



THE AERONAUTICAL JOURNAL

FEBRUARY 1970

- S. I. Sikorsky** THE HELICOPTER—TODAY AND TOMORROW
- J. H. Argyris** THE IMPACT OF THE DIGITAL COMPUTER ON ENGINEERING SCIENCES
(PART 2)
- M. L. Bramson** REPORT ON THE WHITTLE SYSTEM OF AIRCRAFT PROPULSION (THEORETICAL
STAGE)—OCTOBER 1935
- P. Jarrett** DAGENHAM DAYS
- DISCUSSION ON HIJACKING—WHY GOVERNMENTS MUST ACT
- TECHNICAL NOTES
- J. P. H. Webber** On the Extension of the Kantorovich Method
- M. M. Gore and
R. J. Stalker** Shock Tunnel Operation with an Expansive Area Change at the Main
Diaphragm
- K. P. Rao and
G. A. O. Davies** Reinforced Circular Holes in Cylindrical Shells
- J. A. D. Ackroyd** Laminar Boundary Layers Behind Strong Moving Shock Waves
- R. S. Bartlett** High Lift-Drag Ratio Double Wedges of Given Volume which Support Two-
Dimensional Supersonic Flow Fields
- J. S. Rao and
W. Carnegie** Non-Linear Vibrations of Rotating Cantilever Beams

LIBRARY

CORRESPONDENCE

NOTICES

LECTURE SUMMARIES : DIARY

SUPPLEMENTARY PAPERS

- J. Dunham** EXPERIMENTS TOWARDS A CIRCULATION-CONTROLLED LIFTING ROTOR.
PART II. A MODEL ROTOR

THE ROYAL AERONAUTICAL SOCIETY

4 HAMILTON PLACE LONDON W1

27s 6d

THE AERONAUTICAL JOURNAL

THE ROYAL AERONAUTICAL SOCIETY

Incorporating The Institution of Aeronautical Engineers and The Helicopter Association of Great Britain

Telephone: 01-499 3515 Telegrams: Didaskalos, London, W1

Published Monthly at 4 HAMILTON PLACE, LONDON W1V 0BQ

Subscriptions: £15 15s. 0d. per annum, post free Single Copies: 27s. 6d.

VOLUME 74

NUMBER 710

FEBRUARY 1970

CONTENTS

	Page
S. I. Sikorsky THE HELICOPTER—TODAY AND TOMORROW	105
J. H. Argyris THE IMPACT OF THE DIGITAL COMPUTER ON ENGINEERING SCIENCES (PART 2)	111
M. L. Bramson REPORT ON THE WHITTLE SYSTEM OF AIRCRAFT PROPULSION (THEORETICAL STAGE)—OCTOBER 1935	128
P. Jarrett DAGENHAM DAYS	134
DISCUSSION ON HIJACKING—WHY GOVERNMENTS MUST ACT	143
TECHNICAL NOTES	
J. P. H. Webber On the Extension of the Kantorovich Method	146
M. M. Gore and R. J. Stalker Shock Tunnel Operation with an Expansive Area Change at the Main Diaphragm	149
K. P. Rao and G. A. O. Davies Reinforced Circular Holes in Cylindrical Shells	153
J. A. D. Ackroyd Laminar Boundary Layers Behind Strong Moving Shock Waves	155
R. S. Bartlett High Lift-Drag Ratio Double Wedges of Given Volume which Support Two- Dimensional Supersonic Flow Fields	159
J. S. Rao and W. Carnegie Non-Linear Vibrations of Rotating Cantilever Beams	161
LIBRARY	166
CORRESPONDENCE	172
NOTICES	174
LECTURE SUMMARIES : DIARY	
S U P P L E M E N T A R Y P A P E R S	
J. Dunham EXPERIMENTS TOWARDS A CIRCULATION-CONTROLLED LIFTING ROTOR. PART II. A MODEL ROTOR	175

Editor: JOAN BRUCE, BSc, CEng, AFRAeS.

Secretary of the Society: A. M. BALLANTYNE, OBE, TD, BSc,
PhD, CEng, HonFCASI, FAIAA, FRAeS.

4 HAMILTON PLACE, LONDON, W1V 0BQ. Tel: 01-499 3515.

Advertisements Only:

H. E. SOUTHON

Magazine Advertising Ltd, 184 Fleet Street, London, EC4.

Tel: 01-242 0434/5.

**Reproduction of any of the papers published in this journal is
not permitted without the written consent of the Editor.**

**None of the papers or paragraphs must be taken as
expressing the opinion of the Council unless otherwise stated.**

PRINTED BY THE LEWES PRESS WIGHTMAN & CO. LTD., LEWES, SUSSEX, ENGLAND, AND PUBLISHED
BY THE ROYAL AERONAUTICAL SOCIETY, 4 HAMILTON PLACE, LONDON, W1V 0BQ, ENGLAND.

The Royal Aeronautical Society

FOUNDED 1866

INCORPORATED BY ROYAL CHARTER 1949

Patron: HER MAJESTY THE QUEEN

COUNCIL

President: AIR COMMODORE F. R. BANKS, CB, OBE, CEng, HonCGIA, HonFAIAA, HonFRAeS, RAF(retd)

President-Elect: AIR COMMODORE J. R. MORGAN, OBE, BSc(Eng), CEng, FRAeS, RAF(retd)

Vice-Presidents:

SIR ROBERT COCKBURN, KBE, CB, PhD, MSc, CEng, FRAeS
G. S. HISLOP, PhD, BSc, ARCST, CEng, FRAeS
S. D. DAVIES, CBE, BSc(Eng), CEng, FRAeS

Past Presidents:

A. D. BAXTER, MEng, CEng, FRAeS
SIR MORIEN MORGAN, CB, MA, CEng, FRAeS
PROFESSOR D. KEITH-LUCAS, HonDSc, MA, CEng, FRAeS

Members:

CAPTAIN E. C. BEARD, CBE, FRAeS, RN(retd)
M. J. BRENNAN, BSc, CEng, FRAeS
T. T. N. COLERIDGE, BE, CEng, FRAeS (*President of the New Zealand Division*)
H. DAVIES, CB, MSc, CEng, FAIAA, FRAeS
G. A. FORD, CEng, AFRAeS (*President of the Rhodesia Division*)
H. H. GARDNER, HonDSc, BSc, CEng, FRAeS
W. F. HILTON, DSc, PhD, DIC, CEng, AFAIAA, FRAeS
M. S. HUNT, CEng, AFRAeS (*President of the Southern Africa Division*)
B. P. LAIGHT, MSc, CEng, FRAeS
P. S. LANGFORD, BE, CEng, FRAeS (*President of the Australian Division*)
PROFESSOR K. L. C. LEGG, BSc(Eng), BSc, CEng, FRAeS
P. G. MASEFIELD, MA, CEng, HonFAIAA, FRAeS
E. S. MOULT, CBE, PhD, BSc, CEng, FRAeS
W. N. NEAT, MA, CEng, FRAeS
L. F. NICHOLSON, CB, MA, CEng, FRAeS
D. W. NORMAN, BSc(Aero), GradRAeS
G. K. C. PARDOE, BSc, DLC, CEng, FRAeS
(*Chairman, Astronautics and Guided Flight Section*)
AIR VICE-MARSHAL C. N. S. PRINGLE, CBE, MA, CEng, FRAeS
H. ROBERTS, PhD, BSc, DIC, CEng, FRAeS (*Chairman, Rotorcraft Section*)
(*Chairman, Graduates' and Students' Section*)
A. M. THOMPSON, GradRAeS
G. T. WANSBROUGH-WHITE, ARAeS
K. G. WILKINSON, BSc, DIC, ACGI, CEng, FRAeS
J. E. D. WILLIAMS, BSc, FRAeS
N. H. WOOD, DCAe, CEng, AFRAeS

Officers:

Hon. Treasurer: C. F. HUGHESDON, AFC, ARAeS
Solicitor: L. A. WINGFIELD, MC, DFC (*Hon Companion*)
Secretary: A. M. BALLANTYNE, OBE, TD, PhD, BSc, CEng, HonFCASI, FAIAA, FRAeS

Note: The President of each Division and the Chairman of each Section of the Society is a Member of Council by reason of his office.

FEBRUARY 1970

Mechanical C/P Encoding Altimeter from Smiths Industries

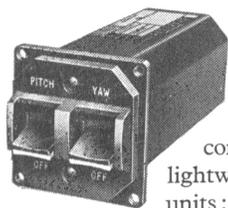
A programme of continuous development in the field of aircraft instrumentation has led to the recent introduction by Smiths Industries Aviation Division of a number of sophisticated new designs.

One of these, the Mechanical Counter/Pointer Altimeter, the 800 series, incorporates a 5-figure readout of altitude by means of counter drums which are driven without servo assistance—a major advance made possible by the development of a unique and more powerful capsule assembly. And the latest version has an optical digital encoder for height reporting to ARINC 548/549.

The five-digit presentation includes zeroes as part of the moving display, obviating the ambiguity that can otherwise occur with two- or even three-digit counter/pointer altimeters. Variants are available with either single or twin baroscales and integral lighting is standard. These altimeters conform to TSO C10b, and TSO C88.

Autostabilisation for Jaguar

An advanced technology autostabiliser system by Smiths Industries is specified for the BAC Jaguar. The system, designed to

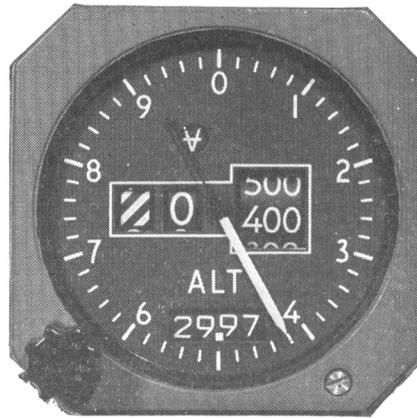


augment the stability of high performance aircraft in both pitch and yaw, consists of only two lightweight compact units: the Pilot's

Selector and the Computer.

Incorporated in the Computer are two Smiths Series 400 Rate Gyroscopes for measurement of pitch and yaw rates and a manometric unit for gain scheduling as a function of airspeed and altitude throughout the flight envelope. The electronic assembly forms a separate unit within the computer case. The outputs from the Computer drive three electro-hydraulic servo actuators, one in yaw and two in pitch.

The Computer power supply is 115V 400Hz.



The Pilot's Selector has been designed for solid mounting and carries the switches needed by the pilot to engage the Autostabiliser in the pitch and/or yaw modes. The unit is housed in a 2 ATI case conforming to ARINC 408, and electrical connections are made through a 19 pin connector.

Smiths Industries—the power monitors.

Engine temperature and speed monitoring, temperature and speed control, overspeed protection and engine life recording are typical functions performed by the engine equipment offered

by Smiths Industries. We have more than 15 years' experience in the design and manufacture of such accessories for many different types of gas turbine.

Monitoring and control equipment includes multi-function units for engines as advanced as the 3-shaft gas turbine. On the less sophisticated side, units have been produced for such applications as A.P.U.'s and booster engines, where the



engine is unattended, with no flight deck instrumentation other than warning lights.

Details of the existing range of Smiths engine equipment, and of the resources and enterprise that can be applied to new projects, are readily available from us.

Capacitance fuel gauging systems—made to measure

During the past 20 years Smiths Industries have designed and manufactured fuel gauging systems for more than 50 types of fixed and rotating wing aircraft.

A recent innovation is the Type 8 system, which features micro-electronics and printed circuit boards, while retaining the flexibility of design and application that distinguished the earlier systems. A significant reduction in size has been achieved without loss of reliability, and the introduction of modular construction has simplified servicing.

A typical gauging system consists of a number of probes in the tank, and a fuel-contents amplifier/indicator.

Type 8 tank probes are self-compensating and each system is individually tailored to the airframe constructor's

requirements, so that the highest practical level of accuracy can be provided for a given aircraft/altitude relationship. Additionally a total fuel contents summation indicator is available and fuel management facilities can be provided.



SMITHS INDUSTRIES LIMITED
AVIATION DIVISION

Head Office: Kelvin House, Wembley, Middlesex. Telephone: 01-452 3333. Telex 25366

THE AERONAUTICAL JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY] 3

[ADVERTISEMENTS FEBRUARY 1970

**Every single military
and civil airfield
in the world is known,
and targeted**



The Harrier alone is not dependent on airfields.

 **Hawker Siddeley - the largest aerospace group in Europe**

Richmond Road, Kingston upon Thames, Surrey, England. Tel: 01-546 7741. Cables: Hawsidair, Kingston upon Thames. Telex: 23726
Hawker Siddeley Group supplies mechanical, electrical and aerospace equipment with world-wide sales and service

ADVERTISEMENTS FEBRUARY 1970]

4 [THE AERONAUTICAL JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY