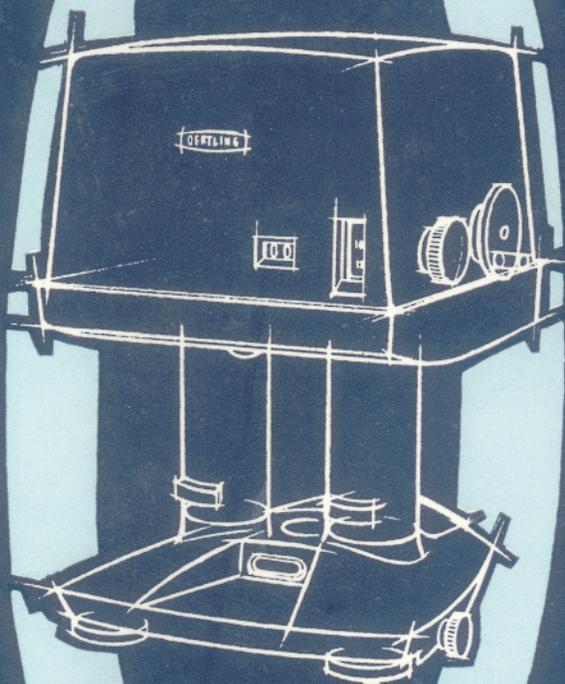


# QO1



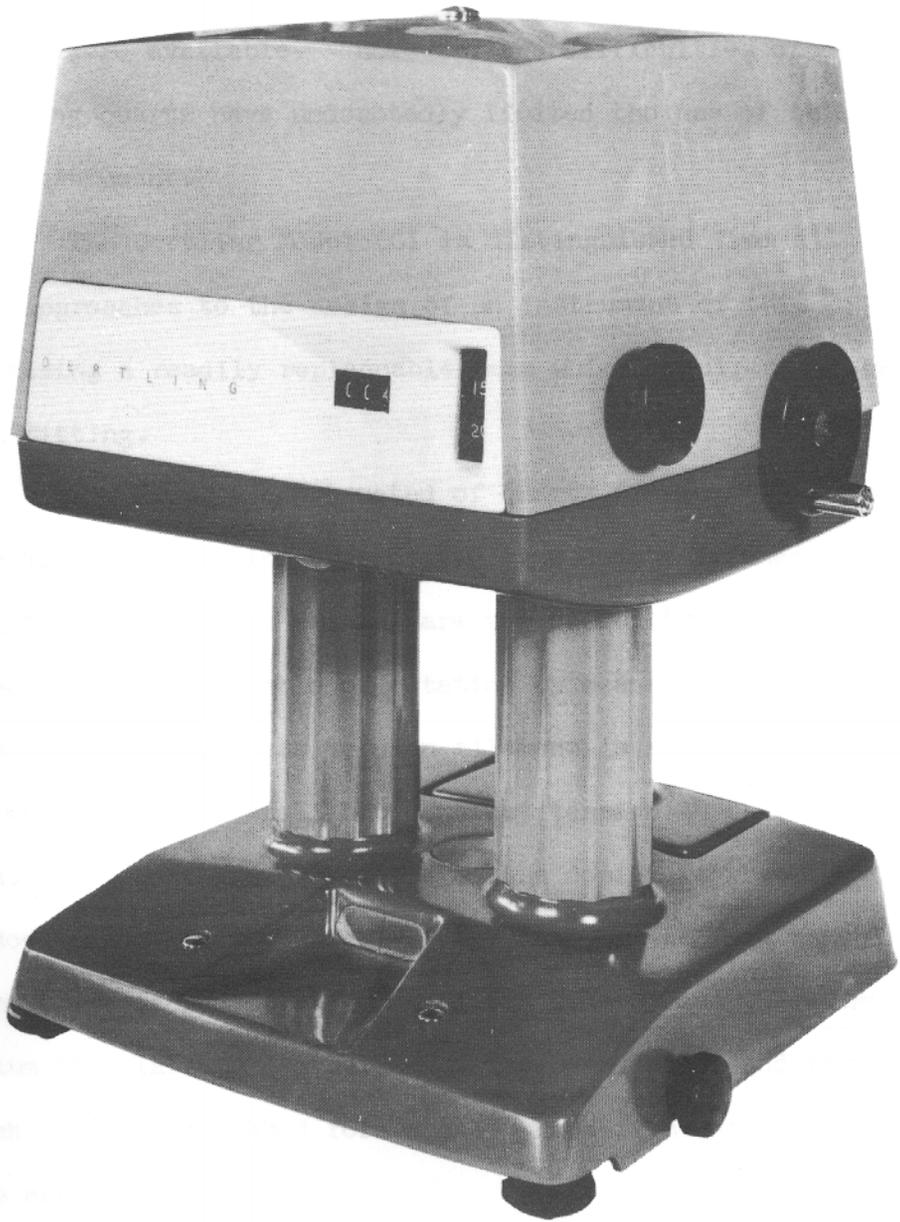
Instruction manual

**OERTLING**

OERTLING  
DECIMICROBALANCE  
Model Q01

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In the past fifty years, a number of sensitive balances using quartz beams have been produced in Laboratories where the requirement for such an instrument existed and quartz-working facilities were available. However, the difficulties of manipulating quartz have undoubtedly limited the use of this type of instrument.

The Oertling Model Q01 is distinguished from all previous approaches to the design of an instrument of this type by having a readily replaceable beam which requires little skill in fitting.

The beam is constructed of quartz fibres and is supported from an aluminium casting by two very fine quartz filaments. Also linking the beam to this casting are two quartz torsion filaments, the front one being capable of rotation by means of a calibrated gearing system. The rear torsion filament is attached to a quartz bow which maintains a small but constant tension in the torsion filament. An outstanding feature of the design is that the torsion fibre does not carry the weight of the beam or the load in the pans. The pans are attached to the ends of the beam by quartz filaments, and aluminium pan plates are provided. The beam, pans, and the casting to which they are attached form a unit which is mounted in the balance case.

The torsion head has coarse and fine adjusting knobs, and is provided with three counting wheels and a reading drum on which

the divisions are approximately 2.7 mm apart. These give a torsion head range of approximately 1 mg., the value of one division on the engraved drum being approximately 0.1 microgramme. The actual value of one division depends on the dimensions of the torsion filament, in particular the fourth power of its diameter. It is thus impossible to ensure that each division is precisely 0.1 microgramme, and calibration is necessary. Details of how this may be carried out are given later. Rotation stops are provided to prevent the torsion filament being broken due to excessive rotation.

Equilibrium of the balance beam is detected by means of an optical projection system in which an image of a pointer attached to the beam is projected on to a ground-glass screen provided with a reference line, at the base of the instrument. The lamp used in the projection system is pre-focussed.

### Specification.

Capacity	250 mg. in each pan
Torsion head sensitivity	1 division on the torsion head is equivalent to approximately 0.1 microgramme, individual calibration being required for each beam. Divisions are 2.7 mm wide.
Torsion head range	Stops are provided on the torsion head to limit the rotation of the torsion filament. The rotation allowed is equivalent to 13,000 divisions, i.e. approximately 1 mg.
Reading	By three numbered wheels and an engraved drum, viewed through apertures at the front of the instrument.

Design	The quartz beam is housed in an aluminium compartment, contained within an outer aluminium and plastic cover. This is mounted from an aluminium base by means of two tubes forming the pan compartments. These are enclosed by thermally insulated covers.
Pans	Flat aluminium, the width between supports being 0.5" (12.7 mm); weighing height 0.75" (19.1 mm). Access to the pans is obtained by raising the thermally insulated covers.
Pan arrests	The pans are supported on platinum points during loading. These are lowered to free the pans by rotating the knobs at either side of the base of the instrument.
Optical system	This provides an illuminated image of the pointer on a ground glass screen in the base. The source of light is a pre-focussed 6 v. 1 a. lamp controlled by a micro-switch operated by the pan arrest mechanism. For use on D.C. supplies, the micro-switch is not operative.
Levelling	The base is provided with two adjustable levelling feet at the front and a fixed foot at the rear.
Finish	Metal parts are polished, plated or painted as appropriate. The general finish of the instrument is in blue and light grey.
Electrical Equipment	For A.C. supplies, a metal cased, fully screened transformer for 100 - 110 v. or 200 - 250 v. For D.C. supplies, a variable resistor covering 100 - 250 v.

Dimensions (overall)	<u>Width</u> 10 $\frac{1}{2}$ " (27 cm.)	<u>Height</u> 14 $\frac{1}{4}$ " (36 cm.)	<u>Depth</u> 9 $\frac{3}{4}$ " (25 cm.)
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### Operation.

It may be found that the rest point of the balance will show small variations with relative humidity, and since, in general, it will not be possible to control the humidity, it will be necessary to eliminate the effect of drift by taking rest points before and after each weighing. In the following it is assumed that the sample is to be

contained in a small boat made of aluminium or platinum foil and that a tare of similar weight is available. The following weighing operations are carried out :

- i. With both pans empty and the pan compartments closed, partially release the pans by rotating the knob at either side of the base of the instrument until the lamp lights, when an image of the pointer will be seen on the screen. Slowly release the pans by further rotation of the knob, and at the same time adjust the torsion head using the fine control knob until the image is central with respect to the mark on the ground glass screen.  
(To move the image from right to left, the torsion head knob should be rotated in a clockwise direction). Note the reading on the counting wheels and drum, e.g. 00537.
- ii. Place sample boat in right hand pan and tare in left hand pan. Close pan compartments, lower pan arrests and re-adjust balance to equilibrium. Note reading, e.g. 01052.
- iii. Remove boat and tare and note reading with no load in the pans, e.g. 00536.
- iv. Place boat with sample in right hand pan, tare in left hand pan. Lower pan stops and note reading, e.g. 02716.
- v. Remove boat and sample and tare from pans, and note reading with no load in pans, e.g. 00535.
- vi. Calculate mean of readings i and iii, i.e. 00537, and subtract from reading ii, this giving the effective weight of the boat in divisions, i.e.  $01052 - 00537 = 00515$ .
- vii. Calculate the mean of readings iii and v., i.e. 00536, and subtract from reading iv., this giving the effective weight in divisions of boat plus sample, i.e.  $02716 - 00536 = 02180$ .
- viii. The difference between readings vi and vii thus gives the weight of the sample in divisions, i.e.  $02180 - 00515 = 01665$ , which when multiplied by the calibration factor, i.e. the value of 1 division in terms of mass, gives the mass in microgrammes.

It will be appreciated that if the sample is in a form in which it can be placed directly on the pan, then only one weighing is necessary with no-load rest points being taken before and after.

To ensure the greatest accuracy, the following precautions

should be taken :

- (a) When opening or closing the pan compartments, the hands should be kept in contact with the covers for as little time as possible.
- (b) Always open both pan compartments even though it is only required to put a load on one pan.
- (c) To minimise the effect of drift, carry out weighings as rapidly as possible, and try to ensure that there are approximately equal time intervals between the various weighings in a determination.
- (d) When operating either pan-arrest or torsion-head knobs, the other arm should be placed at the corresponding position on the other side of the instrument.
- (e) The utmost cleanliness is essential, since even minute specks of dust can cause appreciable changes in reading.
- (f) The right hand numbered wheel changes reading whilst the reading drum is being rotated from 90 to 99. Consequently, when making readings which are between 90 and 99 on the drum, the lower of the two numbers shown by the right hand counting wheel should be noted. A red band is present on the reading drum as a reminder.
- (g) Slight static electricity effects can impair the reproducibility of the balance. The effect can be minimised by earthing the balance and the forceps used for handling the sample. An earthing terminal is provided at the back of the balance for this purpose.

#### Calibration.

This can be carried out in either of two ways :

- A. Using the weighing technique described above, a 1 mg. weight is weighed on the balance, say ten times, and the mean value calculated. Suppose the mean value is 10,274 divisions. The value of 1 division is then evaluated by dividing 1 mg. by 10,274, giving the value of 1 division as 0.0000973 mg. or .0973 microgramme.
- B. A length of fine platinum or aluminium wire is cut into short lengths, the weight of each length being less than 1 mg. These are then weighed individually on the balance, and together on a standard Micro or Semi-micro Chemical Balance. The individual masses of the length of wire in terms of divisions on the torsion head are then totalled, and the value of 1 division obtained by dividing the mass by the total of divisions.

Method B is undoubtedly the more accurate, since the value of one division is ultimately being related to a known weight of, say, 20 mg., which will be known to a greater proportional accuracy than the 1 mg. weight used in method A. However, it should only be necessary to calibrate the balance by method B once, and reserve method A for checking the calibration from time to time. Of course, if a replacement beam is fitted, re-calibration will be necessary.

Unpacking instructions. (The letters refer to parts shown in the photographs at the end of these instructions)

The balance should be unpacked as close to its final location as possible, since damage may be caused by carrying the instrument in its unpacked condition.

The quartz beam and pans are clamped inside the instrument, which is itself mounted by means of screws on a wooden packing board. The unit is housed inside a cardboard carton, together with the parts listed below and a number of cardboard packing pieces. This carton is contained within an outer carton, spaced by cardboard packing pieces.

List of separate parts in a carton.

Two control knobs  
Control knob fixing screw  
Screw driver  
Allan key  
Transformer  
Flex with connecting socket

1. Open outer and inner cartons and remove balance on packing board, together with separate parts as above list.
2. Stand the instrument upside down, using some soft material such as felt to protect the lid. Withdraw the screws holding the packing board, so that it can be removed.  
Replace the balance the right way up.
3. Remove the screws (H) from the rear of the pan compartment covers and dust the exterior of the instrument.
4. Raise both pan covers fully. Lay balance over slightly to the right and remove the split pin (I) below the left hand pan arrest knob. Remove the rubber bands holding the lamp cover in position.

5. Lower both pan arrests by rotating the two screws (E) in a clockwise direction for five complete turns.
6. Turn the pan arrest knob to its maximum travel in a clockwise direction when viewed from the right hand side of the instrument.
7. Using the screwdriver blade in the notches at the base of the clamp, rotate the pan clamp (C) in the right hand pan compartment until the vertical part is central in the aperture.
8. Withdraw the pan clamp (C) from the pan compartment preventing the pan from being pulled outwards by steadying it with forceps.
9. Lift off the pan stop cover (D), and close the pan compartment.
10. Repeat Nos. 7, 8 and 9 for left hand pan. After this stage the balance should only be moved with extreme care.
11. Remove the cover retaining screw (A) and lift off the instrument cover by tilting it forward, sliding it to the right to clear the torsion head shaft, and then raising it.
12. Slacken the screws F1 and F2 until a stop is reached, and then screw F similarly.
13. Slacken the beam locking screw (G) by rotating in an anti-clockwise direction until a stop is reached.
14. Replace the cover and tighten the cover retaining screw (A) just sufficiently to retain the cover in position.
15. Fit the fine and coarse control knobs on the shafts protruding from the side of the cover.
16. Connect the flex to the output terminals of the transformer, and plug the socket into the lamp housing. Connect the input supply to the transformer, switch on the mains supply and check that the lamp lights. Raise both pan covers.

17. Rotate the release knob into a position such that the lamp is just not switched off. Adjust the height of the pan arrests (see note below) by means of the screws (E) until both pans are steadied and the image of the pointer appears central on the ground glass screen. The focus of this image can be adjusted by means of the knurled wheel (B).

At this stage, it is necessary to level the balance by means of the adjusting feet until the pans hang centrally over the pan arrests.

Note. It is important that the pan arrests be raised only just sufficiently to steady the pans. If raised any higher than this, the precision of the balance may be adversely affected.

18. Close pan compartment covers.

19. Release balance by rotating the pan arrest knob clockwise when viewed from the right hand side of the instrument. Balance the beam by means of either the coarse or fine control knobs until the image of the pointer is central on the screen. To move the image from right to left, the torsion head knob should be rotated in a clockwise direction.

The instrument is now ready for use, but it is desirable to allow some time for the balance to become acclimatised to the surroundings.

### Lamp Replacement.

In case of lamp failure, the lamp cover should be lifted off. A replacement 6 v. 1 amp. pre-focussed projector lamp can then be fitted and the cover replaced.

### Beam Replacement.

In the event of damage being caused to beam or the pans, it is necessary for the complete beam unit to be replaced. Whilst this is a simple operation, it is essentially one in which care must be taken, and sudden movements of the hands should be avoided. It is carried out as follows :

1. Remove both torsion head control knobs. Remove the cover retaining screw (A) and lift off the instrument cover.
2. With the Allan key supplied with the instrument, remove the four screws (J1), (J2), (J3) and (J4) and lift off the cover to the beam compartment. Check that the screws F, F1 and F2 are all turned fully anti-clockwise.
3. Remove the two screws (J5) and (J6) holding the beam casting in position.
4. Holding the beam casting as shown in Figure (1), lift it out of the instrument, and hold it in a retort stand and clamp whilst the new beam is being fitted.
5. Clean the interior of the beam and pan compartments, making sure that any broken pieces of quartz fibre are removed. Clean the platinum points on the pan arrests by polishing with chamois leather. It is important that no fibres from the chamois leather should be left on the pan arrests.

6. Remove the two nuts holding the cover on to the replacement beam pack and lift off the cover.
7. Remove the two nuts (Q) and very carefully withdraw the pan pack (P), making sure that the pan supports do not stick to the chamois leather. The use of forceps will be found helpful here. Slacken the two screws (R) until there is a gap of about  $\frac{1}{2}$ " between each plastic pad and the end of the beam. Slacken the pointer locking screw (O) until the stop is reached. As this is done, the beam will be lowered until the weight of the beam is being taken by the two vertical filaments.
8. Place one finger on the torsion collet (M), and keeping pressure against it to prevent it moving out suddenly, withdraw the collet pin (L). Now allow the collet to move slowly out to its limiting position when the torsion fibre is under the correct tension.
9. Set the torsion head reading to be approximately 00500.
10. Holding the replacement beam casting as shown in Fig. (2), remove the two screws (N) and lift the replacement unit out of the pack. In doing this, it will be found helpful if the pack is tilted away from you, so that the pans hang clear of the surfaces against which they are clamped. Care should be taken to prevent the beam and pans touching any part of the pack.
11. Carefully lower the beam into position on the instrument, taking great care that the two pans, the pointer and the quartz bow enter the apertures in the beam compartment. When the beam casting has reached its lowest position, a check should be made

to see that the gear wheels are meshing correctly. The two screws (J5) and (J6) can now be replaced and tightened. Remove the torsion head locking pin (K).

12. Replace the cover to the beam compartment and the four screws (J1), (J2), (J3) and (J4). It is important that screw (J1) be tightened first.
13. Replace the instrument cover together with the cover retaining screw (A), and refit the torsion head control knobs.
14. Raise the pan compartment covers and adjust the pan arrests by means of the two screws (E). It is important that they should be adjusted so that the pointer image is approximately central on the scale when the release knob is turned just sufficiently to allow the lamp to light. It is only necessary for the pans to be steadied during loading, and the precision of the balance may be adversely affected if the pan arrests are set too high. It may also be necessary at this stage to make some slight re-adjustment to the levelling feet to ensure that the pans hang centrally over the pan arrests, and some alteration to the focus adjustment (B) may also be necessary to obtain a sharp image on the screen.
15. It is now necessary to calibrate the beam as described above.
16. Place the beam casting holding the damaged beam in the beam pack, holding it by the two screws (N).

17. Push in the collet (M) and replace the collet pin (L) to hold the collet in this position.
18. Tighten the pointer locking screw (O) guiding the pointer into the conical recess, and keeping the beam upright as it engages the beam steadies. Tighten the screws (R) until the beam is held at each end by the plastic pads.
19. Finally, clamp the pans against their pads, using the pan pack (P) and nuts (Q), making sure that, before clamping, the pans are raised slightly to remove the tension from the pan suspension filaments.
20. Replace the beam pack cover and the two nuts, and return the unit to L. Oertling Ltd.

NOTE.

The above description of packing the defective beam assumes that damage has been slight. If more serious damage has occurred, the beam and pans should be cut away from the beam casting and the latter returned in the beam pack.

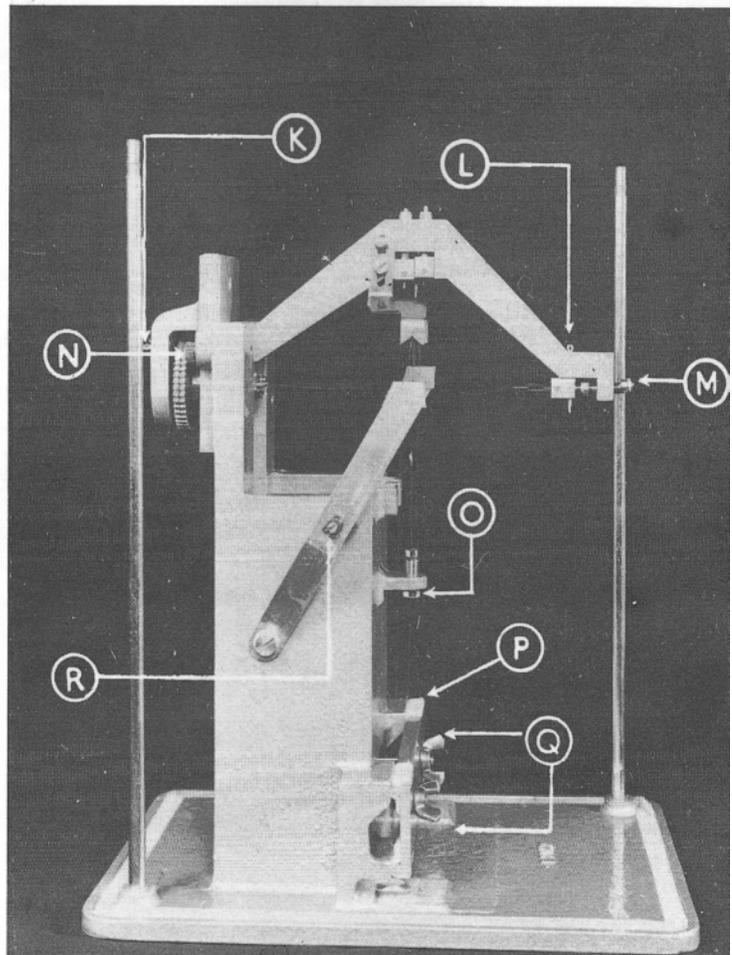
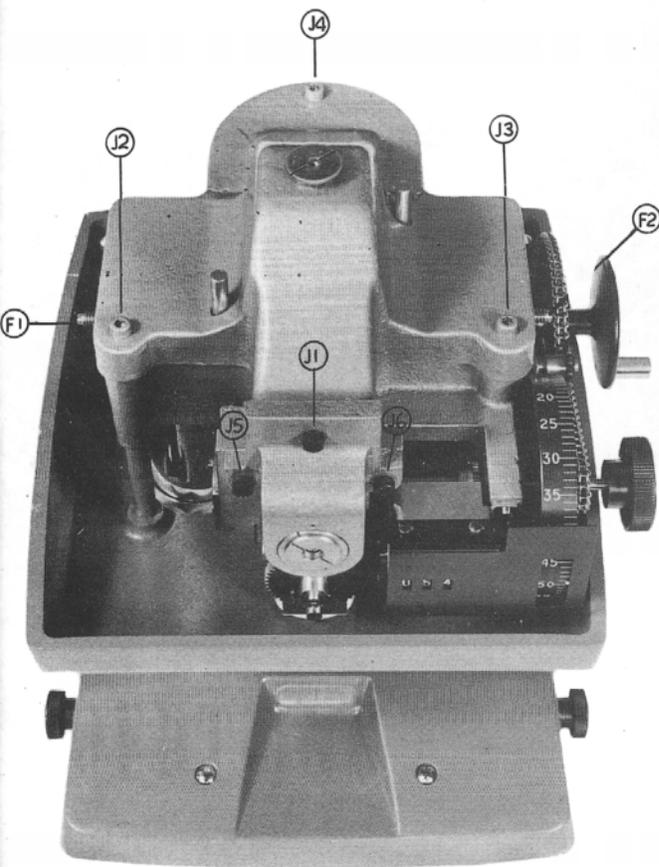
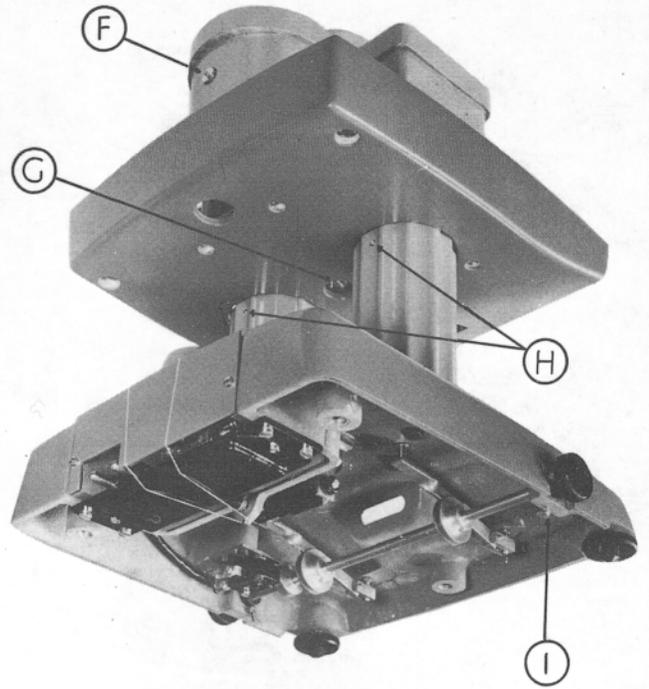
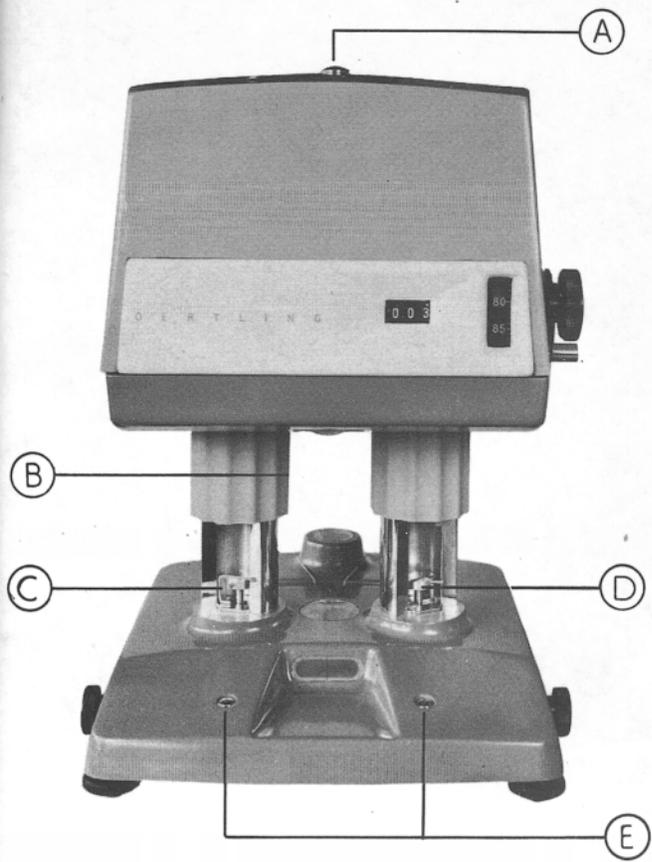


Fig.1

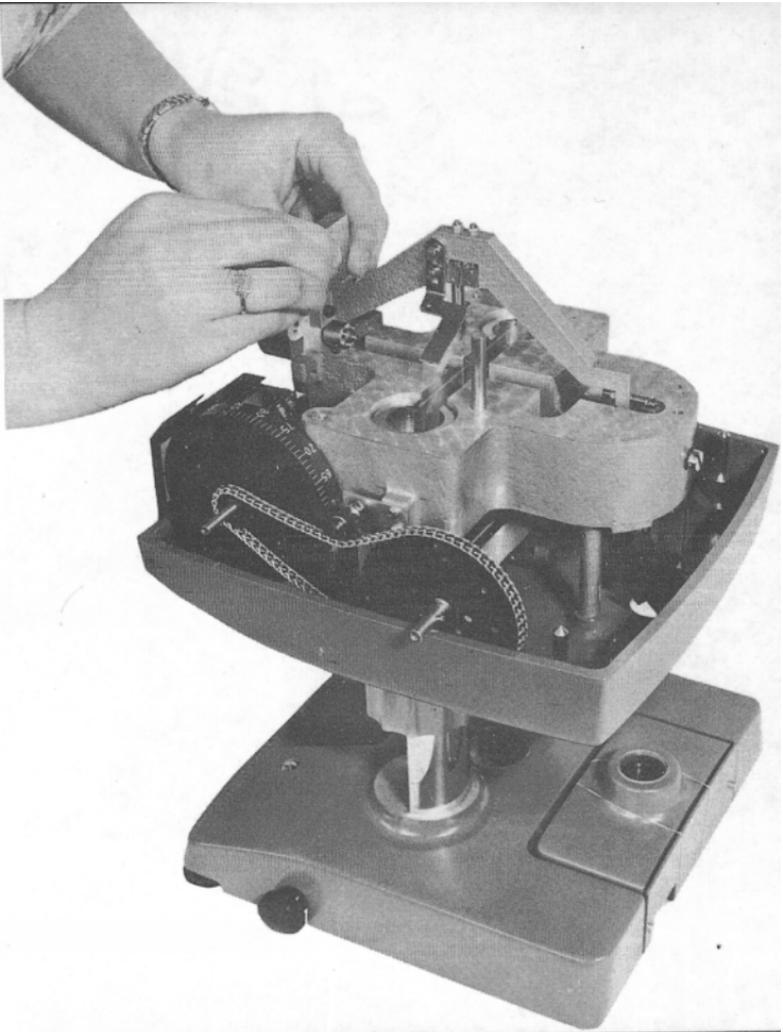


Fig.2

