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DEVELOPMENT OF SERVICE EQUIPMENT*

By Major General Sant Singh, Master-General of the Ordnance, Army Headquarters

Introduction

I have taken 'Development of Service Equipment' as my subject this morning, as it should prove of informative interest to scientists who play a great role in it.

Wars have been fought throughout the ages; at no period, however, in history has there been such phenomenal progress in the development of new equipment as during the present half century—needless to add, on account of the unprecedented pace of scientific and technological advancement; for instance, until the beginning of the present century, the mobility and fire-power of the defence forces were very limited and they had no mechanisation, tanks, mortars, shaped charges, atomic and guided missiles, chemical, microbiological and psychological warfare, wireless communications, electronic devices, radar, magnetic, acoustic and oyster mines, to mention only a few, and above all they lacked our colleagues of the third Service, namely, the Air Force.

Elucidation of terms

Before I begin with the subject proper, I may add that the term "equipment" has been used in the wide sense of all the requisites for conducting a modern war; in other words, munitions for all the three services. Similarly, the term "soldier" is intended to include sailor and airman. By a "service technologist" I mean an officer who has a thorough knowledge of technical matters and a general knowledge of warfare. The converse is the case with regimental and staff officers. The procedure of development followed by the three services is fundamentally the same, though it may vary in detail. Developments are of two kinds :—

(a) an entirely new equipment, and
(b) variation or modification of an existing equipment.

STAGES IN THE DEVELOPMENT OF A NEW EQUIPMENT

In describing to you the development of a new equipment, the principal stages might be mentioned as :—

(a) The idea.
(b) Drafting of Statements of Requirements in amplification of the idea and this forms the basis of research, development and design.
(c) Research, design development and to produce models to the prototype stage.
(d) Trials, both technical and field.
(e) Production, and, of course, the inevitable.
(f) Inspection.

I shall now deal with these seriatim.

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Idea

An idea, which is usually in general terms and not necessarily in terms of an existing equipment, may come from one or more of the following :—

(a) The soldier himself.

(b) The scientist and technologist in the Research and Development Establishments.

(c) Civilian scientists interested in defence matters.

(d) Training Establishments.

Drafting of statement of requirements

The idea is thoroughly examined by all concerned, such as the Arms Directorate and the General Staff, assisted by experts in operational research, particularly with regard to its possible requirement by the soldier. If the need for an equipment which might result from the consummation of the basic idea is established, consultations at various committees or outside progress among the scientists, technologists and user arm in the first instance, lay down in general terms in the form of a statement the requirements which the new equipment might be expected to meet. Such a statement forms the basis of research, design and development that follow. Except in the case of long term research, in which by its very nature the aim is to make a general investigation of some scientific principle which may later be embodied in the design of a new equipment, the object of these preliminary discussions is to ensure that demands are practicable. In other words, what is asked for by the soldier should be capable of achievement either now with the present scientific and technical progress or in the near future with likely further developments.

The order of priority for the carrying out of the project is determined depending on the usefulness of the equipment, degree of urgency and existing commitments.

Depending on the nature of the equipment, the statement would provide indications of information about, say :

(a) need for a new equipment in replacement of or in addition to existing equipment,

(b) simplicity of design, comfort and robustness,

(c) dimensions, weight, air portability,

(d) performance, e.g. radius of action, rates of fire,

(e) impact on training and maintenance,

(f) armour, armament and communications,

(g) ability to withstand extremes of climate and altitude and deterioration during storage,

(h) priority.

Research, development & design

The requisite resources are made available according to the priority allotted and the research, development and design work

proceeds in the Technical Development Establishments concerned, and if called for, in Ord. Factories and also in civilian establishments, e.g. those under industry, universities, Government Department, keeping in mind of course the security aspects. Bearing in mind the requirements specified by the General Staff which can seldom all be satisfied in the same equipment, the development authorities usually submit three or four solutions on paper of the problem set them. Discussions are then held with the General Staff until an acceptable compromise is reached. The Development then takes place through a series of stages which may be broadly expressed as :—

(a) "Rig" i.e. a working arrangement to clear a principle.

(b) Mock-up. A scale model (non-working) usually full size, to indicate lay-out.

(c) Pilot model or models. A full scale model to prove components and technique, and

(d) Prototype.—The final model for user trials.

Trials

Then come a series of trials to test whether the prototype meets the requirements laid down for the equipment. The Technical Development Establishment conducts its departmental trials as a part of the development project to affect the changes necessary as a result of seeing the equipment functioning. When it is fully satisfied, the representatives of the user arm are invited to be present at the trials and offer their comments. In the light of their criticism, further changes may be effected. When both the T.D.E. and the user representatives are satisfied, an order is placed for the supply of a certain number required for ascertaining its behaviour in actual use i.e. field trials, at which Technical Development Establishment representatives are present. When all is clear production drawings are sealed from the prototype emerging as a result of the trials.

Production

They say 'Too many cooks spoil the broth'. I have, therefore, taken good care not to refer to finance, "The Ann Datas" and production earlier. Finance who are responsible for safeguarding that the budgetary allotments are used to the best advantage of the State are associated at all levels in an advisory but not necessarily restrictive capacity with the development project right from the allocation of additional funds for the project, costing of the equipment to the final decision with regard to its production in factories.

With regard to the producer, the advice of the Director-General Ordnance Factories is always sought from time to time as soon as adequate progress has been made in development and design to warrant this which usually happens at the 'Pilot Model' stage referred to above, or even earlier. The Director General, Ordnance Factories is kept in the picture to ensure that what has been designed is capable of easy production and not merely a fanciful design on the drawing board.

Let us assume that after careful consideration of the urgency of the need, estimated requirements, and costs, it is decided to place the order with the Director General, Ordnance Factories for the supply. Having been provided with the drawings and the production order, the DGOF plans his production of the equipment in his factories and turns out, to start with, a relatively small quantity, termed 'Pre-Production Model', ahead of the main run to test production conditions. Having been fully satisfied, regular production is taken in hand.

Inspection

Inspetcion of the components and the complete equipment is done either by a separate Inspection Organisation, or by inspectors who are part of the factory staff. In the latter case a recheck of a proportion of the equipments is carried out by the independent Inspection Organisation before they are accepted and despatched to Ordnance Depots for storage and subsequent issue to units. In all cases, new equipments are tested by actual firing proof, where applicable. Statistical Quality Control is becoming increasingly popular in the manufacture of many small components which are made on automatic machine tools. The operation of Statistical Quality Control methods has now been built up into a science, particularly, in the U.S.A. We have been studying their methods and it is going to be introduced shortly in Ordnance Factories.

INTRODUCTION OF MODIFICATIONS IN SERVICE EQUIPMENT

All concerned in the birth of a new equipment, may rightly feel happy at their achievement. This complacency, however, is short lived, for a number of complaints or suggestions are received by the Arms Director with regard to the equipment from one or more of the following sources :—

(a) the solider as a result of his experience of the use of the equipment in the field.

(b) the E.M.E. Workshops which are responsible for carrying out the repairs and maintenance of the equipment. They may find that the equipment breaks down in certain specified components in all cases.

(c) the scientist either from his studies of the behaviour of the equipment in the field or as a result of recent advances in science and technology.

(d) the Ordnance Depots who may find certain faults developing during storage e.g. growth of fungi in optical systems or tendency to crack and warp or to be inflammable.

(e) 'Intelligence' may either report of a more efficient equipment or provide samples of captured enemy equipment.

The new equipment which I have referred to above is termed Mk. I and in order to eliminate existing defects and to incorporate additional improvements, the process of making a statement, research, development, design, trials, production passes through the

entire cycle, giving rise to an improved equipment termed Mk. II and so on to a series of Mks.

The introduction of new models of cars, radio sets, cameras and similar articles is quite familiar to you and in these cases the modification process is similar to the one described above except that the salesmen, in addition to giving their views as stockists and intelligence agents, act in most cases as the mouthpiece of the user and repair workshops and pass the information to their Principals whose scientists and technologists do the needful.

Quality, the watchword

In the development work, the progress seems sometimes disappointingly slow. You will appreciate the reason for this, when you consider the enormous work that is involved at all stages. This does not deter us from ensuring quality because it is our constant effort that faulty equipment, either in design or in construction, must not be allowed to go into the hands of troops, as loss of confidence in weapons will surely produce the greatest demoralizing effect on the Army.

Present position in India

Besides the Defence Science Organisation under Dr. Kothari, Scientific Adviser to Ministry of Defence, and our getting considerable technical information from the U.K., there are a number of Technical Development Establishments in various parts of the country for developing and manufacturing Service equipment. We have made great headway towards self-sufficiency in General Stores including Textiles, and our designs can compete with some of the best in the world. We have, however, still a great leeway to make in the fields of armament in general, and fighting and soft vehicles in particular. We are fully aware of the causes underlying this shortcoming and are making all possible efforts to remedy them.

In this connection, I am glad to note that you have chosen for your discussions during this conference such topics, namely Ballistics and Operational Research, as are of immense value in promoting armament development, both as regards design and evaluation.

CO-ORDINATION OF THE ABOVE ACTIVITIES AND THE M.G.O.

I shall now refer to the co-ordination of the activities on which the development and production of Service Equipment depends. About a year ago, I was reading a book entitled 'War in Ancient India' by Dikshitar. In the Chapter dealing with the Departments of the Army in Ancient India, he refers to the Department of Arsenals, called 'Ayudhgara' in those days, which was under a Superintendent known then as Shastrashala-dhyaksha or merely Shastradhyaksha. The functions of this department were :—

(a) to employ skilled workmen and mechanics of all grades.

(b) to manufacture (and also repair) armaments, armour for both warriors and war animals, and accessories.

(c) to store the above (armaments, armour and accessories) according to prescribed rules so that they do not deteriorate. (This is analogous to our present stores preservation).

(d) to maintain registers for the stocks, receipt and issue of the above.

(e) take provision action.

he Arsenal was a department of State and no individual or firm uld manufacture arms.

I was deeply struck with the fact that the functions of the present y M.G.O. are almost the same as those of his counterpart in cient India. In the U.K., the War Office had the complete M.G.O. ganization till the beginning of World War II when its functions ere transferred to the newly created Ministry of Supply. We ed to adopt the British system and in disregard of the warning of ose with experience the M.G.O. Branch was abolished as such in ril 1947 and its functions distributed amongst other Branches stead of being co-ordinated by one Head. It was not long before realised the incorrectness of the step taken and the M.G.O. anch was reconstituted in January 1949 to revive and weld the ch needed integration of scientific research, design, development. sting and Inspection (which are under the Director of Technical velopment), provisioning, stocking and issue (which are under rector of Ordnance Services) and maintenance and repair (which me under the Directorate of Mechanical Engineering). There is, wever, an important partner in the team still missing, namely, oduction, which is at present separate under the Director General, dnance Factories.

When Armament, Development and Production were at a low b in ENGLAND and when WOOLWICH was the only arsenal, all its from scientific planning upto production were under the ntrol of the M.G.O. Even when production increased vastly during e war and forty three new arsenals were created the same func- ns although transferred to the Ministry of Supply still remained der one co-ordinating head known as the Controller of Supplies unitions) who is a Lieut.-General so far as Defence supplies are ncerned and Air Marshal in the case of Air Force. The advantages such an integrated Organisation cannot be over-emphasized.

ientists and the future

Before I conclude, may I quote two lines from an old rhyme ?

"When in danger and in doubt
Always keep a good look-out".

The piping days of peace do not seem to return and it is, there- e, incumbent on the Defence Services to ensure that their uipment is more than a match against possible disturbers, of the ace of the country both internal or external. In the discharge of s responsibility the Services naturally depend a good deal on ntists of the Defence Science Service in particular and on the ilian scientists of this country in general who must therefore

keep an unceasing vigil towards scientific and technoligical developments in their relation to possible service applications.

So, Gentlemen, we in the Armed Forces, shall look forward to your continued interest and help in technical matters, and also your assistance in the general industrialisation of the country because the continued purchase of equipment from abroad is rather an expensive and an undependable business particularly in an emergency.