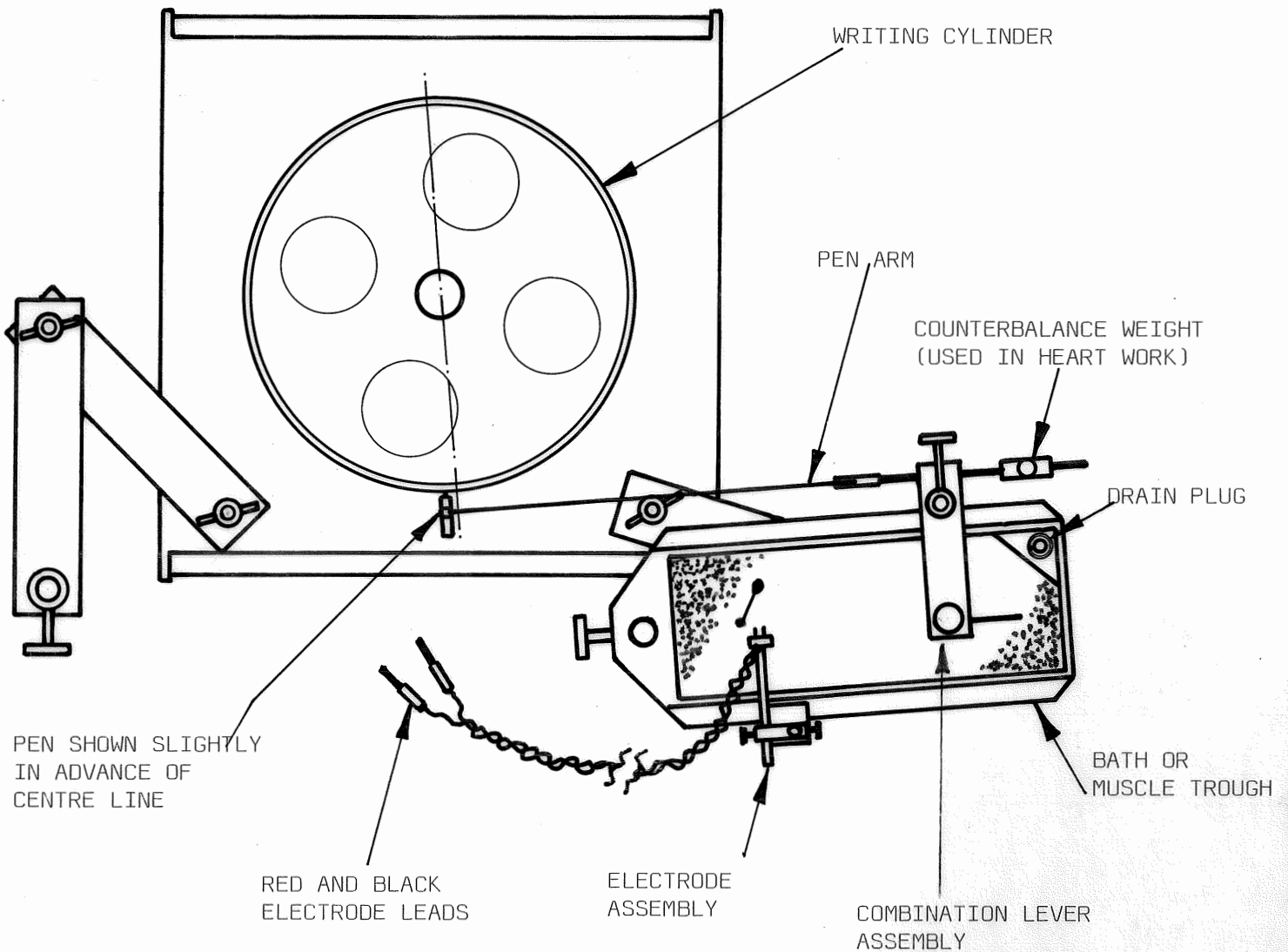
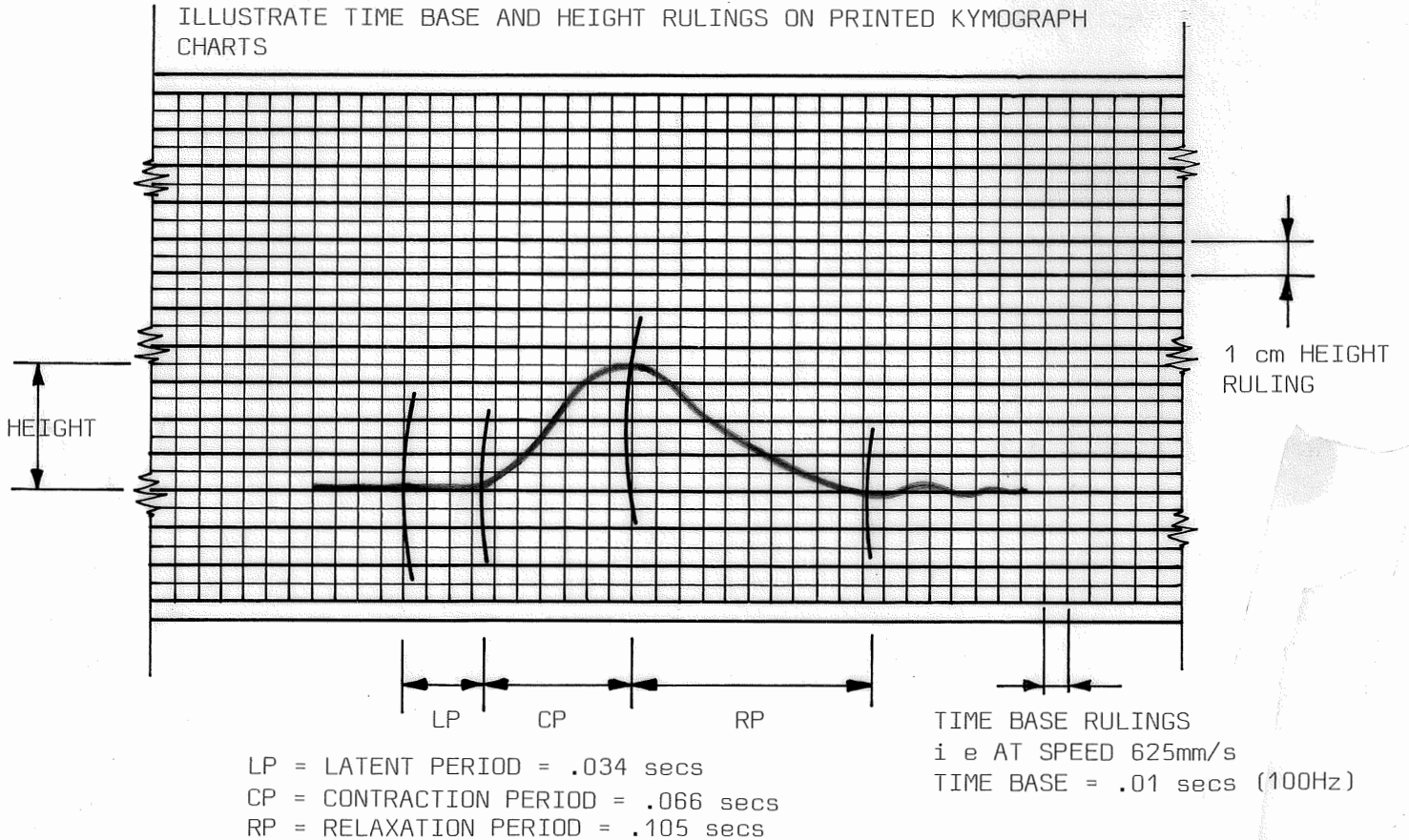


DIAGRAM SHOWING ARRANGEMENT OF FROG BATH WITH FRONTAL-TYPE INK WRITING LEVER FOR FROG HEART RECORDING



FACSIMILE OF TRACING SHOWING FROG NERVE/MUSCLE PREPARATION TO ILLUSTRATE TIME BASE AND HEIGHT RULINGS ON PRINTED KYMOGRAPH CHARTS



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