
Proceedings of the Symposium on

Application of Mechatronics

24–25 April, 1990
Hong Kong Polytechnic
Hong Kong

Organised by

- The Institute of Measurement and Control, Hong Kong Local Section
- Hong Kong Polytechnic
- Guangdong Provincial Association for Science and Technology
- Guangdong Provincial Mechanical Engineering Society

Edited by
T.P. Leung
Department of Mechanical and Marine Engineering
Hong Kong Polytechnic

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Editor
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Department of Mechanical and Marine Engineering
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PREFACE

The Symposium on the Application of Mechatronics is jointly organised by the Institute of Measurement and Control (Hong Kong Local Section), the Hong Kong Polytechnic, Guangdong Provincial Association for Science and Technology and the Guangdong Provincial Mechanical Engineering Society.

It will be held in the Hong Kong Polytechnic during April 24-26, 1990. This issue of Proceedings includes all the 21 papers presented at the Symposium.

The Symposium serves the purpose of promoting the exchange of know-how and information in the area of mechatronics for experts and practising engineers in the region. In view of the trend of the integration of mechanical and electronic components to form new products and systems, it is timely to hold the Symposium for the enhancement of relationships between professionals of the region.

I would like to express my most sincere thanks to Guangdong Provincial for Science and Technology for co-ordinating all the papers presented by authors in mainland China. I am indebted to the many colleagues who have helped with the details of the meeting and the publication of the Proceedings, in particular Mr. Barry Cousins, Chairman of the Institute of Measurement and Control (Hong Kong Local Section), without whose support the Symposium cannot be realised. I am also grateful to generous donations and advertisement sponsorships from the many companies that have made the Symposium possible.

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Editor

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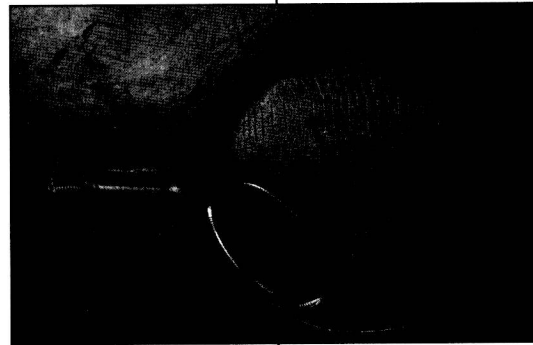
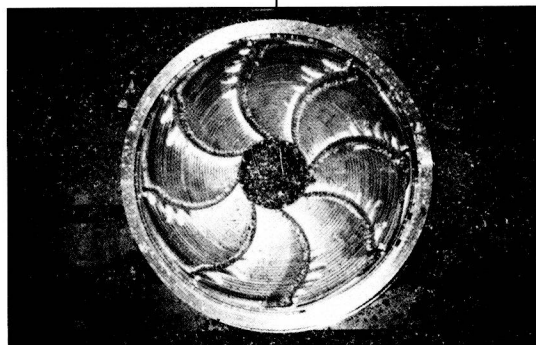
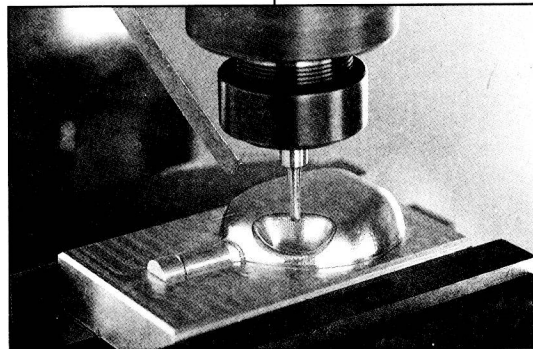
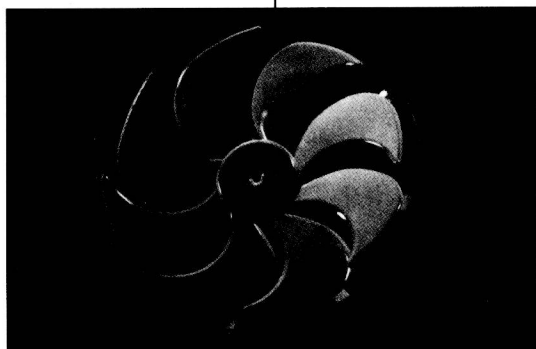
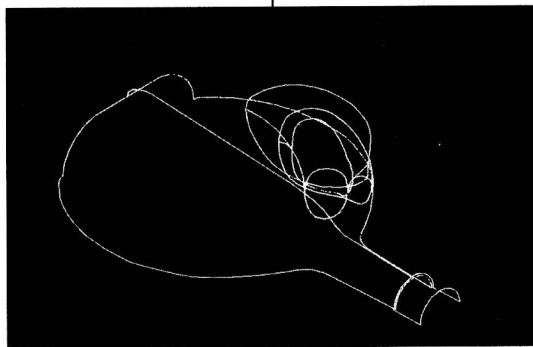
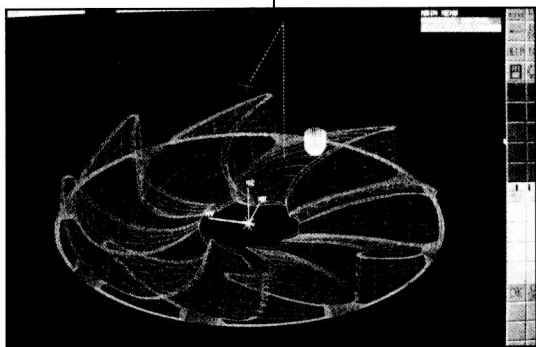
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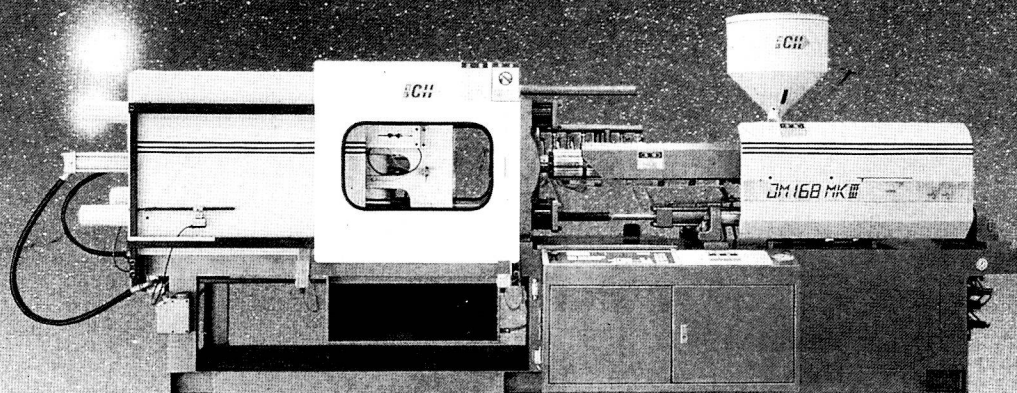
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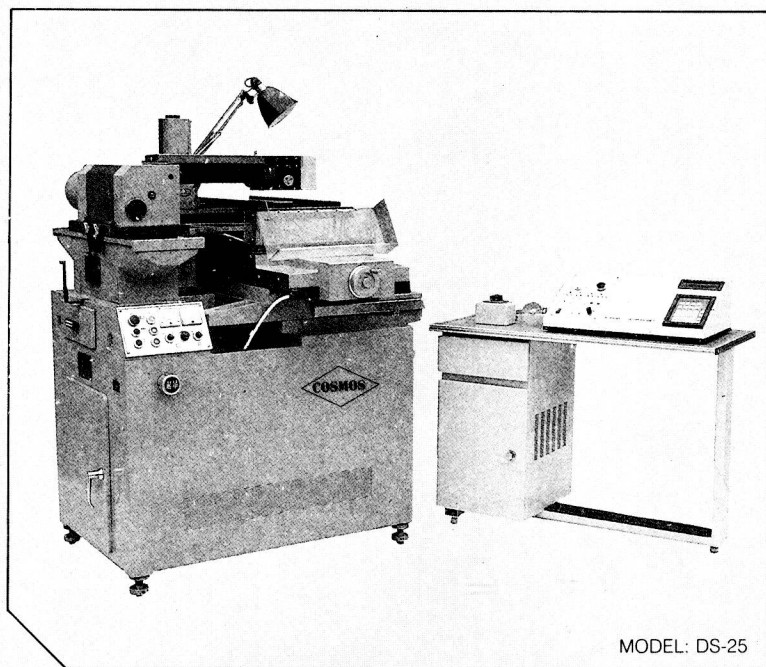
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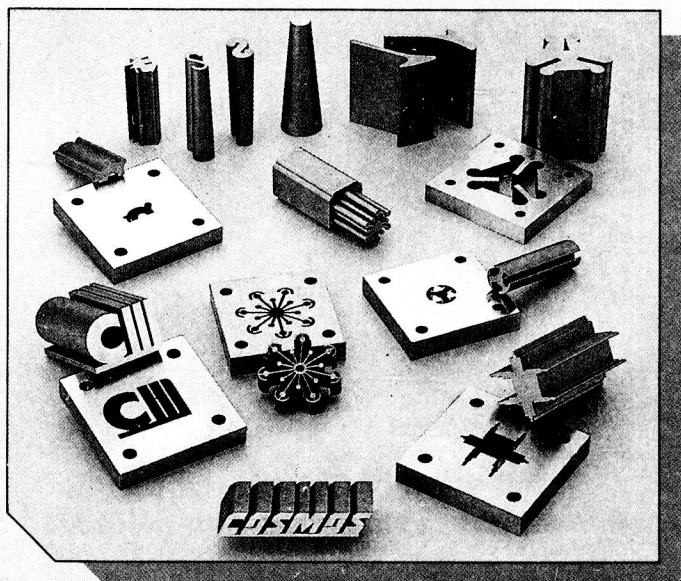
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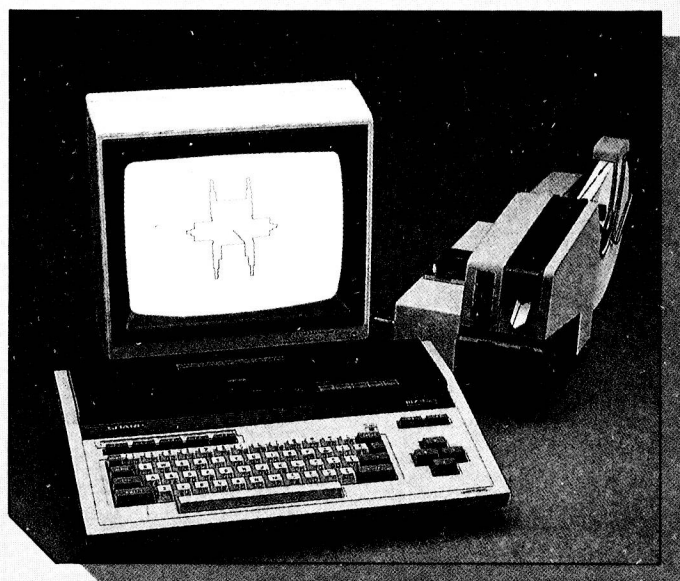
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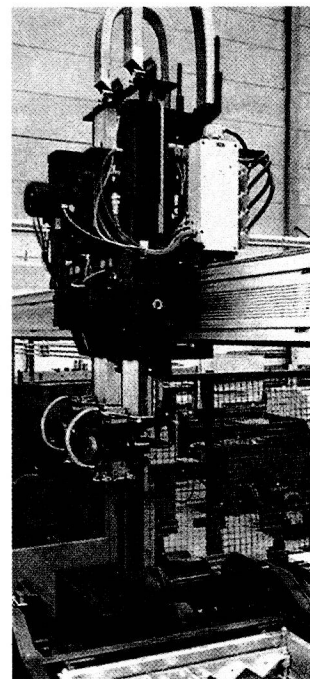
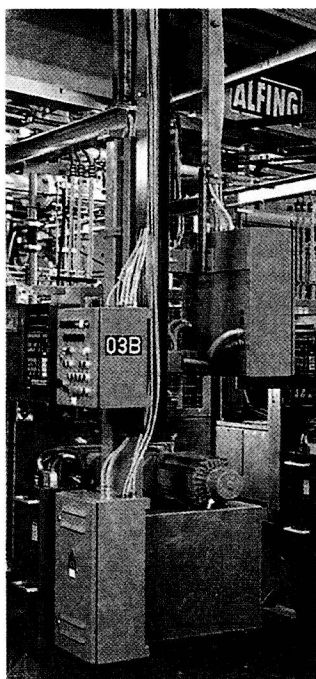
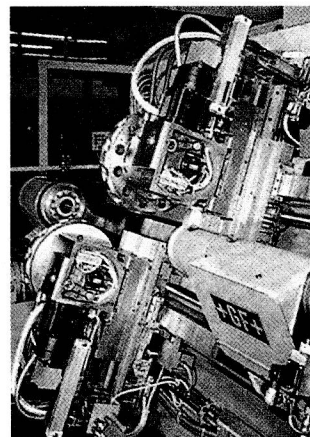
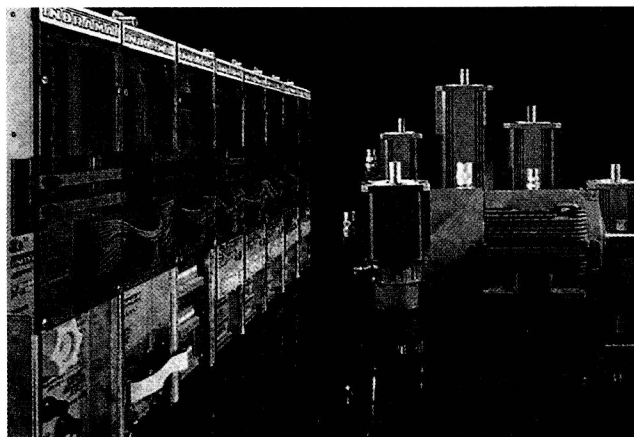
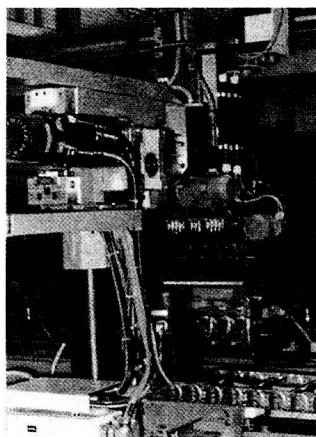
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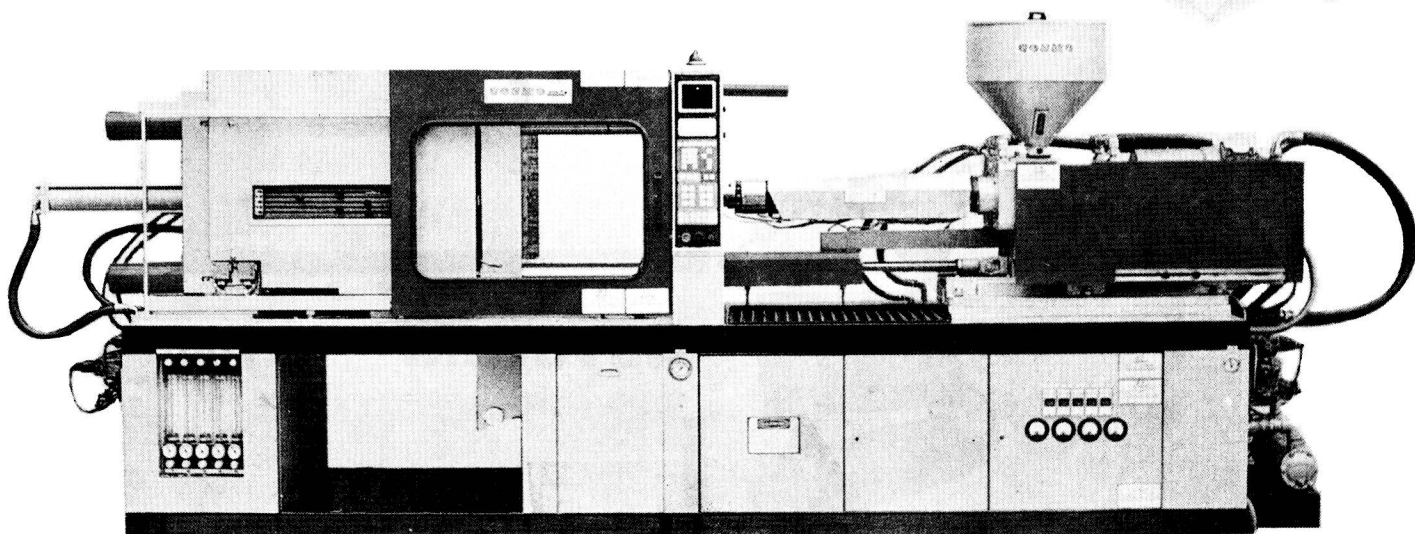
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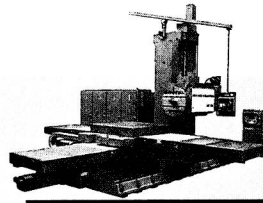
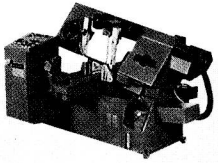
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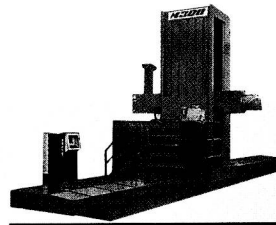
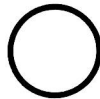
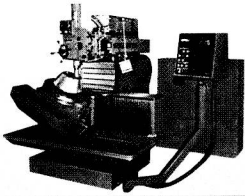
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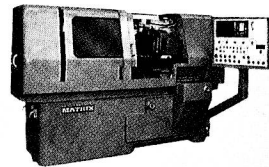
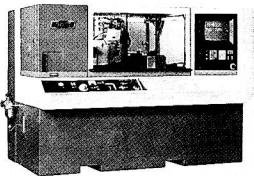
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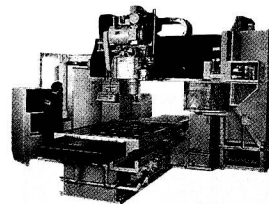
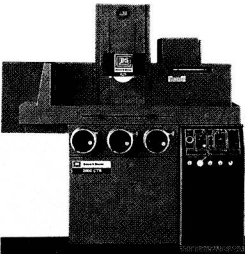
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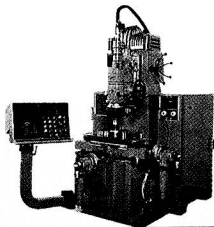
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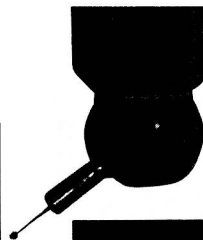
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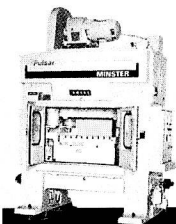
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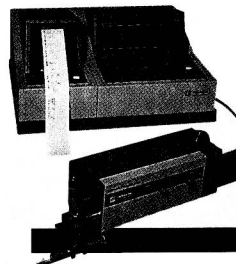
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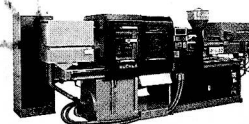
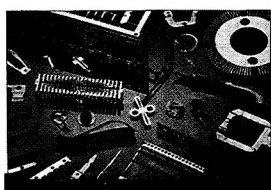
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SUMMARY The authors have developed a pneumatic inserting assembly robot of precision parts controlled by tactility. The paper details principle of the robot and its tactile sensor, and the conditions for realizing inserting automatically and smoothly. The authors analyse the dynamic characteristics of the system of tactile sensor and the effect of certain parameters on it, and state the experimental results as well.

ANNOTATION

- A the effective area of bellows (m^2),
 b viscosity damping coefficient ($N.s/m$),
 C rigidity of the bellows and the inter spring (N/m),
 C_c volume fluid conductance of the linear resistance ($m^5/s.N$),
 C_f the rigidity of return spring of flap-per (N/m),
 C_1, C_2 the characteristic constants of the nozzle-flapper amplifier
 $C_1 = -\partial Q_a / \partial \delta = -\partial Q_b / \partial \delta$,
 $C_2 = -\partial Q_a / \partial p_a = -\partial Q_b / \partial p_b$,
 D differential operator, $D = d/dt$,
 F_1 load force (N),
 $k_1 = C_1 R T_s / p_i$ (m^2/s),
 $k_2 = C_2 R T_s / 2 p_i$ ($m^5/N.s$),
 $k_3 = V_i / 2 k p_i$ (m^5/N),
 $k_4 = m g l_4 / 2 C_f l_2 l_3$,
 $k_5 = C_c / 2$ ($m^5/s.N$),
 k the ratio of the specific heats, $k=1.4$,
 l_2, l_3, l_4 the length of the lever arm (m),
 m the mass of the moving part (kg),
 p absolute pressure (Pa),
 Q mass flow (kg/s),
 R gas constant,
 T_s the temprature of the air in gas source and system (K),
 V_i the stable volume of bellows (m^3),
 V_t the volume of the additive chamber (m^3),
 δ the clearance between the nozzle and flapper (m),
 τ time constant (s), $\tau = V_t / k C_c p_i$.

1. OPERATION PRINCIPLE

In mechanical industry, up to now a great quantity of assembly is still finished by handwork. It is profound to develop an assembly robot for realizing assembly operation automatically. A typical operation in assembly includes inserting an axle into a hole. If the clearance is very small (about several μm), the operation is usually finished by the sensitive tactility of hands of skillful workers. By means of pneumatic tactility control it can be realized automatical assembly work instead of that of hand.

The authors of this paper have developed a pneumatic inserting assembly robot controlled by tactility, the appearance of its wrist is shown as Fig. 1. The main performance is as bellow, the diameter of the part, axle and hole, is equal to 20mm, the clearance is greater or equal to 7.5 μm , and the permitted deviation in the original location between the centre of the axle and hole is not greater than $\pm 2mm$. The inserting-operation time is less than 1s.

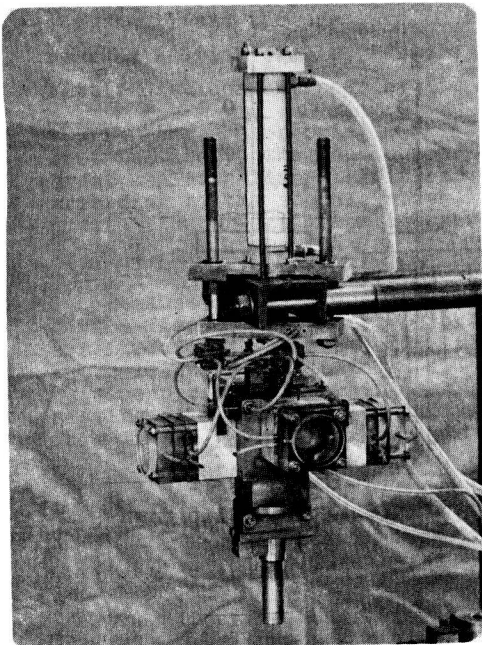


Fig. 1 The appearance of robot wrist

The program of the robot inserting-assembly operation is $A_1 B_1 C_0 B_0 A_0 B_1 C_1 B_0$ (see Fig. 2). The process of automatical inserting operation is as follows (see Fig. 3).

1.1 Initial Locating

Cylinder A draws back the arm. Holding the

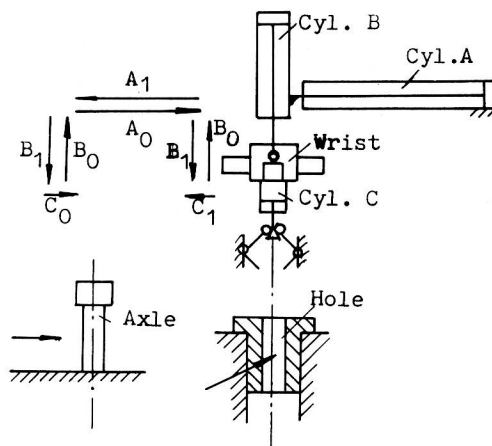


Fig. 2