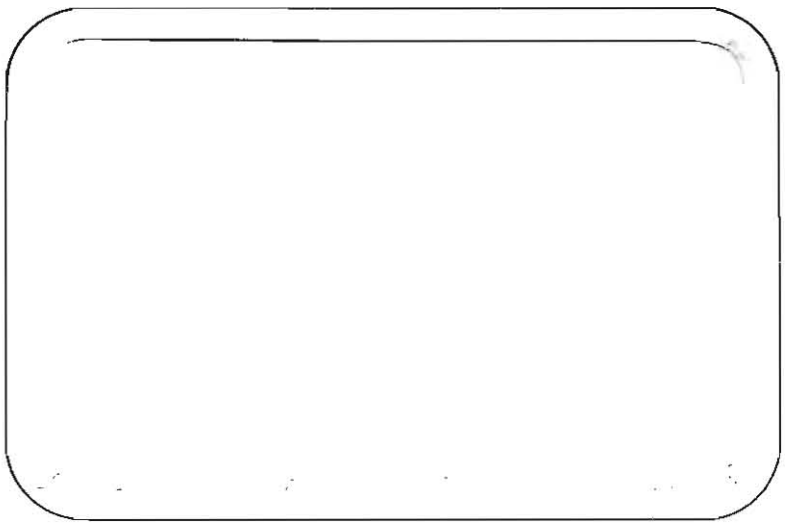
cussons
TECHNOLOGY



INSTRUCTION MANUAL

P6247

FLOW VISUALISATION UNIT

102

ISSUE 1
MAY 1989

MANUFACTURERS LIABILITY

UNITED KINGDOM HEALTH AND SAFETY AT WORK ACT

G. Cussons Ltd. hereby draws the attention of all users of its equipment to the provisions of the U.K. Health and Safety at Work Act, or of any similar provisions relating to health and safety of people at work in other countries and territories, which refer to the liability of manufacturers or suppliers of equipment.

Under the U.K. act manufacturers or suppliers of equipment cannot be liable for the consequence of its use unless it is installed, maintained and operated strictly in accordance with the instructions published by the manufacturers or suppliers. This same limit of liability is hereby assumed by G. Cussons Ltd. to be valid in all countries or territories.

Therefore G. Cussons Ltd. will not be liable for the consequences of failure to heed warnings and precautions, improper installation or maintenance, improper use or incorrect operation of equipment manufactured or supplied by them. Furthermore, modifications to equipment, unless specifically authorised in writing by the Company in advance of their implementation, will invalidate equipment warranty and absolve G. Cussons Ltd. from liability.

G. Cussons Ltd. recognises the need for equipment to be safe to operate and to be fit for the purpose for which it is designed. The Company pays considerable attention to these aspects and designs and manufactures equipment to the highest safety standards with highly visible quality assurance.

Any customers requiring further advice on safety aspects concerning installation and use of Cussons equipment should write to the company as follows:-

G. Cussons Ltd.,
Technical Services Department,
102 Great Clowes Street,
Manchester,
England M7 9RH.

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RECEIPT AND UNPACKING

Irrespective of who has arranged the carriage and insurance of the goods, the carriers and insurers require that claims for loss or damage are submitted within a specified period after receipt of the goods. This period is often as short as 72 hours. It is important therefore for the customer to carry out the following procedure as soon as the equipment is received.

a) On receipt, the goods should be signed for "unexamined".

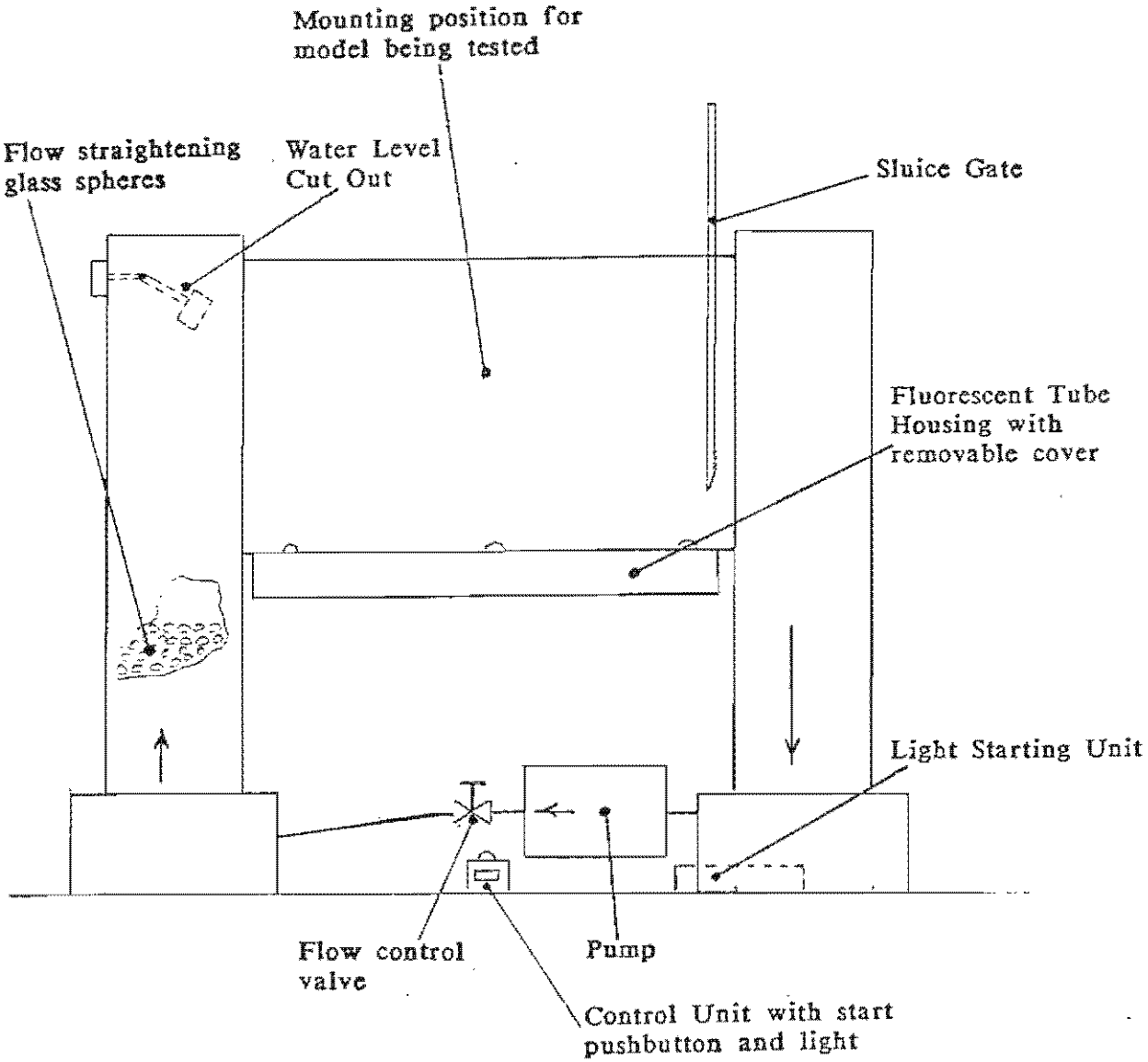
b) Immediately unpack and check the equipment against the dispatch check lists/packing lists enclosed with the equipment.

c) Advise the carrier within 72 hours of receipt, of any damaged or missing items, holding them responsible for the damage or loss. A copy of this advice document must also be sent to G. Cussons Ltd.

d) If insurance has been arranged by yourselves you must advise your insurers of the damage/loss enclosing a copy of the advice document that you have submitted to the carrier.

e) If insurance has been arranged by G. Cussons Ltd., you must advise the local agent at the address indicated on the original Insurance Certificate in your possession. A copy of this advice document must also be sent to G. Cussons Ltd.

All evidence of loss or damage should be retained by you. Claims for loss or damage cannot be entertained if the above procedures are not adhered to.



FLOW CIRCUIT

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1. INTRODUCTION.

It is often extremely important to be aware of the flow pattern existing around any flow circuit component and the Cussons P6247 Flow Visualisation Unit enables this to be done in a relatively simple fashion. Component modifications can be studied quickly and effectively and a qualitative appreciation of the flow problems which exist can be demonstrated.

The Flow Visualisation Unit caters for the following standard flow patterns :-

Bends and elbows

Sharp contraction and enlargement

Smooth contraction and enlargement (Venturi Nozzle)

Aerofoil section

Cylinder

Bank of cylindrical tubes (heat exchanger)

The flow pattern is clearly indicated by 'styrocell spheres' which are present in the water in the Flow Visualisation Unit.

Note :- On changing models it will be advantageous to remove any 'styrocell spheres' (used to display flow pattern) which have attached themselves to the wall of the Visualisation Unit by spraying with a jet of water from a wash bottle (bottle not supplied).

2. DESCRIPTION.

The flow circuit is depicted in the frontispiece and as can be seen, water is pumped via a flow control valve into a vertical perspex cylindrical tower. The tower contains glass spheres which ensure that a uniform flow of water leaves the tower and progresses through the test model channel unit. The flow out of this unit is controlled by a sluice gate which can be positioned as required. The water circuit is completed by another vertical tower which leads the water back to the pump inlet. The models themselves which are described in Section 3 are open channel two dimensional units and the flow pattern is displayed by the use of $^{1}/_{8}$mm diameter 'styrocell' (unexpanded polystyrene) spheres which are placed in the water to suit the prevailing flow conditions.

A pump cut out is contained in the inlet tower in case the water level rises too high due to the sluice gate positioning related to the rate of flow. The model being tested can be illuminated by a fluorescent tube mounted below the flow channel.

Initially the unit is filled with clean water (containing a small quantity of detergent to prevent static charge attraction) to a point approximately half way up the inlet and outlet tanks. Additionally a small quantity of 'household bleach' should be introduced to the water to prevent the growth of algae. If, on running the pump, the level in the outlet tank falls too low, because the sluice gate is too low for example, then the pump will draw in air and this will cause the pump motor to race. A further addition of water will then be required to stop this condition. Approximately 10cc of styrocell spheres should be added to the water to enable the relevant flow patterns to be observed. A switch is positioned on the base of the unit which will energise the flow pump and the fluorescent light unit which enables the flow patterns to be clearly seen.

3. NOTES AND FLOW DIAGRAMS FOR MODELS TO BE TESTED.

The following diagrams and comments are very general in character since variations occur with flow velocity.

Bends and Elbows (Fig. 1)

Whenever the direction of a flow stream is abruptly changed, as at a sharp bend or elbow, a loss of head is experienced. This is due to the formation of a partial 'vena contracta', because of separation of the flow from the tube wall on passing the sharp bend or elbow, and to the subsequent re-enlargement and shock which then takes place. The diagrams here illustrate the formation of eddies which absorb energy from the flow stream thus reducing the head available.

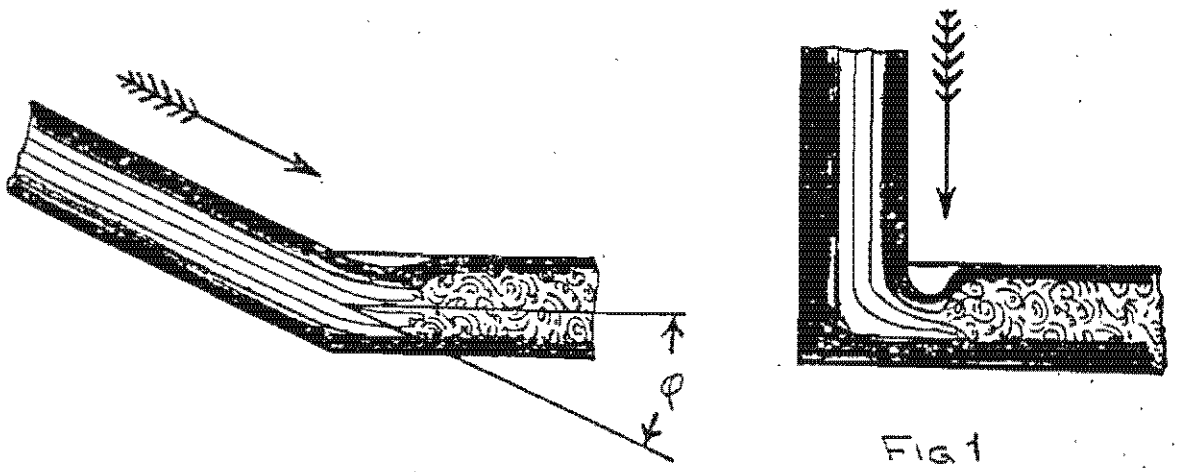

Fig 1

Sharp Contraction and Enlargement (Fig. 2a and 2b)

The diagrams illustrate the formation of eddies, at a sharp contraction or enlargement, which absorb energy from the flow stream, and thus reduce the head available. A vena contracta (a_c) is formed by the contraction flow.

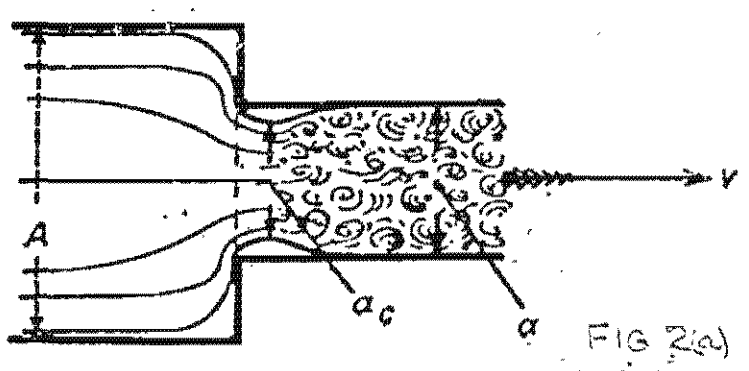

FIG 2(a)

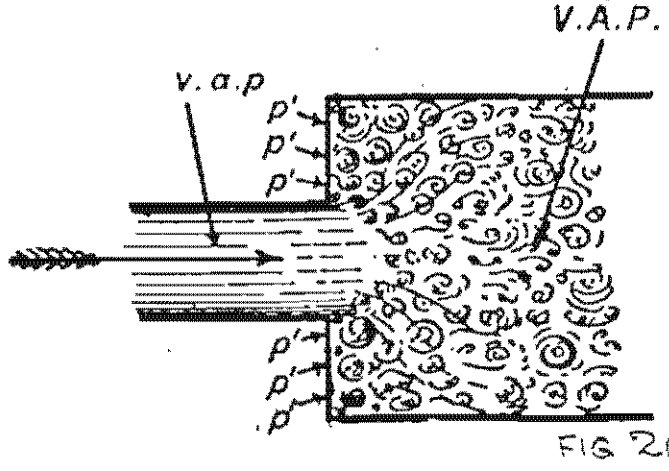

FIG 2(b)

Smooth Contraction and Enlargement (Fig. 3)

The Venturi Tube is a good example of this condition. The Tube is carefully angled and dimensioned so that the flow through it is without separation and hence its insertion in a flow circuit causes minimal head loss.

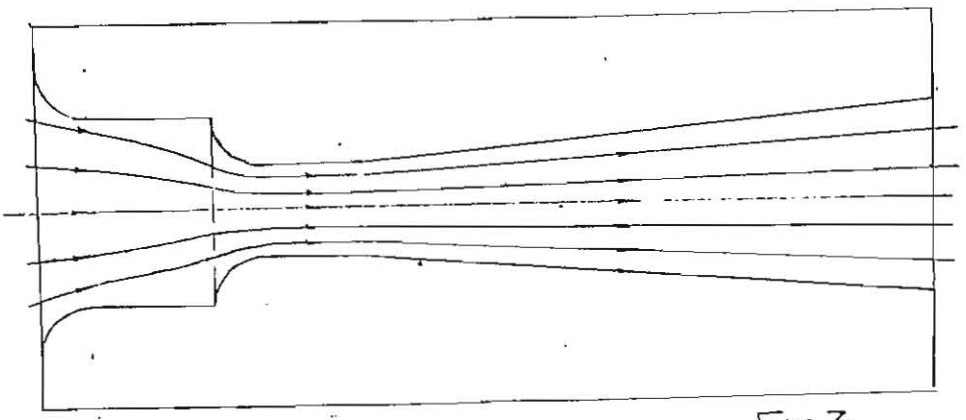

FIG 3.

Aerofoil Section (Fig. 4a b c d)

The diagrams illustrate the development of lift on an aerofoil section, maintained at a constant angle, with increase of velocity.

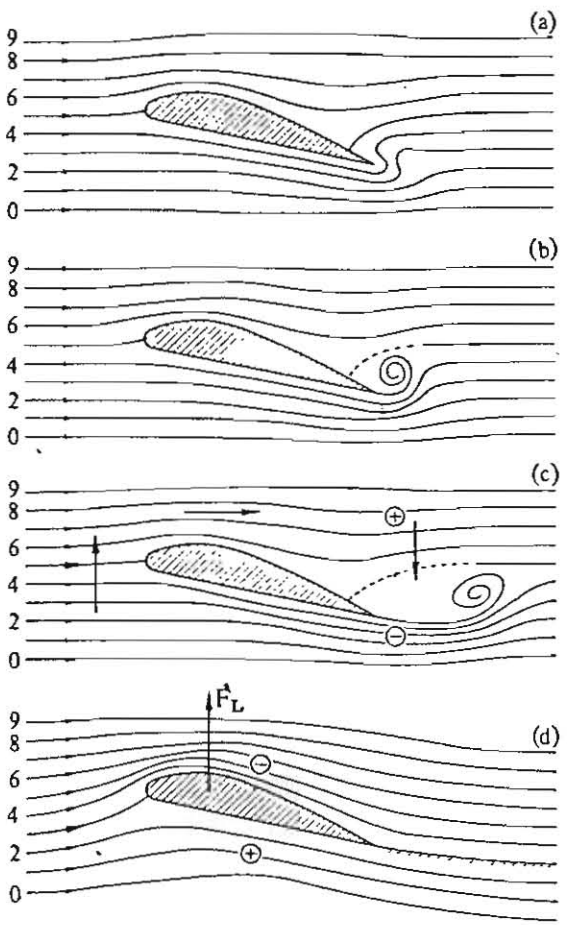

Fig. 4 Development of flow past an aerofoil

Cylinder (Fig. 5)

The series of diagrams illustrates the formation of turbulence in the wake behind a cylinder placed transversely to the flow . As the velocity is increased a turbulent boundary layer will eventually surround the cylinder.

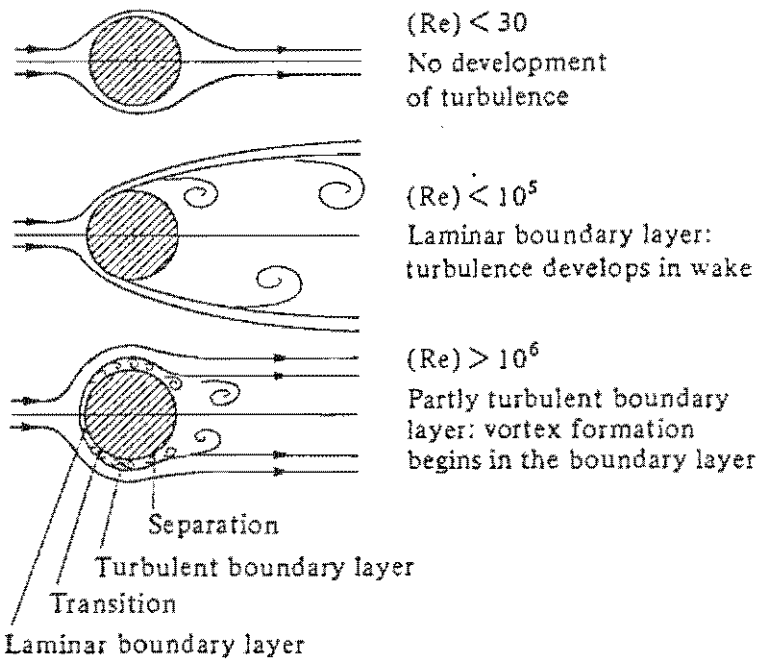

Fig. 5 Development of turbulence in a wake

Bank of Cylindrical Tubes (Heat Exchanger) (Fig. 6)

In a typical cross-flow heat exchanger, the degree of turbulence increases as the flow penetrates the bank of tubes. The increased turbulence causes an increase in the Heat Transfer Co-efficient and hence an increase in heat flow between the two circuits.

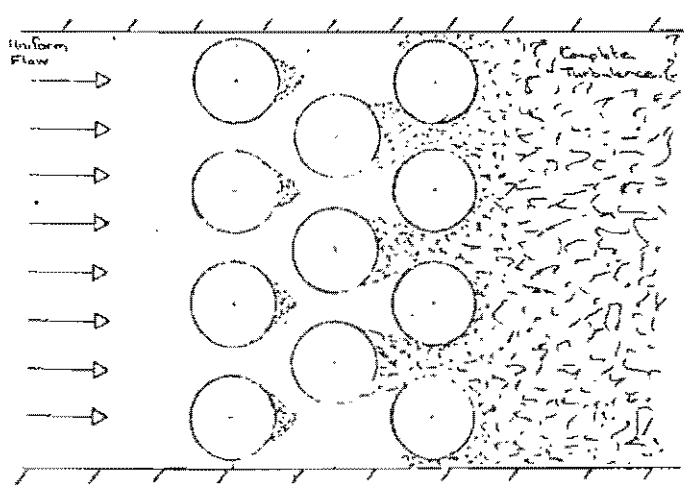

FIG 6.

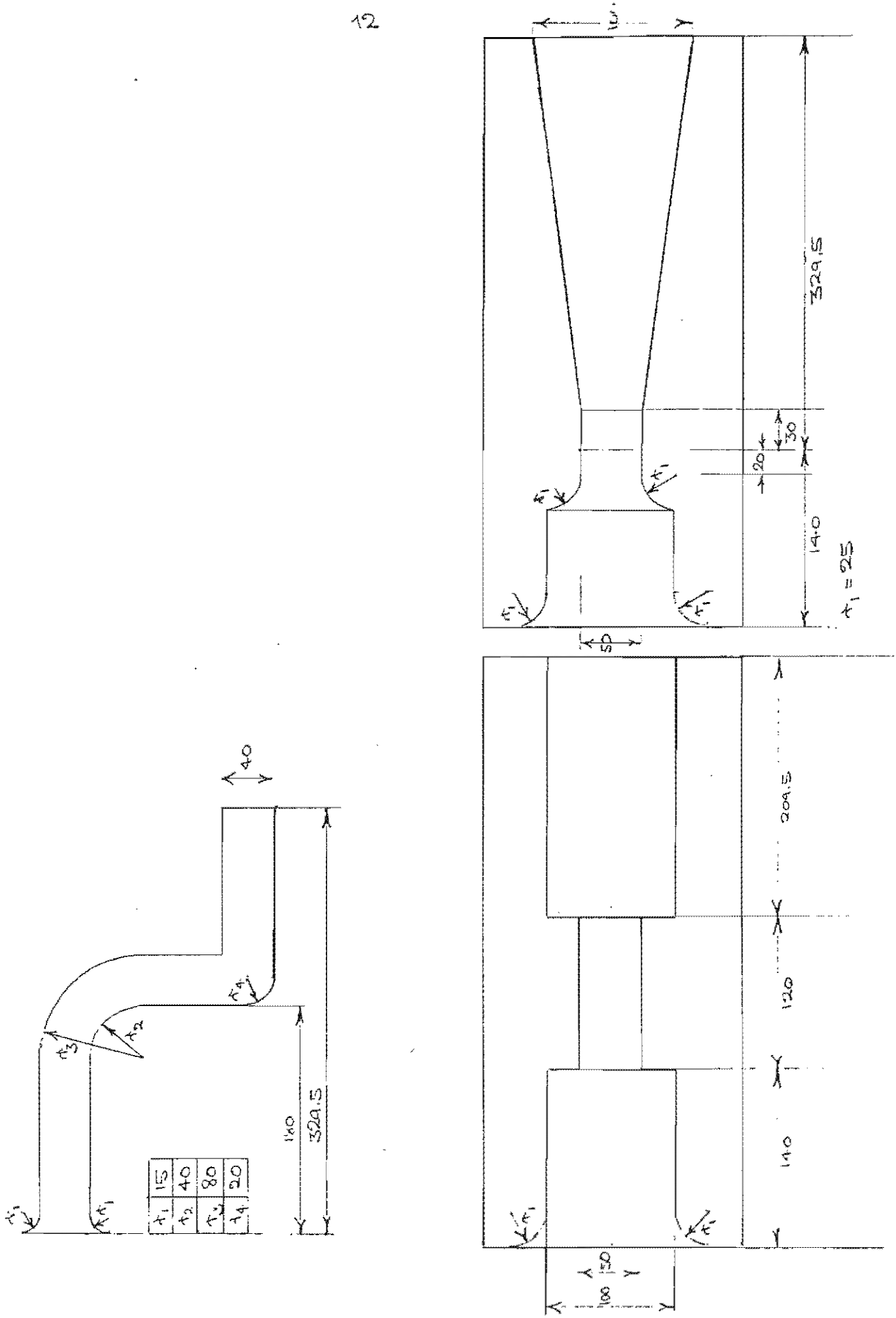

Fig. 7 Dimensioned Sketches Relating To Test Models

4. MAINTENANCE.

To replace the fluorescent tube, first switch off the electrical supply at the control box situated at the foot of the equipment. Then unscrew the six knurled head screws which hold the guard situated under the flow channel and the tube can then be replaced.

Any scratches which may appear on the perspex flow channel can be removed by gently rubbing with suitable perspex polish on a soft cloth.

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